Variable-Length Encoding (VLE) Programming Environments Manual:

A Supplement to the EREF

VLEPEM
Rev. 0
07/2007

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About This Book

The primary objective of this manual is to help programmers provide software that is compatible with processors that implement the VLE category.

To locate any published errata or updates for this document, refer to the web at http://www.freescale.com.

This book is used as a reference guide for assembler programmers. It uses a standardized format instruction to describe each instruction, showing syntax, instruction format, register translation language (RTL) code that describes how the instruction works, and a listing of which, if any, registers are affected. At the bottom of each instruction entry is a figure that shows the operations on elements within source operands and where the results of those operations are placed in the destination operand.

The *VLE Programming Interface Manual* (VLE PIM) is a reference guide for high-level programmers. The VLE PIM describes how programmers can access VLE functionality from programming languages such as C and C++. It defines a programming model for use with the VLE instruction set. Processors that implement the Power ISA use the VLE instruction set as an extension to the base and embedded categories of the Power ISA.

Because it is important to distinguish between the categories of the Power ISA to ensure compatibility across multiple platforms, those distinctions are shown clearly throughout this book. This document stays consistent with the Power ISA in referring to three levels, or programming environments, which are as follows:

- User instruction set architecture (UISA)—The UISA defines the level of the architecture to which user-level software should conform. The UISA defines the base user-level instruction set, user-level registers, data types, memory conventions, and the memory and programming models seen by application programmers.
- Virtual environment architecture (VEA)—The VEA, which is the smallest component of the Power architecture, defines additional user-level functionality that falls outside typical user-level software requirements. The VEA describes the memory model for an environment in which multiple processors or other devices can access external memory and defines aspects of the cache model and cache control instructions from a user-level perspective. VEA resources are particularly useful for optimizing memory accesses and for managing resources in an environment in which other processors and other devices can access external memory.

  Implementations that conform to the VEA also conform to the UISA but may not necessarily adhere to the OEA.
- Operating environment architecture (OEA)—The OEA defines supervisor-level resources typically required by an operating system. It defines the memory management model, supervisor-level registers, and the exception model.

  Implementations that conform to the OEA also conform to the UISA and VEA.

Most of the discussions on the VLE are at the UISA level. For ease in reference, this book and the processor reference manuals have arranged the architecture information into topics that build on one another, beginning with a description and complete summary of registers and instructions (for all three environments) and progressing to more specialized topics such as the cache, exception, and memory management models. As such, chapters may include information from multiple levels of the architecture, but when discussing OEA and VEA, the level is noted in the text.

It is beyond the scope of this manual to describe individual devices that implement VLE. It must be kept in mind that each processor that implements the Power ISA is unique in its implementation.

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Audience

This manual is intended for system software and hardware developers, and for application programmers who want to develop products using the VLE. It is assumed that the reader understands operating systems, microprocessor system design, and the basic principles of RISC processing and details of the Power ISA.

This book describes how VLE interacts with the other components of the Power architecture.

Organization

Following is a summary and a brief description of the major sections of this manual:

- Chapter 1, "Introduction," is useful for those who want a general understanding of the features and functions of the VLE. This chapter provides an overview of how the VLE defines the register set, operand conventions, addressing modes, instruction set, and interrupt model.
- Chapter 2, "Instruction Model," describes the VLE instruction set, including operand conventions, addressing modes, and instruction syntax. It also provides a brief description of the VLE instructions organized by function.
- Chapter 3, "VLE Instruction Set," functions as a handbook for the VLE instruction set. Instructions are sorted by mnemonic. Each instruction description includes the instruction formats and figures where it helps in understanding what the instruction does.
- Appendix A, "VLE Instruction Formats," lists all of the VLE formats, grouped according to mnemonic, opcode, and form, in both decimal and binary order.
- Appendix B, "VLE Instruction Set Tables," lists all VLE instructions, grouped according to mnemonic and opcode.
- This manual also includes an index.

Suggested Reading

This section lists additional reading that provides background for the information in this manual as well as general information about the VLE and the Power ISA.

General Information

The following documentation provides useful information about the PowerPC architecture and computer architecture in general:

- *Computer Architecture: A Quantitative Approach*, Third Edition, by John L. Hennessy and David A. Patterson.
- *Computer Organization and Design: The Hardware/Software Interface*, Third Edition, David A. Patterson and John L. Hennessy.

Related Documentation

Freescale documentation is available from the sources listed on the back of the title page; the document order numbers, when applicable, are included in parentheses for ease in ordering:

- *EREF: A Programmer's Reference Manual for Freescale Embedded Processors* (EREFRM). Describes the programming, memory management, cache, and interrupt models defined by the Power ISA for embedded environment processors.
- *Power ISA™*, The latest version of the Power instruction set architecture can be downloaded from the website www.power.org.
- *VLE Programming Interface Manual* (VLEPIM). Provides the VLE-specific extensions to the e500 application binary interface.
- *e500 Application Binary Interface User's Guide* (E500ABIUG). Establishes a standard binary interface for application programs on systems that implement the interfaces defined in the System V Interface Definition, Issue 3. This includes systems that have implemented UNIX System V Release 4.
- Reference manuals. The following reference manuals provide details information about processor cores and integrated devices:
  - — Core reference manuals—These books describe the features and behavior of individual microprocessor cores and provide specific information about how functionality described in the EREF is implemented by a particular core. They also describe implementation-specific features and microarchitectural details, such as instruction timing and cache hardware details, that lie outside the architecture specification.
  - — Integrated device reference manuals—These manuals describe the features and behavior of integrated devices that implement a Power ISA processor core. It is important to understand that some features defined for a core may not be supported on all devices that implement that core.

    Also, some features are defined in a general way at the core level and have meaning only in the context of how the core is implemented. For example, any implementation-specific behavior of register fields can be described only in the reference manual for the integrated device.

    Each of these documents include the following two chapters that are pertinent to the core:
    - A core overview. This chapter provides a general overview of how the core works and indicates which of a core’s features are implemented on the integrated device.
    - A register summary chapter. This chapter gives the most specific information about how register fields can be interpreted in the context of the implementation.

These reference manuals also describe how the core interacts with other blocks on the integrated device, especially regarding topics such as reset, interrupt controllers, memory and cache management, debug, and global utilities.

- Addenda/errata to reference manuals—Errata documents are provided to address errors in published documents.

  Because some processors have follow-on parts, often an addendum is provided that describes the additional features and functionality changes. These addenda, which may also contain errata, are intended for use with the corresponding reference manuals.

  Always check the Freescale website for updates to reference manuals.
- Hardware specifications—Hardware specifications provide specific data regarding bus timing; signal behavior; AC, DC, and thermal characteristics; and other design considerations.
- Product brief—Each integrated device has a product brief that provides an overview of its features. This document is roughly the equivalent to the overview (Chapter 1) of the device's reference manual.
- Application notes—These short documents address specific design issues useful to programmers and engineers working with Freescale processors.

Additional literature is published as new processors become available. For current documentation, refer to http://www.freescale.com.

Conventions

This document uses the following notational conventions:

cleared/set	When a bit takes the value zero, it is said to be cleared; when it takes a value of one, it is said to be set.
mnemonics	Instruction mnemonics are shown in lowercase bold
italics	Italics indicate variable command parameters, for example, **bcctr***x*
	Book titles in text are set in italics
0x0	Prefix to denote hexadecimal number
0b0	Prefix to denote binary number
rA, **r**B	Instruction syntax used to identify a source general-purpose register (GPR)
rD	Instruction syntax used to identify a destination GPR
frA, **fr**B, **fr**C	Instruction syntax used to identify a source floating-point register (FPR)
frD	Instruction syntax used to identify a destination FPR
REG[FIELD]	Abbreviations for registers are shown in uppercase text. Specific bits, fields, or ranges appear in brackets.
x	In some contexts, such as signal encodings, an unitalicized x indicates a don't care.
x	An italicized *x* indicates an alphanumeric variable
n	An italicized *n* indicates an numeric variable

¬	NOT logical operator
&	AND logical operator
|	OR logical operator
0000	Indicates reserved bits or bit fields in a register. Although these bits may be written to as ones or zeros, they are always read as zeros.

Additional conventions used with instruction encodings are described in Section A.2, “VLE Instruction Formats.”

Acronyms and Abbreviations

Table i contains acronyms and abbreviations that are used in this document. Note that the meanings for some acronyms (such as XER) are historical, and the words for which an acronym stands may not be intuitively obvious.

Table i. Acronyms and Abbreviated Terms

Term	Meaning
CR	Condition register
CTR	Count register
DEC	Decrementer register
EA	Effective address
EREF	Programmer's Reference Manual for Freescale Embedded Processors
GPR	General-purpose register
IEEE	Institute of Electrical and Electronics Engineers
IU	Integer unit
LR	Link register
LRU	Least recently used
LSB	Least-significant byte
lsb	Least-significant bit
LSU	Load/store unit
MMU	Memory management unit
MSB	Most-significant byte
msb	Most-significant bit
MSR	Machine state register
NaN	Not a number
No-op	No operation
OEA	Operating environment architecture
PMC*n*	Performance monitor counter register
PVR	Processor version register
RISC	Reduced instruction set computing
RTL	Register transfer language

Table i. Acronyms and Abbreviated Terms (continued)

Term	Meaning
SIMM	Signed immediate value
SPR	Special-purpose register
SRR0	Machine status save/restore register 0
SRR1	Machine status save/restore register 1
TB	Time base facility
TBL	Time base lower register
TBU	Time base upper register
TLB	Translation lookaside buffer
UIMM	Unsigned immediate value
UISA	User instruction set architecture
VA	Virtual address
VEA	Virtual environment architecture
VLEPEM	*VLE Programming Environments Manual*
VLEPIM	*VLE Technology Programming Interface Manual*
XER	Register used for indicating conditions such as carries and overflows for integer operations

Terminology Conventions

Table ii lists certain terms used in this manual that differ from the architecture terminology conventions.

Table ii. Terminology Conventions

The Architecture Specification	This Manual
Extended mnemonics	Simplified mnemonics
Fixed-point unit (FXU)	Integer unit (IU)
Privileged mode (or privileged state)	Supervisor-level privilege
Problem mode (or problem state)	User-level privilege
Real address	Physical address
Relocation	Translation
Storage (locations)	Memory
Storage (the act of)	Access
Store in	Write back
Store through	Write through

Table iii describes instruction field notation conventions used in this manual.

Table iii. Instruction Field Conventions

The Architecture Specification	Equivalent to:
BA, BB, BT	**crb**A, **crb**B, **crb**D (respectively)
BF, BFA	**crf**D, **crf**S (respectively)
D	d
DS	ds
/, //, ///	0...0 (shaded)
RA, RB, RT, RS	**r**A, **r**B, **r**D, **r**S (respectively)
SI	SIMM
U	IMM
UI	UIMM

Chapter 1
Introduction

This chapter describes computation modes, document conventions, a processor overview, instruction formats, storage addressing, and instruction addressing for the variable length encoding (VLE) programming model.

1.1 Overview

VLE is a re-encoding of much of the Power instruction set using both 16- and 32-bit instruction formats. VLE is defined as a supplement to the Power ISA. Code pages using VLE encoding or non-VLE encoding can be intermingled in a system providing focus on both high performance and code density.

Offering 16-bit versions of Power instructions makes it possible to implement more space-efficient binary representations of applications for embedded environments where code density may affect overall system cost and, to a somewhat lesser extent, performance. This set of alternate encodings is selected on a page basis. A single storage attribute bit selects between standard instruction encodings and VLE instructions for that page.

Instruction encodings in pages marked as VLE are either 16 or 32 bits long and are aligned on 16-bit boundaries; therefore, all instruction pages marked as VLE must use big-endian byte ordering.

The programming model uses the same register set with both instruction set encodings, although some registers are not accessible by VLE instructions using the 16-bit formats and not all condition register (CR) fields are used by conditional branch instructions or instructions that access the CR executing from a VLE instruction page. In addition, due to the more restrictive encodings imposed by VLE instruction formats, immediate fields and displacements differ in size and use.

VLE additional instruction fields are described in the EREF.

Other than the requirement of big-endian byte ordering for instruction pages and the additional storage attribute to identify whether the instruction page corresponds to a VLE section of code, VLE complies with the memory model, register model, timer facilities, debug facilities, and interrupt/exception model defined in the user instruction set architecture (UISA), the virtual environment architecture (VEA), and the operating environment architecture (OEA). VLE instructions therefore execute in the same environment as non-VLE instructions.

1.2 Documentation Conventions

Book VLE adheres to the documentation conventions defined in the EREF. Note, however, that this book defines instructions that apply to the UISA, VEA, and OEA.

1.2.1 Description of Instruction Operation

The RTL (register transfer language) descriptions in Book VLE conform to the conventions described in the EREF.

1.3 Instruction Mnemonics and Operands

The description of each instruction includes the mnemonic and a formatted list of operands. VLE instruction semantics are either identical or similar to those of other instructions in the architecture, as described in the following:

- Where the semantics, side-effects, and binary encodings are identical, the standard mnemonics and formats are used. Such unchanged instructions are listed (Table B-2 and Table B-3) and appropriately referenced, but the instruction definitions are not replicated in this book.
- Where the semantics are similar but the binary encodings differ, the standard mnemonic is typically preceded with an **e_** to denote a VLE instruction. To distinguish between similar instructions available in both 16- and 32-bit forms under VLE and standard instructions, VLE instructions encoded with 16 bits have an **se_** prefix.

Examples of VLE-supported instructions are shown below:

- **stwx r**S,**r**A,**r**B—Standard UISA instruction
- **e_stw r**S,D**(r**A**)**—32-bit VLE instruction
- **se_stw r**Z,SD4**(r**X**)**—16-bit VLE instruction

Chapter 2
Instruction Model

This chapter provides an overview of the VLE instruction model, including the following:

- Section 2.1, “VLE Storage Addressing”
- Section 2.2, “VLE Compatibility with the Standard Architecture”
- Section 2.3, “Branch Operation Instructions”
- Section 2.4, “Integer Instructions”
- Section 2.5, “Storage Control Instructions”
- Section 2.6, “Additional Categories Available in VLE”

2.1 VLE Storage Addressing

A program references memory using the effective address (EA) the processor computes when it executes a memory access or branch instruction (or certain other instructions defined in the VEA and OEA) or when it fetches the next sequential instruction.

2.1.1 Data Storage Addressing Modes

Table 2-1 lists data storage addressing modes supported by VLE. Instruction forms are described in Appendix A, “VLE Instruction Formats.”

Table 2-1. Data Storage Addressing Modes

Mode	Description
Base+16-bit displacement (D-form, 32-bit format)	The 16-bit D field is sign-extended and added to the contents of the GPR designated by **r**A or to zero if **r**A = 0 to produce the EA.
Base+8-bit displacement (D8-form,32-bit format)	The 8-bit D8 field is sign-extended and added to the contents of the GPR designated by **r**A or to zero if **r**A = 0 to produce the EA.
Base+scaled 4-bit displacement (SD4-form, 16-bit format)	The 4-bit SD4 field zero-extended, scaled (shifted left) according to the size of the operand, and added to the contents of the GPR designated by **r**X to produce the EA. (Note that **r**X = 0 is not a special case.
Base+Index (X-form, 32-bit format)	The GPR contents designated by **r**B are added to the GPR contents designated by **r**A or to zero if **r**A = 0 to produce the EA.

2.1.2 Instruction Storage Addressing Modes

Table 2-2 lists instruction storage addressing modes supported by VLE.

Table 2-2. Instruction Storage Addressing Modes

Mode	Description
Taken BD24-form branch instructions (32-bit instruction format)	The 24-bit BD24 field is concatenated on the right with 0b0, sign-extended, and then added to the address of the branch instruction.
Taken B15-form branch instructions (32-bit instruction format)	The 15-bit BD15 field is concatenated on the right with 0b0, sign-extended, and then added to the address of the branch instruction to form the EA of the next instruction.
Take BD8-form branch instructions (16-bit instruction format)	The 8-bit BD8 field is concatenated on the right with 0b0, sign-extended, and then added to the address of the branch instruction to form the EA of the next instruction.
Sequential instruction fetching (or non-taken branch instructions)	The value 4 [2] is added to the address of the current 32-bit [16-bit] instruction to form the EA of the next instruction. If the address of the current instruction is 0xFFFF_FFFF_FFFF_FFFC [0xFFFF_FFFF_FFFF_FFFE] in 64-bit mode or 0xFFFF_FFFC [0xFFFF_FFFE] in 32-bit mode, the address of the next sequential instruction is undefined.
Any branch instruction with LK = 1 (32-bit instruction format)	The value 4 is added to the address of the current branch instruction and the result is placed into the LR. If the address of the current instruction is 0xFFFF_FFFF_FFFF_FFFC in 64-bit mode o r0xFFFF_FFFC in 32-bit mode, the result placed into the LR is undefined.
Branch **se_bl. se_blrl. se_bctrl** instructions (16-bit instruction format)	The value 2 is added to the address of the current branch instruction and the result is placed into the LR. If the address of the current instruction is 0xFFFF_FFFF_FFFF_FFFE in 64-bit mode or 0xFFFF_FFFE in 32-bit mode, the result placed into the LR is undefined.

2.1.2.1 Misaligned, Mismatched, and Byte-Ordering Instruction Storage Exceptions

A misaligned instruction storage exception occurs when an implementation that supports VLE attempts to execute an instruction that is not 32-bit aligned and the VLE storage attribute is not set for the page that corresponds to the effective address of the instruction. The attempted execution can be the result of a branch instruction that has bit 62 of the target address set or the result of an **rfi**, **se_rfi**, **rfci**, **se_rfci**, **rfdi**, **se_rfdi**, **rfmci**, or **se_rfmci** instruction that has bit 62 set in the respective save/restore register. If a misaligned instruction storage exception is detected and no higher priority exception exists, an instruction storage interrupt occurs, setting SRR0 to the misaligned address for which execution was attempted.

A mismatched instruction storage exception occurs when an implementation that supports VLE attempts to execute an instruction that crosses a page boundary for which the first page has the VLE storage attribute set and the second page has the VLE storage attribute bit cleared. If a mismatched instruction storage exception is detected and no higher priority exception exists, an instruction storage interrupt occurs, setting SRR0 to the misaligned address for which execution was attempted.

A byte-ordering instruction storage exception occurs when an implementation that supports VLE attempts to execute an instruction that has the VLE storage attribute set and the E (Endian) storage attribute set for the page that corresponds to the effective address of the instruction. If a byte-ordering instruction storage exception is detected and no higher priority exception exists, an instruction storage interrupt occurs, setting SRR0 to the address for which execution was attempted.

2.1.2.2 VLE Exception Syndrome Bits

VLE defines the following bits to facilitate VLE exception handling, as described in the EREF:

- ESR[VLEMI] is set when an exception and subsequent interrupt is caused by the execution or attempted execution of an instruction that resides in memory with the VLE storage attribute set.
- ESR[MIF] is set when an instruction storage interrupt is caused by a misaligned instruction storage exception, or when an instruction TLB error interrupt was caused by a TLB miss on the second half of a misaligned 32-bit instruction.
- ESR[BO] is set when an instruction storage interrupt is caused by a mismatched instruction storage exception or a byte-ordering instruction storage exception.

NOTE (Programming)

When an instruction TLB error interrupt occurs as the result of an instruction TLB miss on the second half of a 32-bit VLE instruction that is aligned to only 16-bits, SRR0 points to the first half of the instruction and ESR[MIF] is set. Any other status posted as a result of the TLB miss (such as MAS register updates) reflects the page corresponding to the second half of the instruction that caused the instruction TLB miss.

2.2 VLE Compatibility with the Standard Architecture

This chapter addresses the relationship between VLE and the standard architecture.

2.2.1 Overview

VLE uses the same semantics as other Power ISA instructions. Due to the limited instruction encoding formats, VLE instructions typically support reduced immediate fields and displacements, and not all operations defined by the standard architecture are encoded in VLE. The design criteria are to capture all useful operations, with most frequent operations given priority. Immediate fields and displacements are provided to cover the majority of ranges encountered in embedded control code. Instructions are encoded in either a 16- or 32-bit format, and these may be freely intermixed.

VLE instructions cannot access FPRs. VLE instructions use GPRs and SPRs with the following limitations:

- Most VLE instructions using 16-bit formats are limited to addressing GPR0–GPR7 and GPR24–GPR31. Move instructions are provided to transfer register contents between these registers and GPR8–GPR23.
- VLE compare and bit test instructions using the 16-bit formats implicitly set their results in CR0.

VLE instruction encodings are generally different than instructions defined by the standard architecture, except that most instructions falling within primary opcode 31 are encoded identically and have identical semantics unless they affect or access a resource unsupported by VLE.

2.2.2 VLE Processor and Storage Control Extensions

This section describes additional functionality to support VLE.

2.2.2.1 Instruction Extensions

This section describes extensions to support VLE operations. Because instructions may reside on a half-word boundary, bit 62 is not masked by instructions that read an instruction address from a register, such as LR, CTR, or a save/restore register 0 that holds an instruction address:

The instruction set defined by the standard architecture is modified to support halfword instruction addressing, as follows:

- Return from interrupt instructions (**rfi**, **rfci**, **rfdi**, and **rfmci**) no longer mask bit 62 of the respective save/restore register 0. The destination address is SRR0[0–62] || 0b0, CSRR0[0–62] || 0b0, DSRR0[0–62] || 0b0, MCSRR0[0–62] || 0b0, respectively.
- **bclr**, **bclrl**, **bcctr**, and **bcctrl** no longer mask bit 62 of LR or CTR. The destination address is LR[0–62] || 0b0 or CTR[0–62] || 0b0.

2.2.2.2 MMU Extensions

VLE operation is indicated by the VLE storage page attribute. When this attribute is set, instruction fetches from that page are decoded and processed as VLE instructions. See the EREF.

When instructions execute from a page whose VLE storage attribute is set, the processor is in VLE mode.

2.2.3 VLE Limitations

VLE instruction fetches are valid only when performed in a big-endian mode. Attempting to fetch an instruction in a little-endian mode from a page with the VLE storage attribute set causes an instruction storage byte-ordering exception.

Support for concurrent modification and execution of VLE instructions is implementation-dependent.

2.3 Branch Operation Instructions

This section describes branch instructions that can be executed when a processor is in VLE mode. It also describes the registers that support them.

2.3.1 Branch Processor Registers

The following registers support branch operations:

- Section 2.3.1.1, “Condition Register (CR)”
- Section 2.3.1.2, “Link Register (LR)”
- Section 2.3.1.3, “Count Register (CTR)”

2.3.1.1 Condition Register (CR)

The CR reflects the result of certain operations and provides a mechanism for testing (and branching).

VLE uses the entire CR, as described in the EREF, but some comparison operations and all branch instructions are limited to using CR0–CR3. The full UISA-defined CR field and logical operations are provided, however.

CR bits are grouped into eight 4-bit fields, CR field 0 (CR0) ... CR field 7 (CR7), which are set by VLE-defined instructions in one of the following ways:

- Specified CR fields can be set by a move to the CR from a GPR (**mtcrf**, **mtocrf**).
- A specified CR field can be set by a move to the CR from another CR field (**e_mcrf**) or from XER[32–35] (**mcrxr**).
- CR field 0 can be set as the implicit result of an integer instruction.
- A specified CR field can be set as the result of an integer compare instruction.
- CR field 0 can be set as the result of an integer bit test instruction.

Other instructions from implemented categories may also set bits in the CR in the same manner that they would when not in VLE mode.

Instructions are provided to perform logical operations on individual CR bits and to test individual CR bits.

For all integer instructions in which the Rc bit is defined and set, and for **e_add2i.**, **e_and2i.**, and **e_and2is.,** the first three bits of CR field 0 ($CR_{32:34}$) are set by signed comparison of the result to zero, and the fourth bit of CR field 0 (CR[35]) is copied from the final state of XER[SO]. “Result” here refers to the entire 64-bit value placed into the target register in 64-bit mode, and to bits 32–63 of the value placed into the target register in 32-bit mode.

```
if (64-bit mode)
  then M ← 0
  else M ← 32
if      (target_register)M:63 < 0 then c ← 0b100
else if (target_register)M:63 > 0 then c ← 0b010
else                                   c ← 0b001
CR0 ← c || XERSO
```

If any portion of the result is undefined, the value placed into the first three bits of CR field 0 is undefined.

The bits of CR field 0 are interpreted as shown in Table 2-3.

Table 2-3. CR0 Field Descriptions

Bits	Name	Description
32	LT	Negative—The result is negative.
33	GT	Positive—The result is positive.
34	EQ	Zero—The result is 0.
35	SO	Summary overflow—This is a copy of the contents of XER[SO] at the completion of the instruction.

2.3.1.1.1 Condition Register Setting for Compare Instructions

For compare instructions, a CR field specified by the BF operand for the **e_cmph**, **e_cmphl**, **e_cmpi**, and **e_cmpli** instructions, or CR0 for the **se_cmpl**, **e_cmp16i**, **e_cmph16i**, **e_cmphl16i**, **e_cmpl16i**, **se_cmp**, **se_cmph**, **se_cmphl**, **se_cmpi**, and **se_cmpli** instructions, is set to reflect the result of the comparison. The CR field bits are interpreted as shown below. A complete description of how the bits are set is given in the instruction descriptions and the EREF.

Condition register bits settings for compare instructions are interpreted as shown in Table 2-4.

Table 2-4. Condition Register Settings for Compare Instructions

CR Bit[1]	Description
4×BF + 32	Less than (LT). For signed integer compare, (**r**A) or (**r**X) < sci8, SI, (**r**B), or (**r**Y). For unsigned integer compare, (**r**A) or (**r**X) $<^{u}$ sci8, UI, UI5, (**r**B), or (**r**Y).
4×BF + 33	Greater than (GT). For signed integer compare, (**r**A) or (**r**X) > sci8, SI, (**r**B), or (**r**Y). For unsigned integer compare, (**r**A) or (**r**X) $>^{u}$ sci8, UI, UI5, (**r**B), or (**r**Y).
4×BF + 34	Equal (EQ). For integer compare, (rA) or (**r**X) = sci8, UI, UI5, SI, (**r**B), or (**r**Y).
4×BF + 35	Summary overflow (SO). For integer compare, this is a copy of XER[SO] at the completion of the instruction.

[1] **e_cmpi**, and **e_cmpli** instructions have a BF32 field instead of a BF field; for these instructions, BF32 should be substituted for BF in the table.

2.3.1.1.2 Condition Register Setting for the Bit Test Instruction

The Bit Test Immediate instruction, **se_btsti**, also sets CR field 0. See the instruction description and also the EREF.

2.3.1.2 Link Register (LR)

VLE instructions use the LR as defined in the UISA, although VLE defines a subset of the variants defined for conditional branches involving the LR.

2.3.1.3 Count Register (CTR)

VLE instructions use the CTR as defined in the UISA, although VLE defines a subset of the variants defined for conditional branches involving the CTR.

2.3.2 Branch Instructions

The sequence of instruction execution can be changed by the branch instructions. Because VLE instructions must be aligned on half-word boundaries, the low-order bit of the generated branch target address is forced to 0 by the processor in performing the branch.

The branch instructions compute the EA of the target in one of the following ways, as described in Section 2.1.2, “Instruction Storage Addressing Modes.”

1. Adding a displacement to the address of the branch instruction.
2. Using the address contained in the LR (Branch to Link Register [and Link]).

3. Using the address contained in the CTR (Branch to Count Register [and Link]).

Branching can be conditional or unconditional, and the return address can optionally be provided. If the return address is to be provided (LK = 1), the EA of the instruction following the branch instruction is placed into the LR after the branch target address has been computed; this is done regardless of whether the branch is taken.

In branch conditional instructions, the BI32 or BI16 instruction field specifies the CR bit to be tested. For 32-bit instructions using BI32, CR[32–47] (corresponding to bits in CR0:CR3) may be specified. For 16-bit instructions using BI16, only CR[32–35] (bits within CR0) may be specified.

In branch conditional instructions, the BO32 or BO16 field specifies the conditions under which the branch is taken and how the branch is affected by or affects the CR and CTR. Note that VLE instructions also have different encodings for the BO32 and BO16 fields than in the UISA-defined BO field.

If the BO32 field specifies that the CTR is to be decremented, in 64-bit mode CTR[0–63] are decremented, and in 32-bit mode CTR[32–63] are decremented. If BO16 or BO32 specifies a condition that must be TRUE or FALSE, that condition is obtained from the contents of CR[BI32+32] or CR[BI16+32]. (Note that CR bits are numbered 32–63. BI32 or BI16 refers to the condition register bit field in the branch instruction encoding. For example, specifying BI32 = 2 refers to CR[34].)

For Table 2-5, let M = 0 in 64-bit mode and M = 32 in 32-bit mode.

Encodings for the BO32 field for VLE are shown in Table 2-5.

Table 2-5. BO32 Field Encodings

BO32	Description
00	Branch if the condition is false.
01	Branch if the condition is true.
10	Decrement CTR[M–63], then branch if the decremented value ¦ 0
11	Decrement CTR[M–63], then branch if the decremented value = 0.

Encodings for the BO16 field for VLE are shown in Table 2-6.

Table 2-6. BO16 Field Encodings

BO16	Description
0	Branch if the condition is false.
1	Branch if the condition is true.

2.3.3 System Linkage Instructions

The system linkage instructions enable the program to call on the system to perform a service and provide a means by which the system can return from performing a service or from processing an interrupt. System linkage instructions defined by VLE are identical in semantics to system linkage instructions defined in the UISA and OEA, with the exception of the LEV field, but are encoded differently.

se_sc provides the same functionality as **sc** without the LEV field. **se_rfi**, **se_rfci**, **se_rfdi**, and **se_rfmci** provide the same functionality as **rfi**, **rfci**, **rfdi**, and **rfmci,** respectively.

2.4 Integer Instructions

This section lists the integer instructions supported by VLE.

2.4.1 Integer Load Instructions

The integer load instructions compute the EA of the memory to be accessed as described in Section 2.1.1, "Data Storage Addressing Modes."

The byte, halfword, word, or doubleword in storage addressed by EA is loaded into **r**D or **r**Z.

VLE supports both big- and little-endian byte ordering for data accesses.

Some integer load instructions have an update form in which **r**A is updated with the EA. For these forms, if **r**A¦0 and **r**A¦**r**D, the EA is placed into **r**A and the memory element (byte, halfword, word, or doubleword) addressed by EA is loaded into **r**D. If **r**A = 0 or **r**A = **r**D, the instruction form is invalid. This is the same behavior as specified for UISA load with update instructions.

The integer load instructions, **lbzx**, **lbzux**, **lhzx**, **lhzux**, **lwzx**, and **lwzux**, are available in VLE mode. The mnemonics, decoding, and semantics for these instructions are identical to those defined by the UISA. See the EREF for the instruction definitions.

The integer load instructions, **lwax**, **lwaux**, **ldx**, and **ldux,** are available in VLE mode on 64-bit implementations. The mnemonics, decoding, and semantics for these instructions are identical to those in the UISA. See the EREF for the instruction definitions.

2.4.2 Integer Load and Store with Byte Reversal Instructions

The integer load with byte reversal and store with byte reversal instructions, **lhbrx**, **lwbrx**, **sthbrx**, and **stwbrx,** are available in VLE mode. The mnemonics, decoding, and semantics for these instructions are identical to those in the UISA. See the EREF for instruction definitions.

2.4.3 Integer Load and Store Multiple Instructions

The load/store multiple instructions have preferred forms; see the EREF. In the preferred forms storage alignment satisfies the following rule.

- The combination of the EA and **r**D (**r**S) is such that the low-order byte of GPR 31 is loaded (stored) from (into) the last byte of an aligned quadword in storage.

2.4.4 Integer Arithmetic Instructions

The integer arithmetic instructions use the contents of the GPRs as source operands and place results into GPRs, into status bits in the XER, and into CR0.

The integer arithmetic instructions treat source operands as signed integers unless an instruction is explicitly identified as performing an unsigned operation.

The **e_add2i.** instruction and other arithmetic instructions with Rc=1 set the first three bits of CR0 to characterize the result placed into the target register. In 64-bit mode, these bits are set by signed comparison of the result to 0. In 32-bit mode, these bits are set by signed comparison of the low-order 32 bits of the result to zero.

e_addic[.] and **e_subfic**[.] always set CA to reflect the carry out of bit 0 in 64-bit mode and out of bit 32 in 32-bit mode.

The integer arithmetic instructions, **add[.], addo[.]**, **addc[.]**, **addco[.]**, **adde[.]**, **addeo[.]**, **addme[.]**, **addmeo[.]**, **addze[.]**, **addzeo[.]**, **divw[.]**, **divwo[.]**, **divwu[.]**, **divwuo[.]**, **mulhw[.]**, **mulhwu[.]**, **mullw[.]**, **mullwo[.] neg[.]**, **nego[.]**, **subf[.]**, **subfo[.] subfe[.]**, **subfeo[.]**, **subfme[.]**, **subfmeo[.]**, **subfze[.]**, **subfzeo[.]**, **subfc[.]**, and **subfco[.]** are available in VLE mode. The mnemonics, decoding, and semantics for these instructions are identical to those in the UISA; see the EREF for the instruction definitions.

The integer arithmetic instructions, **mulld[.]**, **mulldo[.]**, **mulhd[.]**, **muldu[.]**, **divd[.]**, **divdo[.]**, **divdu[.]**, and **divduo[.]** are available in VLE mode on 64-bit implementations. The mnemonics, decoding, and semantics for those instructions are identical to these in the UISA; see the EREF for the instruction definitions.

2.4.5 Integer Trap Instructions

The integer trap instruction **tw** is available in VLE mode. The mnemonics, decoding, and semantics for this instruction are identical to that in the UISA; see the EREF for the instruction definition.

The integer trap instruction **td** is available in VLE mode on 64-bit implementations. The mnemonic, decoding, and semantics for the **td** instruction are identical to those in the UISA; see the EREF for the instruction definitions.

2.4.6 Integer Select Instruction

The Integer Select instruction **isel** provides a means to select one of two registers and place the result in a destination register under the control of a predicate value supplied by a CR bit.

The **isel** is available in VLE mode. The mnemonics, decoding, and semantics for this instruction are identical to that in the UISA; see the EREF for the instruction definition.

2.4.7 Integer Logical, Bit, and Move Instructions

The logical instructions perform bit-parallel operations on 64-bit operands. The bit instructions manipulate a bit, or create a bit mask, in a register. The move instructions move a register or an immediate value into a register.

The X-form logical instructions with Rc=1, the SCI8-form logical instructions with Rc=1, the RR-form logical instructions with Rc=1, the **e_and2i.** instruction, and the **e_and2is.** instruction set the first three bits of CR field 0 as the arithmetic instructions described in Section 2.4.4, “Integer Arithmetic

Instructions.” (Also see Section 2.3.1.1, “Condition Register (CR).”) The logical instructions do not change the SO, OV, and CA bits in the XER.

The integer logical instructions, **and[.]**, **or[.]**, **xor[.]**, **nand[.]**, **nor[.]**, **eqv[.]**, **andc[.]**, **orc[.]**, **extsb[.]**, **extsh[.]**, **cntlzw[.]**, and **popcntb**, are available in VLE mode. The mnemonics, decoding, and semantics for these instructions are identical to those in the UISA; see the EREF for instruction definitions.

The integer logical instructions, **extsw[.]** and **cntlzd[.],** are available in VLE mode on 64-bit implementations. The mnemonics, decoding, and semantics for these instructions are identical to those in the UISA; see the EREF for instruction definitions.

2.5 Storage Control Instructions

2.5.1 Storage Synchronization Instructions

The memory synchronization instructions implemented by VLE are identical in semantics to those defined in the VEA and OEA. The **se_isync** instruction is defined by VLE but has the same semantics as **isync**.

The load and reserve instruction **lwarx** and the store conditional instruction **stwcx** are available in VLE mode. The mnemonics, decoding, and semantics for those instructions are identical to those in the VEA; see the EREF for instruction definitions.

The load and reserve instruction **ldarx** and the store conditional instruction **stdcx** are available in VLE mode on 64-bit implementations. The mnemonics, decoding, and semantics for those instructions are identical to those in the VEA; see the EREF for instruction definitions.

Memory barrier instructions, **sync** (**msync**) and **mbar** are available in VLE mode. The mnemonics, decoding, and semantics for those instructions are identical to those in the VEA; see the EREF for instruction definitions.

The **wait** instruction is available in VLE mode if the category Wait is implemented. The mnemonics, decoding, and semantics for **wait** are identical to those in the VEA; see the EREF for the instruction definition.

2.5.2 Cache Management Instructions

Cache management instructions implemented by VLE are identical to those defined in the VEA and OEA.

The cache management instructions, **dcba**, **dcbf**, **dcbst**, **dcbt**, **dcbtst**, **dcbz**, **icbi**, and **icbt**, are available in VLE mode. The mnemonics, decoding, and semantics for these instructions are identical to those in the VEA; see the EREF instruction definitions.

dcbi is available in VLE mode. The mnemonics, decoding, and semantics for this instruction are identical to those in the OEA; see the EREF for instruction definition.

2.5.3 Cache Locking Instructions

Cache locking instructions implemented by VLE are identical to those defined by the OEA. If the cache locking instructions are implemented in VLE, the embedded cache locking instructions must also be implemented.

The cache locking instructions defined by the OEA, **dcbtls**, **dcbtstls, dcblc, icbtls**, and **icblc** are available in VLE mode. The mnemonics, decoding, and semantics for these instructions are identical to those defined in the OEA; see the EREF for instruction definitions.

2.5.4 TLB Management Instructions

The TLB management instructions implemented by VLE are identical to those defined by the OEA.

The OEA-defined TLB management instructions, **tlbre**, **tlbwe, tlbivax, tlbsync**, and **tlbsx**, are available in VLE mode. The mnemonics, decoding, and semantics for these instructions are identical to those in the OEA. See the EREF for instruction definitions.

Instructions and resources from category Embedded.MMU Type FSL are available if that category is implemented.

2.5.5 Instruction Alignment and Byte Ordering

Only big-endian instruction memory is supported when executing from a page of VLE instructions. Attempting to fetch VLE instructions from a page marked as little-endian generates an instruction storage interrupt byte-ordering exception.

2.6 Additional Categories Available in VLE

Processors that implement VLE may implement instructions and resources from categories other than Base and Embedded. User documentation for each processor core indicates which of these may be implemented. These instructions are described in the EREF.

Such categories include those for which all the instructions in the category use primary opcode 4 or primary opcode 31, as listed below:

- Move assist. Move assist instructions implemented by VLE are identical to those defined in the UISA. The mnemonics, decoding, and semantics for those instructions are identical to those in the UISA; see the EREF for the instruction definitions.
- Vector. Vector instructions implemented by VLE are identical to those defined in the UISA. The mnemonics, decoding, and semantics for those instructions are identical to those in the UISA; see the EREF for the instruction definitions.
- Signal processing engine (SPE). SPE instructions implemented by VLE are identical to those defined in the UISA. The mnemonics, decoding, and semantics for those instructions are identical to those in the UISA; see the EREF for the instruction definitions.
- Embedded floating-point. Embedded floating-point instructions implemented by VLE are identical to those defined in the UISA.The mnemonics, decoding, and semantics for those instructions are identical to those in the UISA; see the EREF for the instruction definitions.

- Legacy move assist. Legacy move assist instructions implemented by VLE are identical to those defined in the UISA. The mnemonics, decoding, and semantics for those instructions are identical to those in the UISA; see the EREF for instruction definitions.
- External PID. External process ID instructions implemented by VLE are identical to those defined by the OEA. Semantics for those instructions are identical to those in the OEA; see the EREF for the instruction definitions.
- Embedded performance monitor. Embedded performance monitor instructions implemented by VLE are identical to those defined by the OEA. The mnemonics, decoding, and semantics for those instructions are identical to those in the OEA; see the EREF for the instruction definitions.
- Processor control. Processor control instructions implemented by VLE are identical to those defined by the OEA. The mnemonics, decoding, and semantics for those instructions are identical to those in the OEA; see the EREF for the instruction definitions.

Chapter 3
VLE Instruction Set

The VLE extension ISA is defined in the instruction pages in this chapter. Because of the various immediate field and displacement field calculations used in the VLE extension, a description of the less obvious ones precedes the actual instruction pages, and the instruction descriptions generally assume the appropriate calculation has been performed.

NOTE

The instructions in this section are listed in order of the root instruction. For example, **e_cmpi** and **se_cmpi** are both listed under **cmpi**.

3.1 Supported Power ISA Instructions

Table 3-1 lists instructions that are used by the VLE extension that are defined by the UISA, VEA, or OEA. Those instructions are described in the EREF.

Descriptions in this chapter indicate any limitations on the behavior of VLE instructions as compared to their non-VLE equivalents.

Table 3-1. Non-VLE Instructions Listed by Mnemonic

Mnemonic	Instruction
add rD,**r**A,**r**B **add.** rD,**r**A,**r**B **addo** rD,**r**A,**r**B **addo.** rD,**r**A,**r**B	Add
addc rD,**r**A,**r**B **addc.** rD,**r**A,**r**B **addco** rD,**r**A,**r**B **addco.** rD,**r**A,**r**B	Add Carrying
adde rD,**r**A,**r**B **adde.** rD,**r**A,**r**B **addeo** rD,**r**A,**r**B **addeo.** rD,**r**A,**r**B	Add Extended
andc[.] rA,**r**S,**r**B	AND with Complement
and[.] rA,**r**S,**r**B	AND
cmp cr**r**D,L,**r**A,**r**B	Compare
cmpl cr**r**D,L,**r**A,**r**B	Compare Logical
cntlzw rA,**r**S **cntlzw.** rA,**r**S	Count Leading Zeros Word
dcba rA,**r**B	Data Cache Block Allocate

Table 3-1. Non-VLE Instructions Listed by Mnemonic (continued)

Mnemonic	Instruction
dcbf rA,rB	Data Cache Block Flush
dcbi rA,rB	Data Cache Block Invalidate
dcbst rA,rB	Data Cache Block Store
dcbt CT,rA,rB	Data Cache Block Touch
dcbtst CT,rA,rB	Data Cache Block Touch for Store
dcbz rA,rB	Data Cache Block set to Zero
divw rD,rA,rB **divw.** rD,rA,rB **divwo** rD,rA,rB **divwo.** rD,rA,rB	Divide Word
divwu rD,rA,rB **divwu.** rD,rA,rB **divwuo** rD,rA,rB **divwuo.** rD,rA,rB	Divide Word Unsigned
eqv rA,rS,rB **eqv.** rA,rS,rB	Equivalent
extsb rA,rS **extsb.** rA,rS	Extend Sign Byte
extsh rA,rS **extsh.** rA,rS	Extend Sign Halfword
e_srwi rA,rS,SH	Shift Right Word Immediate
icbi rA,rB	Instruction Cache Block Invalidate
icbt CT,rA,rB	Instruction Cache Block Touch
lbzx rD,rA,rB **lbzux** rD,rA,rB	Load Byte and Zero Indexed Load Byte and Zero with Update Indexed
lhax rD,rA,rB **lhaux** rD,rA,rB	Load Halfword Algebraic Indexed Load Halfword Algebraic with Update Indexed
lhbrx rD,rA,rB	Load Halfword Byte-Reverse Indexed
lhzx rD,rA,rB **lhzux** rD,rA,rB	Load Halfword and Zero Indexed Load Halfword and Zero with Update Indexed
lwarx rD,rA,rB	Load Word And Reserve Indexed
lwbrx rD,rA,rB	Load Word Byte-Reverse Indexed
lwzx rD,rA,rB **lwzux** rD,rA,rB	Load Word and Zero Indexed Load Word and Zero with Update Indexed
mbar	Memory Barrier
mcrxr crD	Move to Condition Register from Integer Exception Register
mfcr rD	Move From condition register
mfdcr rD,DCRN	Move From Device Control Register

Table 3-1. Non-VLE Instructions Listed by Mnemonic (continued)

Mnemonic	Instruction
mfmsr rD	Move From Machine State Register
mfspr rD,SPRN	Move From Special Purpose Register
msync	Memory Synchronize
mtcrf FXM,rS	Move to Condition Register Fields
mtdcr DCRN,rS	Move To Device Control Register
mtmsr rS	Move To Machine State Register
mtspr SPRN,rS	Move To Special Purpose Register
mulhw rD,rA,rB **mulhw.** rD,rA,rB	Multiply High Word
mulhwu rD,rA,rB **mulhwu.** rD,rA,rB	Multiply High Word Unsigned
mullw rD,rA,rB **mullw.** rD,rA,rB **mullwo** rD,rA,rB **mullwo.** rD,rA,rB	Multiply Low Word
nand rA,rS,rB **nand.** rA,rS,rB	NAND
neg rD,rA **neg.** rD,rA **nego** rD,rA **nego.** rD,rA	Negate
nor rA,rS,rB **nor.** rA,rS,rB	NOR
or rA,rS,rB **or.** rA,rS,rB	OR
orc rA,rS,rB **orc.** rA,rS,rB	OR with Complement
slw rA,rS,rB **slw.** rA,rS,rB	Shift Left Word
sraw rA,rS,rB **sraw.** rA,rS,rB	Shift Right Algebraic Word
srawi rA,rS,SH **srawi.** rA,rS,SH	Shift Right Algebraic Word Immediate
srw rA,rS,rB **srw.** rA,rS,rB	Shift Right Word
stbx rS,rA,rB **stbux** rS,rA,rB	Store Byte Indexed Store Byte with Update Indexed
sthbrx rS,rA,rB	Store Halfword Byte-Reverse Indexed
sthx rS,rA,rB **sthux** rS,rA,rB	Store Halfword Indexed Store Halfword with Update Indexed

Table 3-1. Non-VLE Instructions Listed by Mnemonic (continued)

Mnemonic	Instruction
stwbrx rS,rA,rB	Store Word Byte-Reverse Indexed
stwcx. rS,rA,rB	Store Word Conditional Indexed
stwx rS,rA,rB **stwux** rS,rA,rB	Store Word Indexed Store Word with Update Indexed
subf rD,rA,rB **subf.** rD,rA,rB **subfo** rD,rA,rB **subfo.** rD,rA,rB	Subtract From
subfc rD,rA,rB **subfc.** rD,rA,rB **subfco** rD,rA,rB **subfco.** rD,rA,rB	Subtract From Carrying
tlbivax rA,rB	TLB Invalidate Virtual Address Indexed
tlbre	TLB Read Entry
tlbsx rA,rB	TLB Search Indexed
tlbsync	TLB Synchronize
tlbwe	TLB Write Entry
tw TO,rA,rB	Trap Word
wrtee rA	Write MSR External Enable
wrteei E	Write MSR External Enable Immediate
xor rA,rS,rB **xor.** rA,rS,rB	XOR
isel rD,rA,rB,crb	Integer Select

3.2 Immediate Field and Displacement Field Encodings

Table 3-2 shows encodings for immediate and displacement fields.

Table 3-2. Immediate Field and Displacement Field Encodings

Encoding	Description
BD15	Format used by 32-bit branch conditional class instructions. The BD15 field is an 15-bit signed displacement which is sign-extended and shifted left one bit (concatenated with 0b0) and then added to the current instruction address to form the branch target address.
BD24	Format used by 32-bit branch class instructions. The BD24 field is an 24-bit signed displacement which is sign-extended and shifted left one bit (concatenated with 0b0) and then added to the current instruction address to form the branch target address.
BD8	Format used by 16-bit branch and branch conditional class instructions. The BD8 field is an 8-bit signed displacement which is sign-extended and shifted left one bit (concatenated with 0b0) and then added to the current instruction address to form the branch target address.

Table 3-2. Immediate Field and Displacement Field Encodings (continued)

Encoding	Description
D	Format used by some 32-bit load and store class instructions. The D field is a 16-bit signed displacement which is sign-extended to 32 bits, and then added to the base register to form a 32-bit EA.
D8	Format used by some 32-bit load and store class instructions. The D8 field is a 8-bit signed displacement which is sign-extended to 32 bits, and then added to the base register to form a 32-bit EA.

F, SCL,UI8 (SCI8 format)	Format used by some 32-bit arithmetic, compare, and logical instructions. The UI8 field is an 8-bit immediate value shifted left 0, 1, 2, or 3 byte positions according to the value of the SCL field. The remaining bits in the 32-bit word are filled with the value of the F field, and the resulting 32-bit value is used as one operand of the instruction. More formally,
	`if SCL=0 then imm_value ← 24F ‖ UI8 else`
	`if SCL=1 then imm_value ← 16F ‖ UI8 ‖ 8F else`
	`if SCL=2 then imm_value ← 8F ‖ UI8 ‖ 16F`
	`else imm_value ← UI8 ‖ 24F`

LI20	Format used by 32-bit **e_li** instruction. The LI20 field is a 20-bit signed displacement which is sign-extended to 32 bits for the **e_li** instruction.
OIM5	Format used by the 16-bit **se_addi**, **se_cmpli**, and **se_subi[.]** instructions. The OIM5 instruction field is a 5-bit value in the range 0–31 and is used to represent immediate values in the range 1–32; thus the binary encoding of 0b00000 represents an immediate value of 1, 0b00001 represents an immediate value of 2, and so on. In the instruction descriptions, OIMM represents the immediate value, not the OIM5 instruction field binary encoding.
SCI8 format	Refer to F, SCL,UI8 (SCI8 format)
SD4	Format used by 16-bit load and store class instructions. The SD4 field is a 4-bit unsigned immediate value zero-extended to 32 bits, shifted left according to the size of the operation, and then added to the base register to form a 32-bit EA. For byte operations, no shift is performed. For half-word operations, the immediate is shifted left one bit (concatenated with 0b0). For word operations, the immediate is shifted left two bits (concatenated with 0b00). For future double-word operations, the immediate is shifted left three bits (concatenated with 0b000).
SI (D format, I16A format)	Format used by certain 32-bit arithmetic type instructions. The SI field is a 16-bit signed immediate value sign-extended to 32 bits and used as one operand of the instruction. The instruction encoding differs between the D and I16A instruction formats as shown in Figure A-11 and Figure A-12
UI (I16A, I16L formats)	Format used by certain 32-bit logical and arithmetic type instructions. The UI field is a 16-bit unsigned immediate value zero-extended to 32 bits or padded with 16 zeros and used as one operand of the instruction. The instruction encoding differs between the I16A and I16L instruction formats as shown in Figure A-12 and Figure A-13.
UI5	This format is used by some 16-bit Reg+Imm class instructions. The UI5 field is a 5-bit unsigned immediate value zero-extended to 32 bits and used as the second operand of the instruction. For other 16-bit Reg+Imm class instructions, the UI5 field is a 5-bit unsigned immediate value used to select a register bit in the range 0–31.
UI7	This format is used by the 16-bit **se_li** instructions. The UI7 field is a 7-bit unsigned immediate value zero-extended to 32 bits and used as the operand of the instruction.

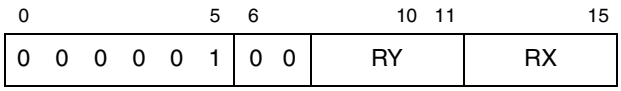
_add*x*

VLE	User

_add*x*

Add

se_add **r**X,**r**Y



$sum_{32:63}$ ← GPR(RX) + GPR(RY)
GPR(RX) ← $sum_{32:63}$

The sum of the contents of GPR(**r**X) and the contents of GPR(**r**Y) is placed into GPR(**r**X).

Special Registers Altered: None

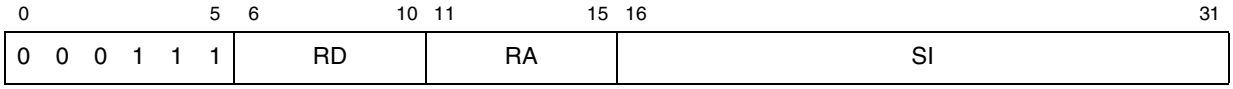
_addi*x*

VLE	User

_addi*x*

Add [2 operand] Immediate [Shifted] [and Record]

e_add16i **r**D,**r**A,SI

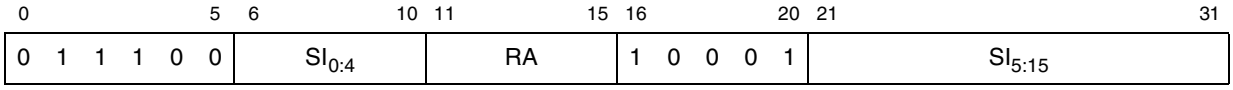



```
a ← GPR(RA)
b ← EXTS(SI)
GPR(RD) ← a + b
```

The sum of the contents of GPR(**r**A) and the sign-extended value of field SI is placed into GPR(**r**D).

Special Registers Altered: None

e_add2i. **r**A,SI

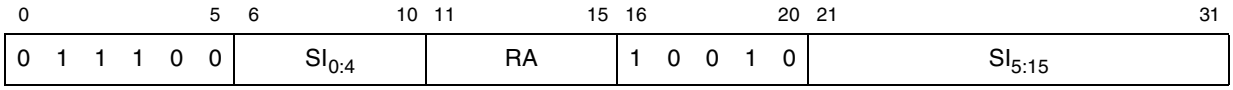



```
SI ← SI0:4 || SI5:15
sum32:63   ←       GPR(RA) + EXTS(SI)
   LT   ← sum32:63 < 0
   GT   ← sum32:63 > 0
   EQ   ← sum32:63 = 0
   CR0  ← LT || GT || EQ || SO
GPR(RA) ← sum32:63
```

The sum of the contents of GPR(**r**A) and the sign-extended value of SI is placed into GPR(**r**A).

Special Registers Altered: CR0

e_add2is **r**A,SI



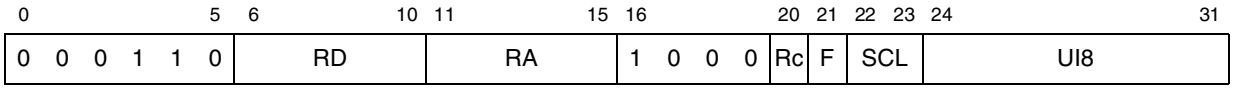

```
SI ← SI0:4 || SI5:15
sum32:63   ←   GPR(RD) + (SI || 16 0)
GPR(RA) ← sum32:63
```

The sum of the contents of GPR(**r**A) and the value of SI concatenated with 16 zeros is placed into GPR(**r**A).

Special Registers Altered: None

e_addi **r**D,**r**A,SCI8 (Rc = 0)

e_addi. **r**D,**r**A,SCI8 (Rc = 1)

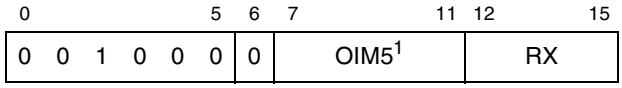



```
imm ← SCI8(F,SCL,UI8)
sum32:63   ←       GPR(RA) + imm
if Rc=1 then do
   LT   ← sum32:63 < 0
   GT   ← sum32:63 > 0
   EQ   ← sum32:63 = 0
   CR0  ← LT || GT || EQ || SO
GPR(RD) ← sum32:63
```

The sum of the contents of GPR(**r**A) and the value of SCI8 is placed into GPR(**r**D).

Special Registers Altered: CR0 (if Rc = 1)

se_addi **r**X,OIMM



[1] OIMM = OIM5 +1

```
GPR(RX) ← GPR(RX) + (270 || OFFSET(OIM5))
```

The sum of the contents of GPR(**r**X) and the zero-extended offset value of OIM5 (a final value in the range 1–32), is placed into GPR(**r**X).

Special Registers Altered: None

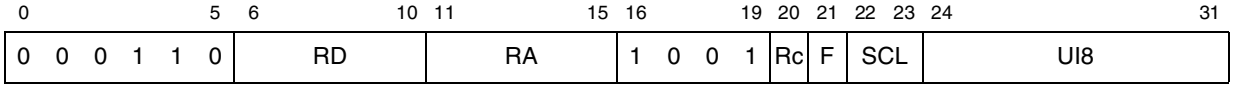
_addic*x*

VLE	User

_addic*x*

Add Immediate Carrying [and Record]

e_addic **r**D,**r**A,SCI8 (Rc = 0)
e_addic. **r**D,**r**A,SCI8 (Rc = 1)




```
imm ← SCI8(F,SCL,UI8)
carry32:63 ← Carry(GPR(RA) + imm)
sum32:63   ←       GPR(RA) + imm
if Rc=1 then do
   LT   ← sum32:63 < 0
   GT   ← sum32:63 > 0
   EQ   ← sum32:63 = 0
   CR0  ← LT || GT || EQ || SO
GPR(RD) ← sum32:63
CA      ← carry32
```

The sum of the contents of GPR(**r**A) and the value of SCI8 is placed into GPR(**r**D).

Special Registers Altered: CA, CR0 (if Rc=1)

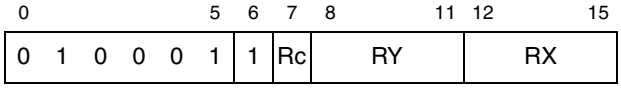
_and*x*

VLE	User

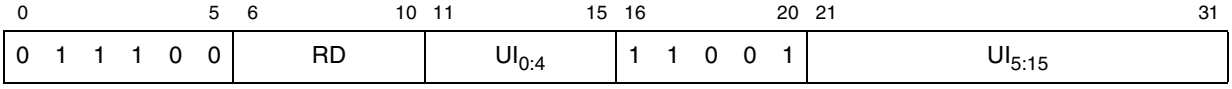
_and*x*

AND [2 operand] [Immediate | with Complement] [and Record]

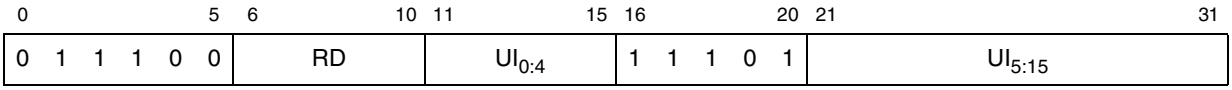
se_and **r**X,**r**Y (Rc = 0)
se_and. **r**X,**r**Y (Rc = 1)



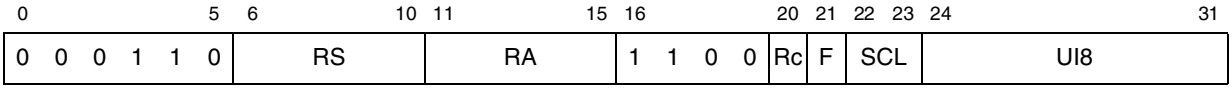
e_and2i. **r**D,UI



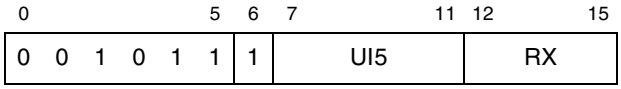
e_and2is. **r**D,UI



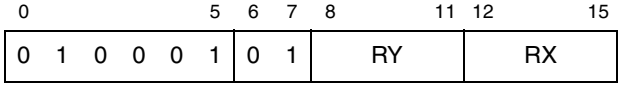
e_andi **r**A,**r**S,SCI8 (Rc = 0)
e_andi. **r**A,**r**S,SCI8 (Rc = 1)



se_andi **r**X,UI5



se_andc **r**X,**r**Y




```
if ‘e_andi[.]’ then b ← SCI8(F,SCL,UI8)
if ‘se_andi’ then b ← UI5
if ‘se_and[.]’ then b ← GPR(RY)
if ‘se_andc’    then b ← ¬GPR(RY)
if ‘e_and2i.’ then b ← 16‘0 || UI0:4 || UI5:15
if ‘e_and2is.’ then b ← UI0:4 || UI5:15 || 16‘0
result32:63 ← GPR(RS or RD or RX) & b
if Rc=1 then do
   LT  ← result32:63 < 0
```

```
    GT  ← result32:63 > 0
    EQ  ← result32:63 = 0
    CR0 ← LT || GT || EQ || SO
if ‘se_and[ci]’ then GPR(RX) ← result32:63 else GPR(RA or RD) ←
result32:63
```

For **e_andi**[**.**], the contents of GPR(**r**S) are ANDed with the value of SCI8.
For **e_and2i.**, the contents of GPR(**r**D) are ANDed with $^{16}0$ || UI.
For **e_and2is.**, the contents of GPR(**r**D) are ANDed with UI || $^{16}0$.
For **se_andi**, the contents of GPR(**r**X) are ANDed with the value of UI5.
For **se_and**[**.**], the contents of GPR(**r**X) are ANDed with the contents of GPR(**r**Y).
For **se_andc**, the contents of GPR(**r**X) are ANDed with the one’s complement of the contents of GPR(**r**Y).
The result is placed into GPR(**r**A) or GPR(**r**X) (**se_and**[**ic**][**.**])

Special Registers Altered: CR0 (if Rc = 1)

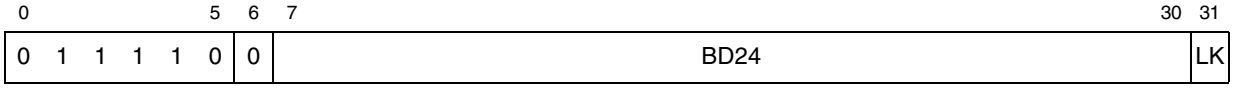
_bx

VLE	User

_bx

Branch [and Link]

e_b BD24 (LK = 0)
e_bl BD24 (LK = 1)




```
a ← CIA
NIA ← (a + EXTS(BD24||0b0))32:63
if LK=1 then LR ← CIA + 4
```

Let the BTEA be calculated as follows:

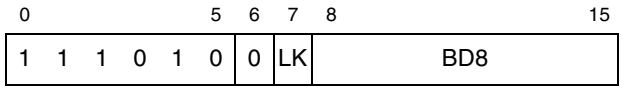
- For **e_b**[**l**], let BTEA be the sum of the CIA and the sign-extended value of the BD24 instruction field concatenated with 0b0.

The BTEA is the address of the next instruction to be executed.

If LK = 1, the sum CIA+4 is placed into the LR.

Special Registers Altered: LR (if LK = 1)

se_b BD8 (LK = 0)
se_bl BD8 (LK = 1)




```
a ← CIA
NIA ← (a + EXTS(BD8||0b0))32:63
if LK=1 then LR ← CIA + 2
```

Let the BTEA be calculated as follows:

- For **se_b**[**l**], let BTEA be the sum of the CIA and the sign-extended value of the BD8 instruction field concatenated with 0b0.

The BTEA is the address of the next instruction to be executed.

If LK = 1, the sum CIA+2 is placed into the LR.

Special Registers Altered: LR (if LK = 1)

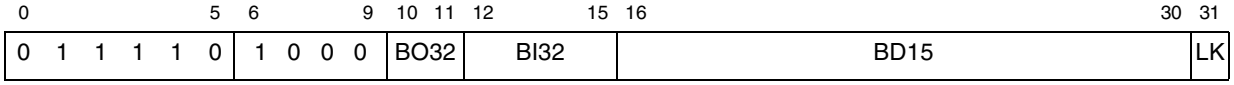
_bc*x*

VLE	User

_bc*x*

Branch Conditional [and Link]

e_bc BO32,BI32,BD15 (LK = 0)
e_bcl BO32,BI32,BD15 (LK = 1)




```
if BO32_0 then CTR_32:63 ← CTR_32:63 - 1
ctr_ok  ← ¬BO32_0 | ((CTR_32:63 ≠ 0) ⊕ BO32_1)
cond_ok ← BO32_0 | (CR_BI32+32 ≡ BO32_1)
if ctr_ok & cond_ok then
                NIA ← (CIA + EXTS(BD15 || 0b0))_32:63
else            NIA ← CIA + 4
if LK=1 then LR ← CIA + 4
```

Let the BTEA be calculated as follows:

- For **e_bc**[**l**], let BTEA be the sum of the CIA and the sign-extended value of the BD15 instruction field concatenated with 0b0.

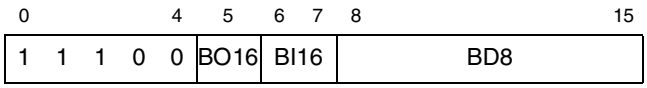
BO32 specifies any conditions that must be met for the branch to be taken, as defined in Section 2.3.2, “Branch Instructions.” The sum BI32+32 specifies the CR bit. Only CR[32–47] may be specified.

If the branch conditions are met, the BTEA is the address of the next instruction to be executed.

If LK = 1, the sum CIA + 4 is placed into the LR.

Special Registers Altered: CTR (if $BO32_0 = 1$)
LR (if LK = 1)

se_bc BO16,BI16,BD8




```
cond_ok ← (CR_BI16+32 ≡ BO16)
if cond_ok then
                NIA ← (CIA + EXTS(BD8 || 0b0))_32:63
else            NIA ← CIA + 2
```

Let the BTEA be calculated as follows:

- For **se_bc**, BTEA is the sum of the CIA and the sign-extended value of the BD8 instruction field concatenated with 0b0.

BO16 specifies any conditions that must be met for the branch to be taken, as defined in Section 2.3.2, “Branch Instructions.” The sum BI16+32 specifies CR bit; only CR[32–35] may be specified.

If the branch conditions are met, the BTEA is the address of the next instruction to be executed.

Special Registers Altered: None

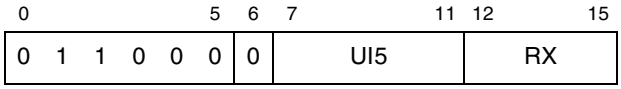
_bclri

VLE	User

_bclri

Bit Clear Immediate

se_bclri **r**X,UI5




```
a ← UI5
b ← a1 || 0 || 31-a1
result32:63 ← GPR(RX) & b
GPR(RX) ← result32:63
```

For **se_bclri**, the bit of GPR(**r**X) specified by the value of UI5 is cleared and all other bits in GPR(**r**X) remain unaffected.

Special Registers Altered: None

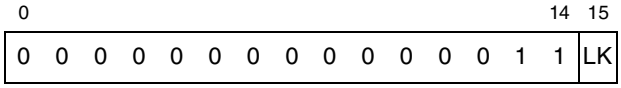
_bctrx

VLE	User

_bctrx

Branch to Count Register [and Link]

se_bctr (LK = 0)
se_bctrl (LK = 1)




```
NIA ← CTR32:62 || 0b0
if LK=1 then LR ← CIA + 2
```

Let the BTEA be calculated as follows:

- For **se_bctr**[**l**], let BTEA be bits 32–62 of the contents of the CTR concatenated with 0b0.

The BTEA is the address of the next instruction to be executed.

If LK = 1, the sum CIA + 2 is placed into the LR.

Special Registers Altered: LR (if LK = 1)

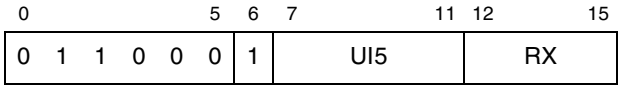
_bgeni

VLE	User

_bgeni

Bit Generate Immediate

se_bgeni **r**X,UI5




```
a ← UI5

b ← a0 || 1 || 31-a0
GPR(RX) ← b
```

For **se_bgeni**, a constant value consisting of a single ’1’ bit surrounded by ’0’s is generated and the value is placed into GPR(**r**X). The position of the ’1’ bit is specified by the UI5 field.

Special Registers Altered: None

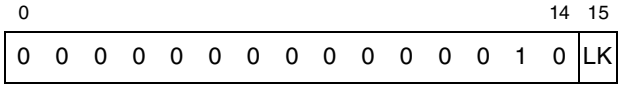
_blr*x*

VLE	User

_blr*x*

Branch to Link Register [and Link]

se_blr (LK = 0)
se_blrl (LK = 1)




```
NIA ← LR32:62 || 0b0
if LK=1 then LR ← CIA + 2
```

Let the BTEA be calculated as follows:

- For **se_blr[l]**, let BTEA be bits 32–62 of the contents of the LR concatenated with 0b0.

The BTEA is the address of the next instruction to be executed.

If LK = 1, the sum CIA + 2 is placed into the LR.

Special Registers Altered: LR (if LK = 1)

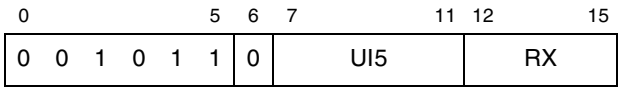
_bmaski

VLE	User

_bmaski

Bit Mask Generate Immediate

se_bmaski **r**X,UI5




```
a ← UI5
if a = 0 then b ← 32 1  else  b ← 32-a 0 || a 1
GPR(RX) ← b
```

For **se_bmaski**, a constant value consisting of a mask of low-order ’1’ bits that is zero-extended to 32 bits is generated, and the value is placed into GPR(**r**X). The number of low-order ’1’ bits is specified by the UI5 field. If UI5 is 0b00000, a value of all ’1’s is generated

Special Registers Altered: None

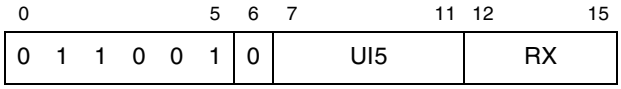
_bseti

VLE	User

_bseti

Bit Set Immediate

se_bseti **r**X,UI5




```
a ← UI5
b ← a0 || 1 || 31-a0
result32:63 ← GPR(RX) | b
GPR(RX) ← result32:63
```

For **se_bseti**, the bit of GPR(**r**X) specified by the value of UI5 is set, and all other bits in GPR(**r**X) remain unaffected.

Special Registers Altered: None

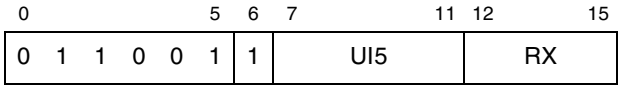
_btsti

VLE	User

_btsti

Bit Test Immediate

se_btsti **r**X,UI5




```
a ← UI5
b ← a0 || 1 || 31-a0
c ← GPR(RX) & b
if c = 320 then d ← 0b001 else d ← 0b010
CR0:3 ← d || XERSO
```

For **se_btsti**, the bit of GPR(**r**X) specified by the value of UI5 is tested for equality to ’1’. The result of the test is recorded in the CR. EQ is set if the tested bit is clear, LT is cleared, and GT is set to the inverse value of EQ.

Special Registers Altered: CR[0–3]

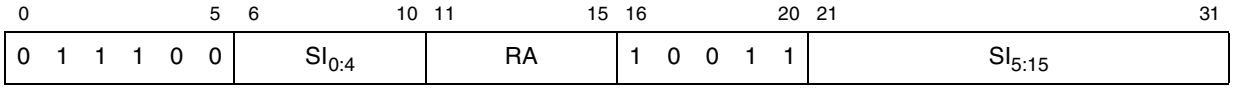
_cmp

VLE	User

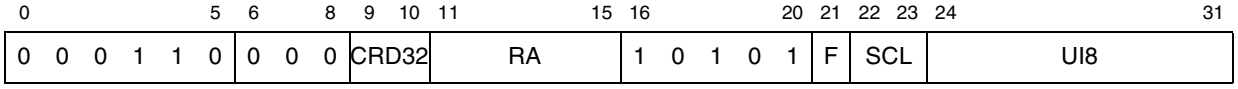
_cmp

Compare [Immediate]

e_cmp16i **r**A,SI



e_cmpi **cr**D32,**r**A,SCI8




```
a ← GPR(RA)32:63
if ‘e_cmpi’  then b ← SCI8(F,SCL,UI8)
if ‘e_cmp16i’  then b ← EXTS(SI0:4 || SI5:15)
if a < b then c ← 0b100
if a > b then c ← 0b010
if a = b then c ← 0b001
if ‘e_cmpi’     then CR4×CRD32+32:4×CRD32+35 ← c || XERSO // only CR0-CR3
if ‘e_cmp16i’     then CR32:35 ← c || XERSO // only CR0
```

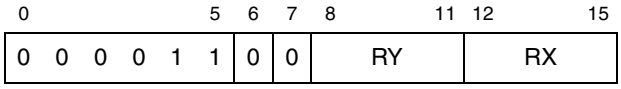
If **e_cmpi**, GPR(**r**A) contents are compared with the value of SCI8, treating operands as signed integers.

If **e_cmp16i**, GPR(**r**A) contents are compared with the sign-extended value of the SI field, treating operands as signed integers.

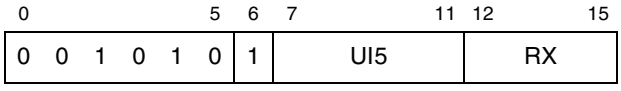
The result of the comparison is placed into CR field **cr**D (**cr**D32). For **e_cmpi**, only CR0–CR3 may be specified. For **e_cmp16i**, only CR0 may be specified.

Special Registers Altered: CR field **cr**D (**cr**D32) (CR0 for **e_cmp16i**)

se_cmp **r**X,**r**Y



se_cmpi **r**X,UI5




```
a ← GPR(RX)32:63
if ‘se_cmpi’  then b ← 270 || UI5
if ‘se_cmp’   then b ← GPR(RY)32:63
if a < b then c ← 0b100
if a > b then c ← 0b010
if a = b then c ← 0b001
```

$$CR_{0:3} \leftarrow c \parallel XER_{SO}$$

If **se_cmp**, the contents of GPR(**r**X) are compared with the contents of GPR(**r**Y), treating the operands as signed integers. The result of the comparison is placed into CR field 0.

If **se_cmpi**, the contents of GPR(**r**X) are compared with the value of the zero-extended UI5 field, treating the operands as signed integers. The result of the comparison is placed into CR field 0.

Special Registers Altered: CR[0–3]

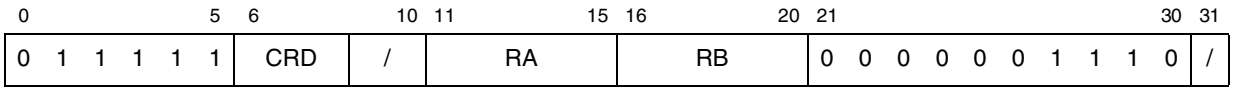
_cmph

VLE	User

_cmph

Compare Halfword [Immediate]

e_cmph **cr**D,**r**A,**r**B

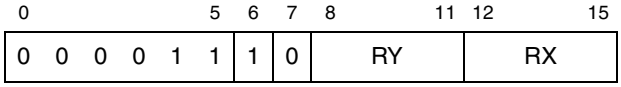



```
a ← EXTS(GPR(RA)48:63)
b ← EXTS(GPR(RB)48:63)
if a < b then c ← 0b100
if a > b then c ← 0b010
if a = b then c ← 0b001
CR4×CRD+32:4×CRD+35 ← c || XERSO
```

For **e_cmph**, the contents of the low-order 16 bits of GPR(**r**A) and GPR(**r**B) are compared, treating the operands as signed integers. The result of the comparison is placed into CR field CRD.

Special Registers Altered: CR field CRD

se_cmph **r**X,**r**Y

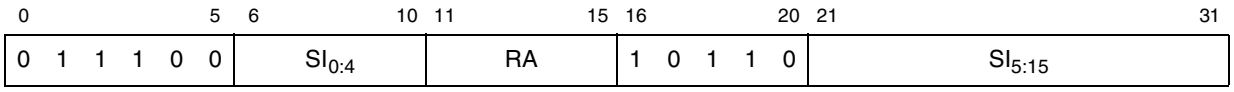



```
a ← EXTS(GPR(RX)48:63)
b ← EXTS(GPR(RY)48:63)
if a < b then c ← 0b100
if a > b then c ← 0b010
if a = b then c ← 0b001
CR0:3 ← c || XERSO
```

For **se_cmph**, the contents of the low-order 16 bits of GPR(**r**X) and GPR(**r**Y) are compared, treating the operands as signed integers. The result of the comparison is placed into CR field 0.

Special Registers Altered: CR[0–3]

e_cmph16i **r**A,SI




```
a ← EXTS(GPR(RA)48:63)
b ← EXTS(SI0:4 || SI5:15)
if a < b then c ← 0b100
if a > b then c ← 0b010
if a = b then c ← 0b001
CR32:35 ← c || XERSO // only CR0
```

The contents of the lower 16-bits of GPR(**r**A) are sign-extended and compared with the sign-extended value of the SI field, treating the operands as signed integers.

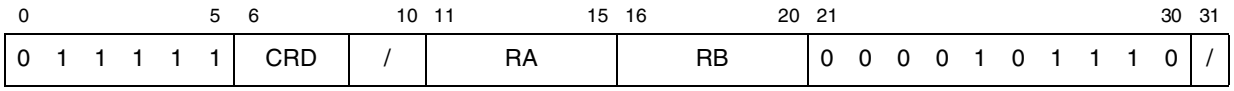
The result of the comparison is placed into CR0.

Special Registers Altered: CR0

cmphl | VLE | User | _cmphl_ _cmphl_

Compare Halfword Logical [Immediate]

e_cmphl **cr**D,**r**A,**r**B

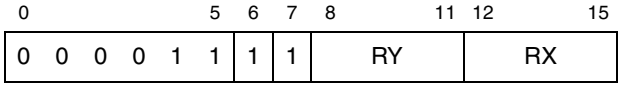



```
a ← EXTZ(GPR(RA)48:63)
b ← EXTZ(GPR(RB)48:63)
if a < b then c ← 0b100
if a > b then c ← 0b010
if a = b then c ← 0b001
CR4×CRD+32:4×CRD+35 ← c || XERSO
```

For **e_cmphl**, the contents of the low-order 16 bits of GPR(**r**A) and GPR(**r**B) are compared, treating the operands as unsigned integers. The result of the comparison is placed into CR field CRD.

Special Registers Altered: CR field CRD

se_cmphl **r**X,**r**Y

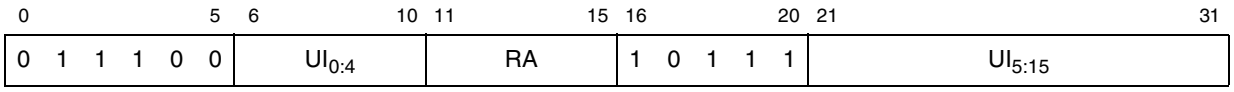



```
a ← GPR(RX)48:63
b ← GPR(RY)48:63
if a < b then c ← 0b100
if a > b then c ← 0b010
if a = b then c ← 0b001
CR0:3 ← c || XERSO
```

For **se_cmphl**, the contents of the low-order 16 bits of GPR(**r**X) and GPR(**r**Y) are compared, treating the operands as unsigned integers. The result of the comparison is placed into CR field 0.

Special Registers Altered: CR[0–3]

e_cmphl16i **r**A,UI




```
a ← 160 || GPR(RA)48:63)
b ← 160 || UI0:4 || UI5:15
if a < b then c ← 0b100
if a > b then c ← 0b010
if a = b then c ← 0b001
CR32:35 ← c || XERSO // only CR0
```

The contents of the lower 16-bits of GPR(**r**A) are zero-extended and compared with the zero-extended value of the UI field, treating the operands as unsigned integers.

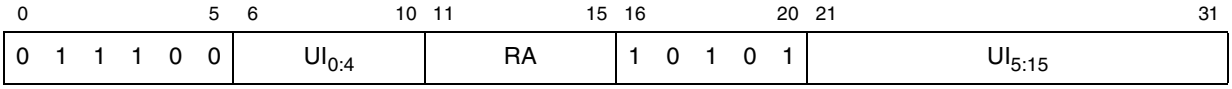
The result of the comparison is placed into CR0.

Special Registers Altered: CR0

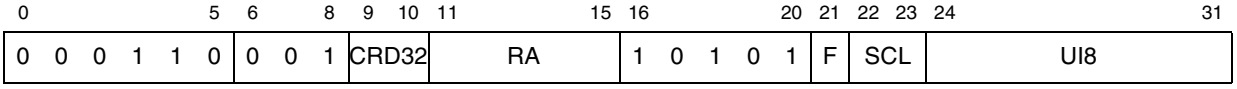
cmpl VLE User _cmpl_ _cmpl_

Compare Logical [Immediate]

e_cmpl16i **r**A,UI



e_cmpli **cr**D32,**r**A,SCI8




```
a ← GPR(RA)32:63
if ‘e_cmpli’ then b ← SCI8(F,SCL,UI8)
if ‘e_cmpl16i’ then b ← 160 || UI0:4 || UI5:15
if a <u b then c ← 0b100
if a >u b then c ← 0b010
if a = b then c ← 0b001
if ‘e_cmpli’     then CR4×CRD32+32:4×CRD32+35 ← c || XERSO // only CR0-CR3
if ‘e_cmp16i’     then CR32:35 ← c || XERSO // only CR0
```

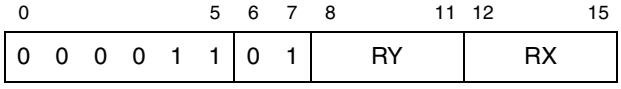
If **e_cmpli**, the contents of bits 32–63 of GPR(**r**A) are compared with the SCI8 value, treating operands as unsigned integers.

If **e_cmpl16i**, GPR(**r**A) and the zero-extended UI value contents are compared, treating operands as unsigned integers.

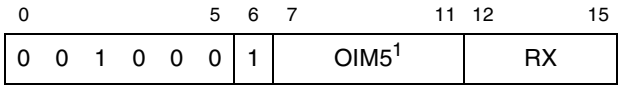
The result of the comparison is placed into CR field CRD (CRD32). For **e_cmpli**, only CR0–CR3 may be specified. For **e_cmpl16i**, only CR0 may be specified.

Special Registers Altered: CR field CRD (CRD32) (CR0 for **e_cmpl16i**)

se_cmpl **r**X,**r**Y



se_cmpli **r**X,OIMM



[1] OIMM = OIM5 +1

```
a ← GPR(RX)32:63
if ‘se_cmpli’  then b ← 270 || OFFSET(OIM5)
if ‘se_cmpl’   then b ← GPR(RY)32:63
```

```
if a <u b then c ← 0b100
if a >u b then c ← 0b010
if a = b then c ← 0b001
CR0:3 ← c || XERSO
```

If **se_cmpl**, the contents of GPR(**r**X) and GPR(**r**Y) are compared, treating operands as unsigned integers. The result is placed into CR field 0.

If **se_cmpli**, the contents of GPR(**r**X) are compared with the zero-extended offset value of OIM5 (a final value in the range 1–32), treating the operands as unsigned integers. The result is placed into CR field 0.

Special Registers Altered: CR[0–3]

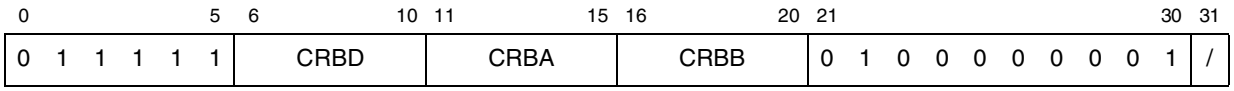
crand

VLE	User

crand _crand_

Condition Register AND

e_crand **crb**D**,crb**A**,crb**B



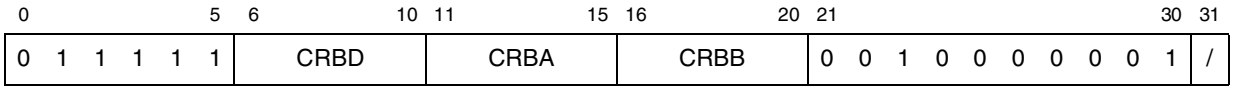
$$CR_{BT+32} \leftarrow CR_{BA+32} \ \& \ CR_{BB+32}$$

The content of bit CRBA+32 of the CR is ANDed with the content of bit CRBB+32 of the CR, and the result is placed into bit CRBD+32 of the CR.

Special Registers Altered: CR

Condition Register AND with Complement

e_crandc **crb**D**,crb**A**,crb**B



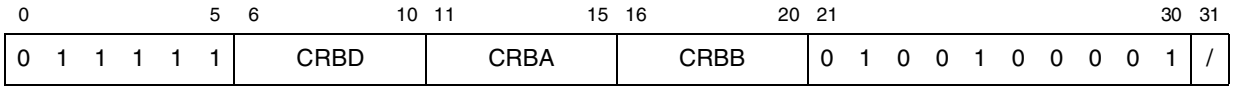
$$CR_{BT+32} \leftarrow CR_{BA+32} \ \& \ \neg CR_{BB+32}$$

The content of bit CRBA+32 of the CR is ANDed with the one's complement of the content of bit CRBB+32 of the CR, and the result is placed into bit CRBD+32 of the CR.

Special Registers Altered: CR

CR Equivalent

e_creqv **crb**D**,crb**A**,crb**B



$$CR_{BT+32} \leftarrow CR_{BA+32} \equiv CR_{BB+32}$$

The content of bit CRBA+32 of the CR is XORed with the content of bit CRBB+32 of the CR, and the one's complement of result is placed into bit CRBD+32 of the CR.

Special Registers Altered: CR

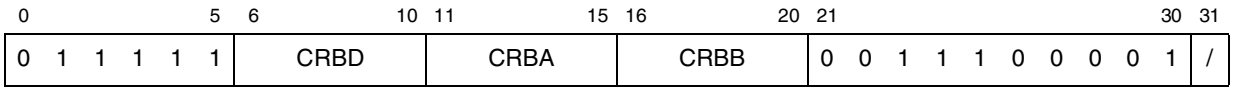
_crnand

VLE	User

__crnand __crnand _

Condition Register NAND

e_crnand **crb**D**,crb**A**,crb**B



$CR_{BT+32} \leftarrow \neg(CR_{BA+32} \ \& \ CR_{BB+32})$

The content of bit CRBA+32 of the CR is ANDed with the content of bit CRBB+32 of the CR, and the one’s complement of the result is placed into bit CRBD+32 of the CR.

Special Registers Altered: CR

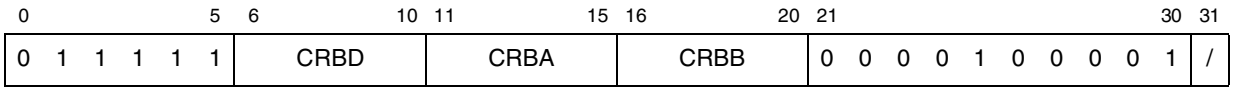
_crnor

VLE	User

_crnor

Condition Register NOR

e_crnor **crb**D,**crb**A,**crb**B



$CR_{BT+32} \leftarrow \neg(CR_{BA+32} \mid CR_{BB+32})$

The content of bit CRBA+32 of the CR is ORed with the content of bit CRBB+32 of the CR, and the one's complement of the result is placed into bit CRBD+32 of the CR.

Special Registers Altered: CR

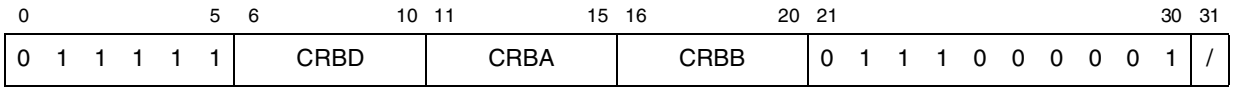
_cror

VLE	User

_cror

Condition Register OR

e_cror **crb**D**,crb**A**,crb**B



$CR_{BT+32} \leftarrow CR_{BA+32} \mid CR_{BB+32}$

The content of bit CRBA+32 of the CR is ORed with the content of bit CRBB+32 of the CR, and the result is placed into bit CRBD+32 of the CR.

Special Registers Altered: CR

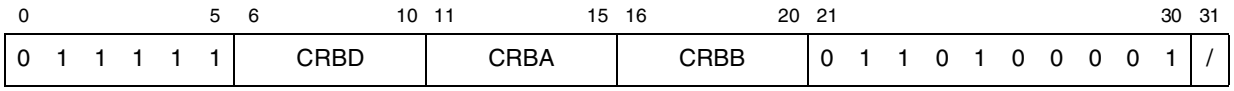
_cror

VLE	User

__cror __cror _

Condition Register OR with Complement

e_crorc **crb**D,**crb**A,**crb**B



$CR_{BT+32} \leftarrow CR_{BA+32} \mid \neg CR_{BB+32}$

The content of bit CRBA+32 of the CR is ORed with the one's complement of the content of bit CRBB+32 of the CR, and the result is placed into bit CRBD+32 of the CR.

Special Registers Altered: CR

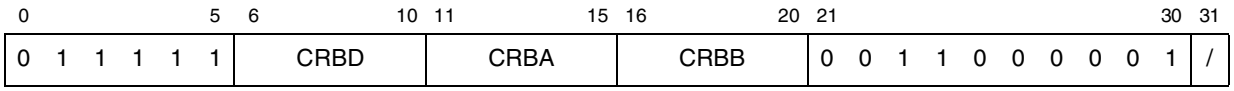
_crxor

VLE	User

__crxor __crxor _

Condition Register XOR

e_crxor **crb**D**,crb**A**,crb**B



$CR_{crbD+32} \leftarrow CR_{BA+32} \oplus CR_{BB+32}$

The content of bit CRBA+32 of the CR is XORed with the content of bit CRBB+32 of the CR, and the result is placed into bit CRBD+32 of the CR.

Special Registers Altered: CR

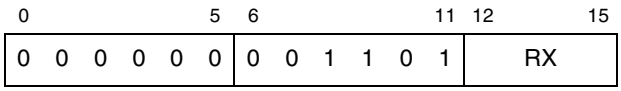
_extsb*x*

VLE	User

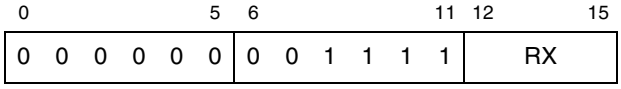
_extsb*x*

Extend Sign (Byte | Halfword)

se_extsb **r**X



se_extsh **r**X




```
if se_extsb then n ← 56
if se_extsh then n ← 48
if 'extsw'    then n ← 32
if Rc=1 then do
   LT  ← GPR(RS)n:63 < 0
   GT  ← GPR(RS)n:63 > 0
   EQ  ← GPR(RS)n:63 = 0
   CR0 ← LT || GT || EQ || SO
s ← GPR(RS or RX)n
GPR(RA or RX) ← n-32s || GPR(RS or RX)n:63
```

For **se_extsb**, the contents of bits 56–63 of GPR(**r**X) are placed into bits 56–63 of GPR(**r**X). Bit 56 of the contents of GPR(**r**X) is copied into bits 32–55 of GPR(**r**X).

For **se_extsh**, the contents of bits 48–63 of GPR(**r**X) are placed into bits 48–63 of GPR(**r**X). Bit 48 of the contents of GPR(**r**X) is copied into bits 32–47 of GPR(**r**X).

Special Registers Altered: CR0 (if Rc=1)

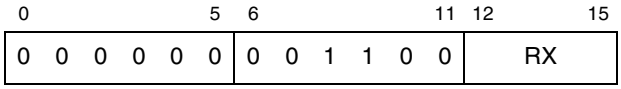
_extz*x*

VLE	User

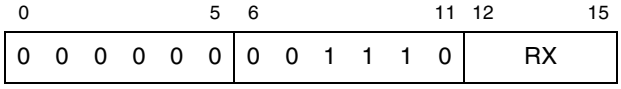
extz*x*

Extend Zero (Byte | Halfword)

se_extzb **r**X



se_extzh **r**X




```
if ‘se_extzb’  then n ← 56
if ‘se_extzh’  then n ← 48
GPR(RX) ← n-32 0 || GPR(RX)n:63
```

For **se_extzb**, the contents of bits 56–63 of GPR(**r**X) are placed into bits 56–63 of GPR(**r**X). Bits 32–55 of GPR(**r**X) are cleared.

For **se_extzh**, the contents of bits 48–63 of GPR(**r**X) are placed into bits 48–63 of GPR(**r**X). Bits 32–47 of GPR(**r**X) are cleared.

Special Registers Altered: None

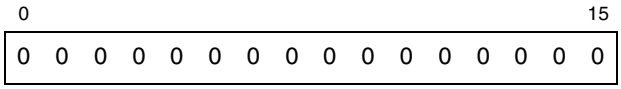
_illegal

VLE	User

_illegal

Illegal

se_illegal




```
SRR1 ← MSR
SRR0 ← CIA
NIA  ← IVPR32:47 || IVOR648:59 || 0b0000
MSRWE,EE,PR,IS,DS,FP,FE0,FE1 ← 0b0000_0000
```

se_illegal is used to request an illegal instruction exception. A program interrupt is generated. The contents of the MSR are copied into SRR1 and the address of the **se_illegal** instruction is placed into SRR0.

MSR[WE,EE,PR,IS,DS,FP,FE0,FE1] are cleared.

The interrupt causes the next instruction to be fetched from address IVPR[32–47]||IVOR6[48–59]||0b0000

This instruction is context synchronizing.

Special Registers Altered: SRR0 SRR1 MSR[WE,EE,PR,IS,DS,FP,FE0,FE1]

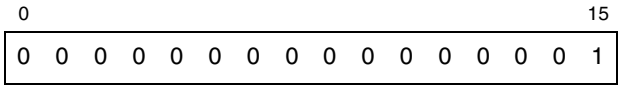
_isync

VLE	User

_isync

Instruction Synchronize

se_isync



The **se_isync** instruction provides an ordering function for the effects of all instructions executed by the processor executing the **se_isync** instruction. Executing an **se_isync** instruction ensures that all instructions preceding the **se_isync** instruction have completed before the **se_isync** instruction completes, and that no subsequent instructions are initiated until after the **se_isync** instruction completes. It also causes any prefetched instructions to be discarded, with the effect that subsequent instructions are fetched and executed in the context established by the instructions preceding the **se_isync** instruction.

The **se_isync** instruction may complete before memory accesses associated with instructions preceding the **se_isync** instruction have been performed.

This instruction is context synchronizing (see Book E). It has identical semantics to Book E **isync**, just a different encoding.

Special Registers Altered: None

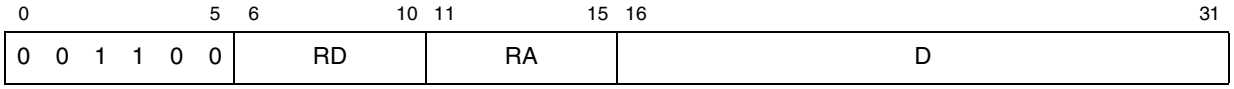
_lbz*x*

VLE	User

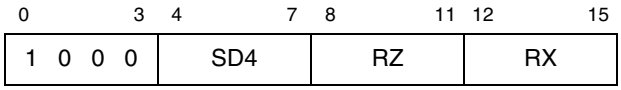
_lbz*x*

Load Byte and Zero [with Update] [Indexed]

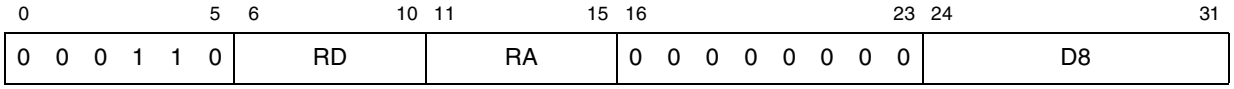
e_lbz **r**D,D(**r**A) (D-mode)



se_lbz **r**Z,SD4(**r**X) (SD4-mode)



e_lbzu **r**D,D8(**r**A) (D8-mode)




```
if (RA=0 & !se_lbz) then a ← 32 0 else a ← GPR(RA or RX)
if D-mode  then EA ← (a + EXTS(D))32:63
if D8-mode   then EA ← (a + EXTS(D8))32:63
if SD4-mode   then EA ← (a + (28 0 || SD4))32:63
GPR(RD or RZ) ← 24 0 || MEM(EA,1)
if e_lbzu then GPR(RA) ← EA
```

Let the EA be calculated as follows:

- For **e_lbz** and **e_lbzu**, let EA be the sum of the contents of GPR(**r**A), or 32 0s if **r**A = 0, and the sign-extended value of the D or D8 instruction field.
- For **se_lbz**, let EA be the sum of the contents of GPR(**r**X) and the zero-extended value of the SD4 instruction field.

The byte in memory addressed by EA is loaded into bits 56–63 of GPR(**r**D or **r**Z). Bits 32–55 of GPR(**r**D or **r**Z) are cleared.

If **e_lbzu**, EA is placed into GPR(**r**A).

If **e_lbzu** and **r**A = 0 or **r**A = **r**D, the instruction form is invalid.

Special Registers Altered: None

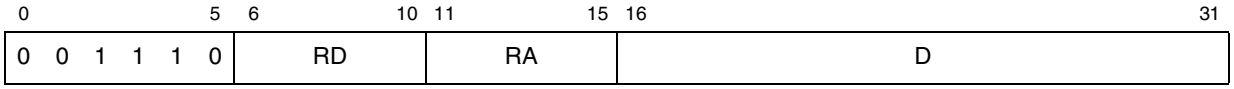
_lhax

VLE	User

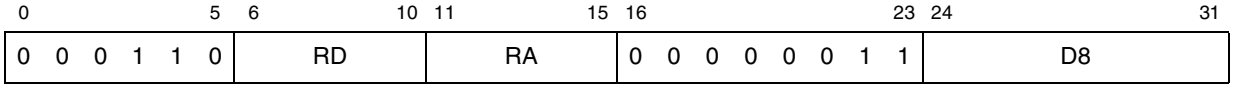
_lhax

Load Halfword Algebraic [with Update] [Indexed]

e_lha **r**D,D(**r**A) (D-mode)



e_lhau **r**D,D8(**r**A) (D8-mode)




```
if RA=0 then a ← 32 0 else a ← GPR(RA)
if D-mode  then EA ← (a + EXTS(D))32:63
if D8-mode then EA ← (a + EXTS(D8))32:63
GPR(RD) ← EXTS(MEM(EA,2))32:63
if e_lhau then GPR(RA) ← EA
```

Let the EA be calculated as follows:

- For **e_lha** and **e_lhau**, let EA be the sum of the contents of GPR(**r**A), or 32 0s if **r**A = 0, and the sign-extended value of the D or D8 instruction field.

The half word in memory addressed by EA is loaded into bits 48–63 of GPR(**r**D). Bits 32–47 of GPR(**r**D) are filled with a copy of bit 0 of the loaded half word.

If **e_lhau**, EA is placed into GPR(**r**A).

If **e_lhau** and **r**A = 0 or **r**A = **r**D, the instruction form is invalid.

Special Registers Altered: None

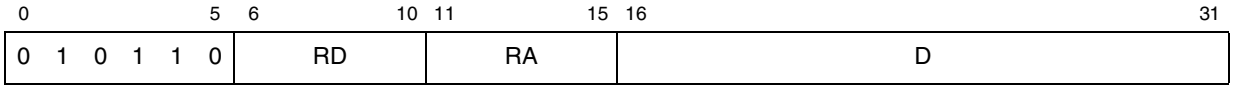
_lhz*x*

VLE	User

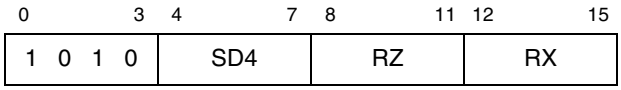
_lhz*x*

Load Halfword and Zero [with Update] [Indexed]

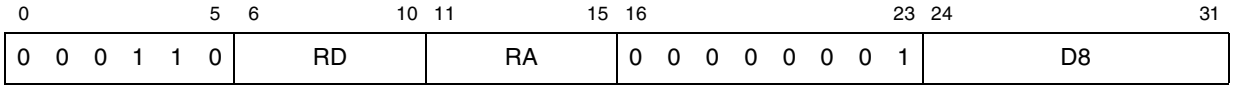
e_lhz **r**D,D(**r**A) (D-mode)



se_lhz **r**Z,SD4(**r**X) (SD4-mode)



e_lhzu **r**D,D8(**r**A) (D8-mode)




```
if (RA=0 & !se_lhz) then a ← 32 0 else a ← GPR(RA or RX)
if D-mode  then EA ← (a + EXTS(D))32:63
if D8-mode   then EA ← (a + EXTS(D8))32:63
if SD4-mode   then EA ← (a + (27 0 || SD4 || 0))32:63
GPR(RD or RZ) ← 16 0 || MEM(EA,2)
if e_lhzu then GPR(RA) ← EA
```

Let the EA be calculated as follows:

- For **e_lhz** and **e_lhzu**, let EA be the sum of the contents of GPR(**r**A), or 32 0s if **r**A = 0, and the sign-extended value of the D or D8 instruction field.
- For **se_lhz** let EA be the sum of the contents of GPR(**r**X) and the zero-extended value of the SD4 instruction field shifted left by 1 bit.

The half word in memory addressed by EA is loaded into bits 48–63 of GPR(**r**D). Bits 32–47 of GPR(**r**D) are cleared.

If **e_lhzu**, EA is placed into GPR(**r**A).

If **e_lhzu** and **r**A = 0 or **r**A = **r**D, the instruction form is invalid.

Special Registers Altered: None

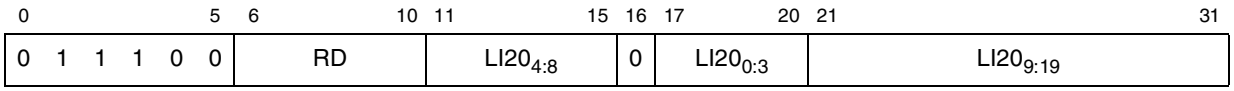
_lix

VLE	User

_lix

Load Immediate [Shifted]

e_li **r**D,LI20 (LI20-mode)

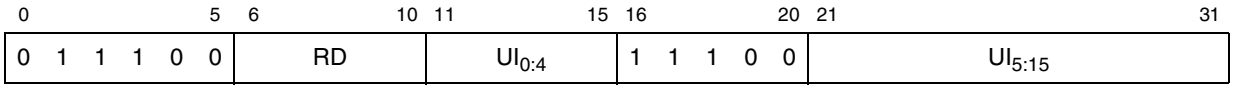


$LI20 \leftarrow LI20_{0:3} \parallel LI20_{4:8} \parallel LI20_{9:19}$
$GPR(RD) \leftarrow EXTS(LI20)$

For **e_li**, the sign-extended LI20 field is placed into GPR(**r**D).

Special Registers Altered: None

e_lis **r**D,UI

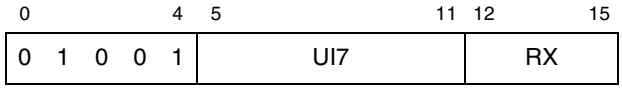


$UI \leftarrow UI_{0:4} \parallel UI_{5:15}$
$GPR(RD) \leftarrow UI \parallel {}^{16}0$

For **e_lis**, the UI field is concatenated on the right with 16 0's and placed into GPR(**r**D).

Special Registers Altered: None

se_li **r**X,UI7



$GPR(RX) \leftarrow {}^{25}0 \parallel UI7$

For **se_li**, the zero-extended UI7 field is placed into GPR(**r**X).

Special Registers Altered: None

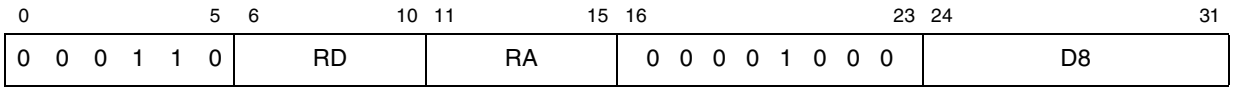
_lmw

VLE	User

_lmw

Load Multiple Word

e_lmw **r**D,D8**(r**A**)**




```
if RA=0 then EA ← EXTS(D8)32:63
else         EA ← (GPR(RA)+EXTS(D8))32:63
r ← RD
do while r ≤ 31
   GPR(r) ← MEM(EA,4)
   r  ← r + 1
   EA ← (EA+4)32:63
```

Let the EA be the sum of the contents of GPR(**r**A), or 32 0s if **r**A = 0, and the sign-extended value of the D8 instruction field.

Let n = (32-rD). n consecutive words starting at EA are loaded into bits 32–63 of registers GPR(**r**D) through GPR(31).

EA must be a multiple of 4. If it is not, either an alignment interrupt is invoked or the results are boundedly undefined. If **r**A is in the range of registers to be loaded, including the case in which **r**A = 0, the instruction form is invalid.

Special Registers Altered: None

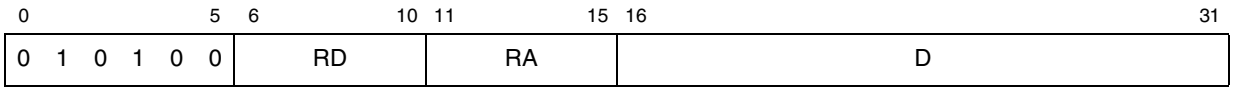
_lwz

VLE | User

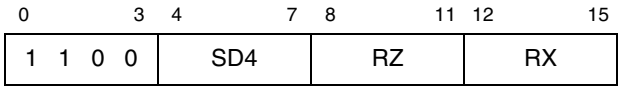
_lwz

Load Word and Zero [with Update] [Indexed]

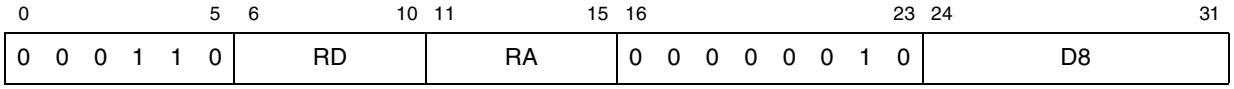
e_lwz **r**D,D(**r**A) (D-mode)



se_lwz **r**Z,SD4(**r**X) (SD4-mode)



e_lwzu **r**D,D8(**r**A) (D8-mode)




```
if (RA=0 & !se_lwz) then a ← 32 0 else a ← GPR(RA or RX)
if D-mode  then EA ← (a + EXTS(D))32:63
if D8-mode   then EA ← (a + EXTS(D8))32:63
if SD4-mode   then EA ← (a + (26 0 || SD4 || 2 0))32:63
GPR(RD or RZ) ← MEM(EA,4)
if e_lwzu then GPR(RA) ← EA
```

Let the EA be calculated as follows:

- For **e_lwz** and **e_lwzu**, let EA be the sum of the contents of GPR(**r**A), or 32 0s if **r**A = 0, and the sign-extended value of the D or D8 instruction field.
- For **se_lwz** let EA be the sum of the contents of GPR(**r**X) and the zero-extended value of the SD4 instruction field shifted left by 2 bits.

The word in memory addressed by the EA is loaded into bits 32–63 of GPR(**r**D).

If **e_lwzu**, EA is placed into GPR(**r**A).

If **e_lwzu** and **r**A = 0 or **r**A = **r**D, the instruction form is invalid.

Special Registers Altered: None

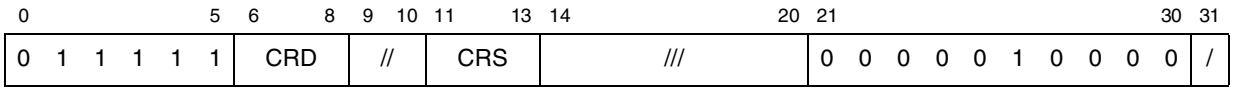
_mcrf

VLE	User

_mcrf

Move CR Field

e_mcrf **crD,crS**



$CR_{4\times CRD+32:4\times CRD+35} \leftarrow CR_{4\times CRS+32:4\times CRS+35}$

The contents of field **cr**S (bits 4×CRS+32 through 4×CRS+35) of the CR are copied to field **cr**D (bits 4×CRD+32 through 4×CRD+35) of the CR.

Special Registers Altered: CR

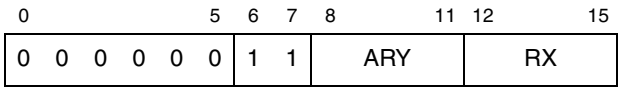
_mfar

VLE	User

_mfar

Move from Alternate Register

se_mfar **r**X**,ar**Y




```
GPR(RX) ← GPR(ARY)
```

For **se_mfar**, the contents of GPR(**ar**Y) are placed into GPR(**r**X). **ar**Y specifies a GPR in the range R8–R23. The encoding 0000 specifies R8, 0001 specifies R9,…, 1111 specifies R23.

Special Registers Altered: None

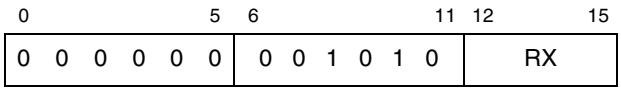
_mfctr

VLE	User

_mfctr

Move From Count Register

se_mfctr **r**X



GPR(RX) ← CTR

The CTR contents are placed into bits 32–63 of GPR(**r**X).

Special Registers Altered: None

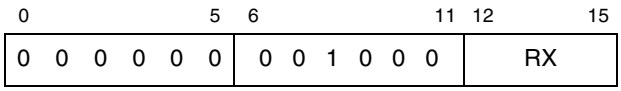
_mflr

VLE	User

_mflr

Move From Link Register

se_mflr **r**X



GPR(RX) ← LR

The LR contents are placed into bits 32–63 of GPR(**r**X).

Special Registers Altered: None

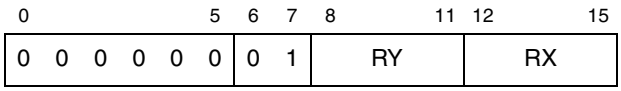
_mr

VLE	User

_mr

Move Register

se_mr **r**X,**r**Y




```
GPR(RX) ← GPR(RY)
```

For **se_mr**, the contents of GPR(**r**Y) are placed into GPR(**r**X).

Special Registers Altered: None

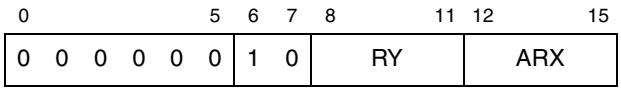
_mtar

VLE	User

_mtar

Move to Alternate Register

se_mtar **ar**X,**r**Y




```
GPR(ARX) ← GPR(RY)
```

For **se_mtar**, the contents of GPR(**r**Y) are placed into GPR(**ar**X). **ar**X specifies a GPR in the range R8–R23. The encoding 0000 specifies R8, 0001 specifies R9,…, 1111 specifies R23.

Special Registers Altered: None

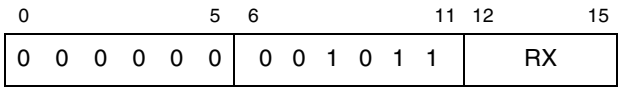
_mtctr

VLE	User

_mtctr

Move To Count Register

se_mtctr **r**X




```
CTR ← GPR(RX)
```

The contents of bits 32–63 of GPR(**r**X) are placed into the CTR.

Special Registers Altered: CTR

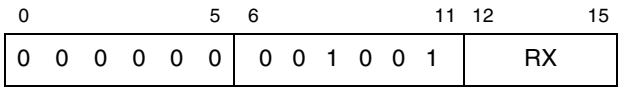
_mtlr

VLE	User

_mtlr

Move To Link Register

se_mtlr **r**X




```
LR ← GPR(RX)
```

The contents of bits 32–63 of GPR(**r**X) are placed into the LR.

Special Registers Altered: LR

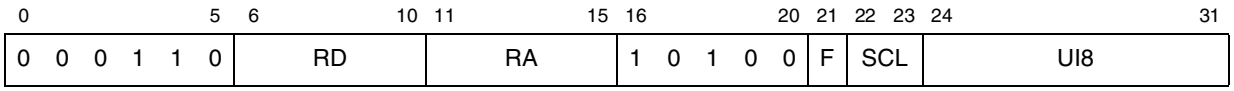
_mulli*x*

VLE	User

_mulli*x*

Multiply Low [2 operand] Immediate

e_mulli **r**D,**r**A,SCI8



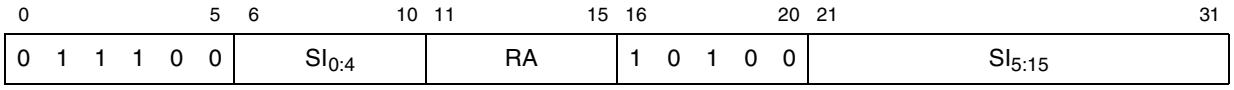

```
imm ← SCI8(F,SCL,UI8)
prod0:63 ← GPR(RA) × imm
GPR(RD) ← prod32:63
```

Bits 32–63 of the 64-bit product of the contents of GPR(**r**A) and the value of SCI8 are placed into GPR(**r**D).

Both operands and the product are interpreted as signed integers.

Special Registers Altered: None

e_mull2i **r**A,SI




```
prod0:63 ← GPR(RA) × EXTS(SI0:4 || SI5:15)
GPR(RA) ← prod32:63
```

Bits 32–63 of the 64-bit product of the contents of GPR(**r**A) and the sign-extended value of the SI field are placed into GPR(**r**A).

Both operands and the product are interpreted as signed integers.

Special Registers Altered: None

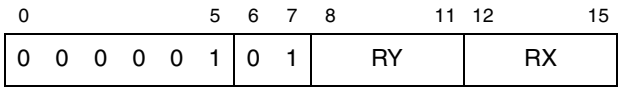
_mullw*x*

VLE	User

_mullw*x*

Multiply Low Word

se_mullw **r**X,**r**Y



$prod_{0:63} \leftarrow GPR(RX)_{32:63} \times GPR(RY)_{32:63}$
$GPR(RX) \leftarrow prod_{32:63}$

Bits 32–63 of the 64-bit product of the contents of bits 32–63 of GPR(**r**X) and the contents of bits 32–63 of GPR(**r**Y) is placed into GPR(**r**X).

Special Registers Altered: None

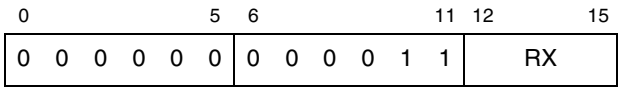
_negx

VLE	User

_negx

Negate

se_neg **r**X



$result_{32:63} \leftarrow \neg GPR(RX) + 1$
$GPR(RX) \leftarrow result_{32:63}$

The sum of the one's complement of the contents of GPR(**r**X) and 1 is placed into GPR(**r**X).

If bits 32–63 of GPR(**r**X) contain the most negative 32-bit number (0x8000_0000), bits 32–63 of the result contain the most negative 32-bit number

Special Registers Altered: None

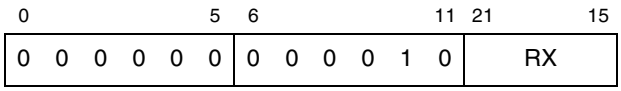
_not*x*

VLE	User

_not*x*

NOT

se_not **r**X



$result_{32:63} \leftarrow \neg GPR(RX)$
$GPR(RX) \leftarrow result_{32:63}$

The contents of GPR(**r**X) are inverted.

Special Registers Altered: None

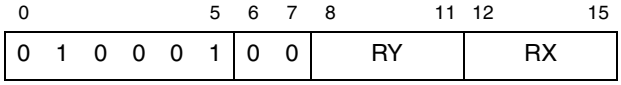
_orx

VLE	User

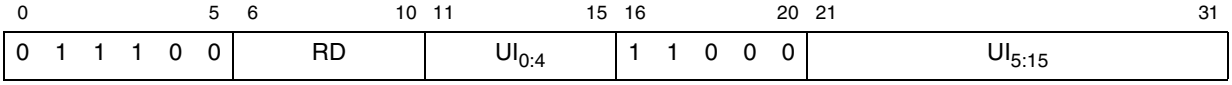
_orx

OR [2 operand] [Immediate | with Complement] [Shifted][and Record]

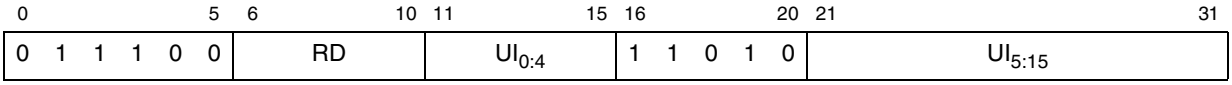
se_or **r**X,**r**Y



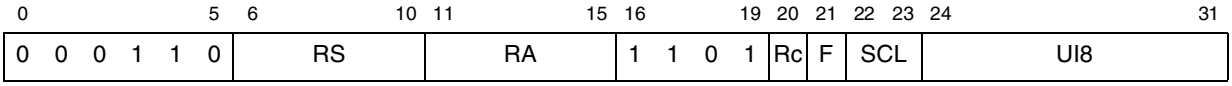
e_or2i **r**D,UI



e_or2is **r**D,UI



e_ori **r**A,**r**S,SCI8 (Rc = 0)
e_ori. **r**A,**r**S,SCI8 (Rc = 1)




```
if ‘e_ori[.]’    then b ← SCI8(F,SCL,UI8)
if ‘e_or2i’  then b ← 16‘0 || UI0:4 || UI5:15
if ‘e_or2is’  then b ← UI0:4 || UI5:15 || 16‘0
if ‘se_or’  then b ← GPR(RB)
result0:63 ← GPR(RS or RD or RX) | b
if Rc=1 then do
   LT  ← result32:63 < 0
   GT  ← result32:63 > 0
   EQ  ← result32:63 = 0
   CR0 ← LT || GT || EQ || SO
GPR(RA or RD or RX) ← result
```

For **e_ori**[.], the contents of GPR(**r**S) are ORed with the value of SCI8.

For **e_or2i,** the contents of GPR(**r**D) are ORed with $^{16}0$ || UI.

For **e_or2is**, the contents of GPR(**r**D) are ORed with UI || $^{16}0$.

For **se_or**, the contents of GPR(**r**X) are ORed with the contents of GPR(**r**Y).

The result is placed into GPR(**r**A or **r**X).

The preferred ‘no-op’ (an instruction that does nothing) is:

```
e_ori  0,0,0
```

Special Registers Altered: CR0 (if Rc = 1)

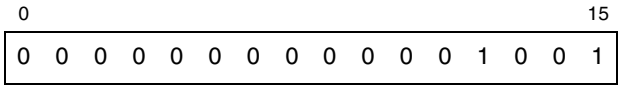
_rfci

VLE | Supervisor

_rfci

Return From Critical Interrupt

se_rfci




```
MSR ← CSRR1
NIA ← CSRR0_0:62 || 0b0
```

The **se_rfci** instruction is used to return from a critical class interrupt, or as a means of establishing a new context and synchronizing on that new context simultaneously.

The contents of CSRR1 are placed into the MSR. If the new MSR value does not enable any pending exceptions, then the next instruction is fetched, under control of the new MSR value, from the address CSRR0[32–62]||0b0. If the new MSR value enables one or more pending exceptions, the interrupt associated with the highest priority pending exception is generated; in this case the value placed into SRR0 or CSRR0 by the interrupt processing mechanism (see Book E) is the address of the instruction that would have been executed next had the interrupt not occurred (that is, the address in CSRR0 at the time of the execution of the **se_rfci**).

Execution of this instruction is privileged and restricted to supervisor mode.

Execution of this instruction is context synchronizing.

Special Registers Altered: MSR

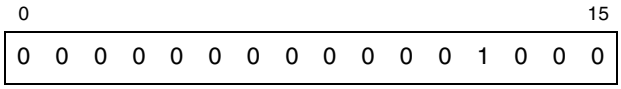
_rfi

VLE	Supervisor

_rfi

Return From Interrupt

se_rfi




```
MSR ← SRR1
NIA ← SRR0_0:62 || 0b0
```

The **se_rfi** instruction is used to return from a non-critical class interrupt, or as a means of simultaneously establishing a new context and synchronizing on that new context.

The contents of SRR1 are placed into the MSR. If the new MSR value does not enable any pending exceptions, then the next instruction is fetched under control of the new MSR value from the address SRR0[32–62]||0b0. If the new MSR value enables one or more pending exceptions, the interrupt associated with the highest priority pending exception is generated; in this case the value placed into SRR0 or CSRR0 by the interrupt processing mechanism (see Book E) is the address of the instruction that would have been executed next had the interrupt not occurred (that is, the address in SRR0 at the time of the execution of the **se_rfi**).

Execution of this instruction is privileged and restricted to supervisor mode.

Execution of this instruction is context synchronizing.

Special Registers Altered: MSR

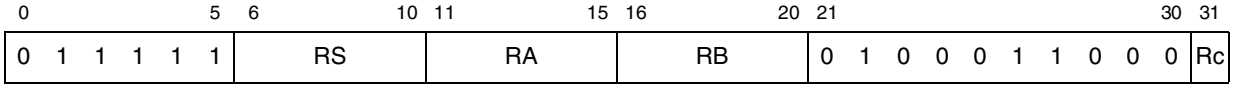
_rlw

VLE	User

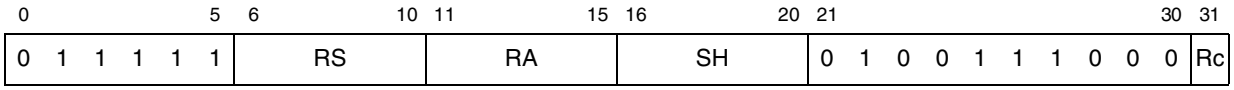
_rlw

Rotate Left Word [Immediate]

e_rlw **r**A,**r**S,**r**B (Rc = 0)
e_rlw. **r**A,**r**S,**r**B (Rc = 1)



e_rlwi **r**A,**r**S,SH (Rc = 0)
e_rlwi. **r**A,**r**S,SH (Rc = 1)




```
if ‘e_rlw[.]’ then n ← GPR(RB)59:63
else               n ← SH
result32:63 ← ROTL32(GPR(RS)32:63,n)
if Rc=1 then do
   LT  ← result32:63 < 0
   GT  ← result32:63 > 0
   EQ  ← result32:63 = 0
   CR0 ← LT || GT || EQ || SO
GPR(RA) ← result32:63
```

If **e_rlw**[**.**], let the shift count *n* be the contents of bits 59–63 of GPR(**r**B).

If **e_rlwi**[**.**], let the shift count *n* be SH.

The contents of GPR(**r**S) are rotated$_{32}$ left *n* bits. The rotated data is placed into GPR(**r**A).

Special Registers Altered: CR0 (if Rc = 1)

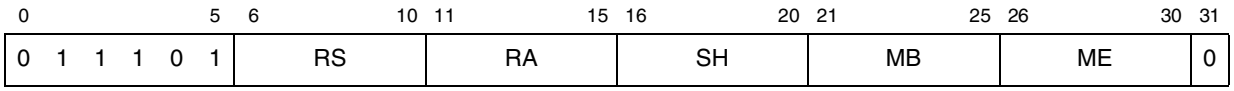
_rlwimi

VLE	User

_rlwimi

Rotate Left Word Immediate then Mask Insert

e_rlwimi **r**A,**r**S,SH,MB,ME




```
n ← SH
b ← MB+32
e ← ME+32
r ← ROTL32(GPR(RS)32:63,n)
m ← MASK(b,e)
result32:63 ← r&m | GPR(RA)&¬m
GPR(RA) ← result32:63
```

Let the shift count *n* be the value SH.

The contents of GPR(**r**S) are rotated$_{32}$ left *n* bits. A mask is generated having 1 bit from bit MB+32 through bit ME+32 and 0 bits elsewhere. The rotated data are inserted into GPR(**r**A) under control of the generated mask (if a mask bit is 1, the associated bit of the rotated data is placed into the target register, and if the mask bit is 0, the associated bit in the target register remains unchanged).

Special Registers Altered: None

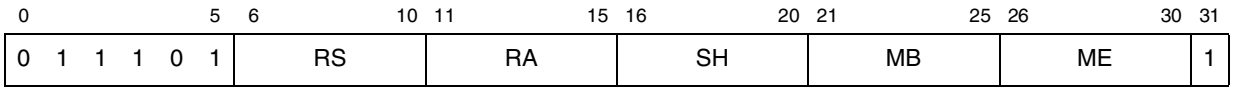
_rlwinm

VLE	User

_rlwinm

Rotate Left Word Immediate then AND with Mask

e_rlwinm **r**A,**r**S,SH,MB,ME




```
n ← SH
b ← MB+32
e ← ME+32
r ← ROTL32(GPR(RS)32:63,n)
m ← MASK(b,e)
result32:63 ← r & m
GPR(RA) ← result32:63
```

Let the shift count *n* be SH.

The contents of GPR(**r**S) are rotated$_{32}$ left *n* bits. A mask is generated having 1 bit from bit MB+32 through bit ME+32 and 0 bits elsewhere. The rotated data are ANDed with the generated mask and the result is placed into GPR(**r**A).

Special Registers Altered: None

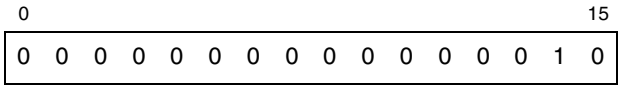
_sc

VLE	User

_sc

System Call

se_sc




```
SRR1 ← MSR
SRR0 ← CIA+2
NIA  ← IVPR32:47 || IVOR848:59 || 0b0000
MSRWE,EE,PR,IS,DS,FP,FE0,FE1 ← 0b0000_0000
```

se_sc is used to request a system service. A system call interrupt is generated. The contents of the MSR are copied into SRR1 and the address of the instruction after the **se_sc** instruction is placed into SRR0.

MSR[WE,EE,PR,IS,DS,FP,FE0,FE1] are cleared.

The interrupt causes the next instruction to be fetched from the address

IVPR[32–47]||IVOR8[48–59]||0b0000

This instruction is context synchronizing.

Special Registers Altered: SRR0 SRR1 MSR[WE,EE,PR,IS,DS,FP,FE0,FE1]

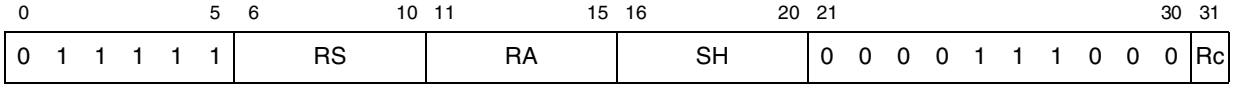
_slwx

VLE	User

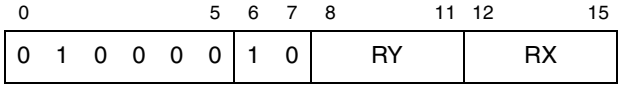
_slwx

Shift Left Word [Immediate] [and Record]

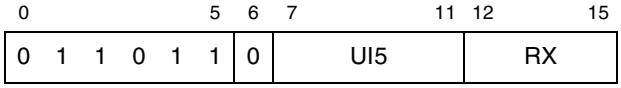
e_slwi **r**A,**r**S,SH (Rc = 0)
e_slwi. **r**A,**r**S,SH (Rc = 1)



se_slw **r**X,**r**Y



se_slwi **r**X,UI5




```
if 'e_slwi[.]' then n ← SH
if se_slw then n ← GPR(RY)58:63
if se_slwi then n ← UI5
r ← ROTL32(GPR(RS or RX)32:63,n)
if n<32 then m ← MASK(32,63-n)
else                m ← 320
result32:63 ← r & m
if Rc=1 then do
   LT  ← result32:63 < 0
   GT  ← result32:63 > 0
   EQ  ← result32:63 = 0
   CR0 ← LT || GT || EQ || SO
GPR(RA or RX) ← result32:63
```

Let the shift count *n* be the value specified by the contents of bits 58–63 of GPR(**r**B or **r**Y), or by the value of the SH or UI5 field.

The contents of bits 32–63 of GPR(**r**S or **r**X) are shifted left *n* bits. Bits shifted out of position 32 are lost. Zeros are supplied to the vacated positions on the right. The 32-bit result is placed into bits 32–63 of GPR(**r**A or **r**X).

Shift amounts from 32 to 63 give a zero result.

Special Registers Altered: CR0 (if Rc = 1)

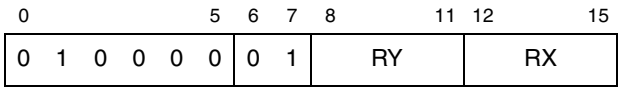
_srawx

VLE	User

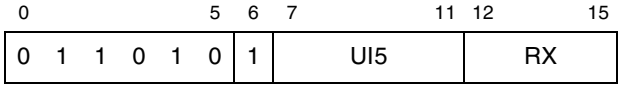
_srawx

Shift Right Algebraic Word [Immediate] [and Record]

se_sraw **r**X,**r**Y



se_srawi **r**X,UI5




```
if 'se_sraw'   then n ← GPR(RY)59:63
if 'se_srawi'  then n ← UI5
r ← ROTL32(GPR(RS or RX)32:63,32-n)
if ((se_sraw & GPR(RY)58=1) then m ← 320
else     m ← MASK(n+32,63)
s ← GPR(RS or RX)32
result0:63 ← r&m | (32s)&¬m
if Rc=1 then do
   LT  ← result32:63 < 0
   GT  ← result32:63 > 0
   EQ  ← result32:63 = 0
   CR0 ← LT || GT || EQ || SO
GPR(RA or RX) ← result32:63
CA      ← s & ((r&¬m)32:63≠0)
```

If **se_sraw**, let the shift count *n* be the contents of bits 58–63 of GPR(**r**Y).

If **se_srawi**, let the shift count *n* be the value of the UI5 field.

The contents of bits 32–63 of GPR(**r**S or **r**X) are shifted right *n* bits. Bits shifted out of position 63 are lost. Bit 32 of **r**S or **r**X is replicated to fill vacated positions on the left. The 32-bit result is placed into bits 32–63 of GPR(**r**A or **r**X).

CA is set if bits 32–63 of GPR(**r**S or **r**X) contain a negative value and any 1 bits are shifted out of bit position 63; otherwise CA is cleared.

A shift amount of zero causes GPR(**r**A or **r**X) to receive EXTS(GPR(**r**S or **r**X)$_{32:63}$), and CA to be cleared. For **se_sraw,** shift amounts from 32 to 63 give a result of 64 sign bits and cause CA to receive bit 32 of the contents of GPR(**r**S or **r**X) (that is, sign bit of GPR(**r**S or **r**X)$_{32:63}$).

Special Registers Altered: CA
CR0 (if Rc = 1)

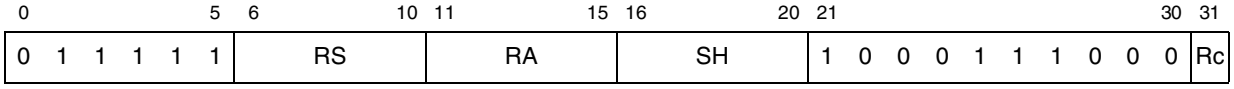
_srwx

VLE	User

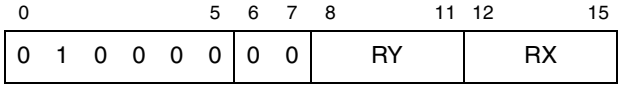
_srwx

Shift Right Word [Immediate] [and Record]

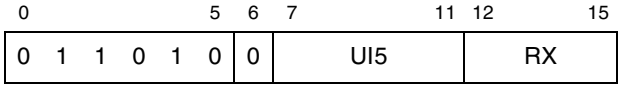
e_srwi **r**A,**r**S,SH (Rc = 0)
e_srwi. **r**A,**r**S,SH (Rc = 1)



se_srw **r**X,**r**Y



se_srwi **r**X,UI5




```
n ← GPR(RB)59:63

if ‘e_srwi[.]’ then n ← SH
if ‘se_srw’   then n ← GPR(RY)59:63
if ‘se_srwi’ then n ← UI5
r ← ROTL32(GPR(RS or RX)32:63,32-n)
if ((se_srw & GPR(RY)58=1) then m ← 320
else                 m ← MASK(n+32,63)
result32:63 ← r & m
if Rc=1 then do
   LT  ← result32:63 < 0
   GT  ← result32:63 > 0
   EQ  ← result32:63 = 0
   CR0 ← LT || GT || EQ || SO
GPR(RA or RX) ← result32:63
```

If **e_srwi**, let the shift count *n* be the value of the SH field.

If **se_srw**, let the shift count *n* be the contents of bits 58–63 of GPR(**r**Y).

If **se_srwi**, let the shift count *n* be the value of the UI5 field.

The contents of bits 32–63 of GPR(**r**S or **r**X) are shifted right *n* bits. Bits shifted out of position 63 are lost. Zeros are supplied to the vacated positions on the left. The 32-bit result is placed into bits 32–63 of GPR(**r**A or **r**X).

Shift amounts from 32 to 63 give a zero result.

Special Registers Altered: CR0 (if Rc = 1)

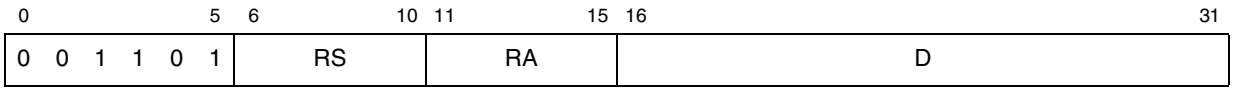
_stb*x*

VLE	User

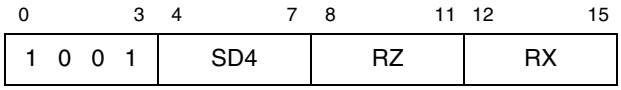
_stb*x*

Store Byte [with Update] [Indexed]

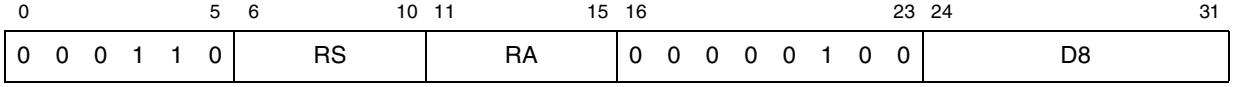
e_stb **r**S,D(**r**A) (D-mode)



se_stb **r**Z,SD4(**r**X) (SD4-mode)



e_stbu **r**S,D8(**r**A) (D8-mode)




```
if (RA=0 & !se_stb) then a ← 32 0 else a ← GPR(RA or RX)
if D-mode  then EA ← (a + EXTS(D))32:63
if D8-mode   then EA ← (a + EXTS(D8))32:63
if SD4-mode   then EA ← (a + (28 0 || SD4))32:63
MEM(EA,1) ← GPR(RS or RZ)56:63
if e_stbu then GPR(RA) ← EA
```

Let the EA be calculated as follows:

- For **e_stb** and **e_stbu**, let EA be the sum of the contents of GPR(**r**A), or 32 0s if **r**A = 0, and the sign-extended value of the D or D8 instruction field.
- For **se_stb**, let EA be the sum of the contents of GPR(**r**X) and the zero-extended value of the SD4 instruction field.

The contents of bits 56–63 of GPR(**r**S) are stored into the byte in memory addressed by EA.

- If **e_stbu**, EA is placed into GPR(**r**A).
- If **e_stbu** and **r**A = 0, the instruction form is invalid.
- None

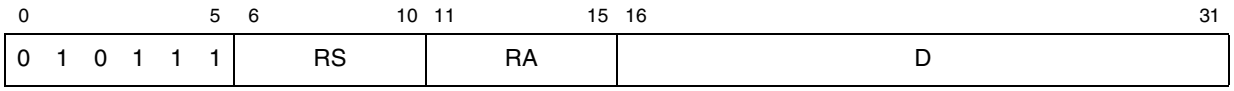
_sthx

VLE	User

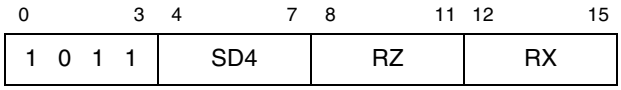
_sthx

Store Halfword [with Update] [Indexed]

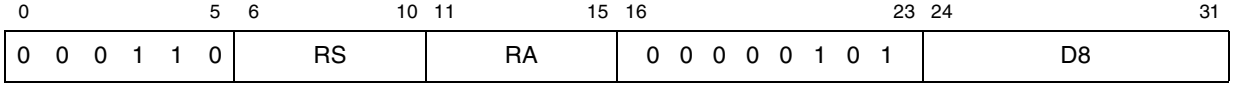
e_sth **r**S,D(**r**A) (D-mode)



se_sth **r**Z,SD4(**r**X) (SD4-mode)



e_sthu **r**S,D8(**r**A) (D8-mode)




```
if (RA=0 & !se_sth) then a ← 32 0 else a ← GPR(RA or RX)
if D-mode  then EA ← (a + EXTS(D))32:63
if D8-mode   then EA ← (a + EXTS(D8))32:63
if SD4-mode   then EA ← (a + (27 0 || SD4 || 0))32:63
MEM(EA,2) ← GPR(RS or RZ)48:63
if e_sthu then GPR(RA) ← EA
```

Let the EA be calculated as follows:

- For **e_sth** and **e_sthu**, let EA be the sum of the contents of GPR(**r**A), or 32 0s if **r**A = 0, and the sign-extended value of the D or D8 instruction field.
- For **se_sth,** let EA be the sum of the contents of GPR(**r**X) and the zero-extended value of the SD4 instruction field shifted left by 1 bit.

The contents of bits 48–63 of GPR(**r**S) are stored into the half word in memory addressed by EA.

If **e_sthu**, EA is placed into GPR(**r**A).

If **e_sthu** and **r**A = 0, the instruction form is invalid.

Special Registers Altered: None

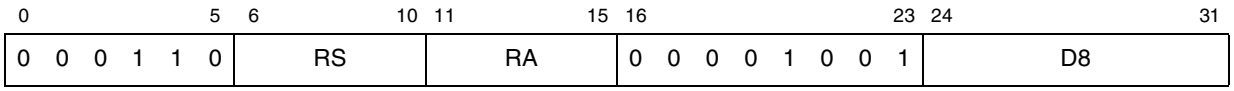
_stmw

VLE	User

_stmw

Store Multiple Word

e_stmw **r**S,D8**(r**A**)** (D8-mode)




```
if RA=0 then EA ← EXTS(D8)32:63
else         EA ← (GPR(RA)+EXTS(D8))32:63
r ← RS
do while r ≤ 31
   MEM(EA,4) ← GPR(r)32:63
   r  ← r + 1
   EA ← (EA+4)32:63
```

Let the EA be the sum of the contents of GPR(**r**A), or 32 0s if **r**A = 0, and the sign-extended value of the D8 instruction field.

Let n = (32 – **r**S). Bits 32–63 of registers GPR(**r**S) through GPR(31) are stored in n consecutive words in memory starting at address EA.

EA must be a multiple of 4. If it is not, either an alignment interrupt is invoked or the results are boundedly undefined.

Special Registers Altered: None

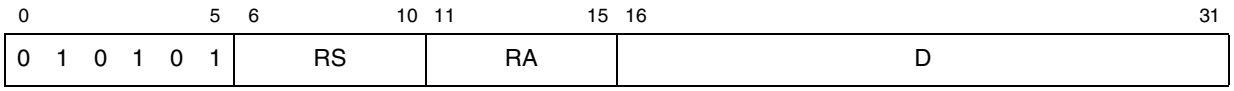
_stwx

VLE | User

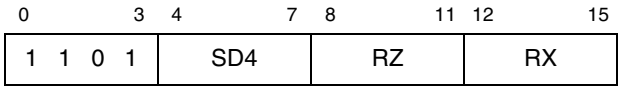
_stwx

Store Word [with Update] [Indexed]

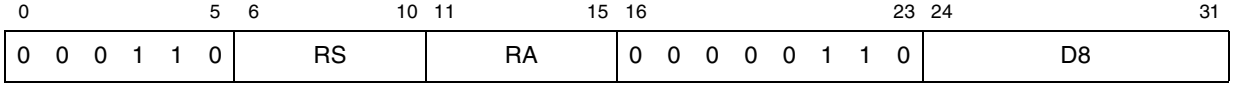
e_stw **r**S,D(**r**A) (D-mode)



se_stw **r**Z,SD4(**r**X) (SD4-mode)



e_stwu **r**S,D8(**r**A) (D8-mode)




```
if (RA=0 & !se_stw) then a ← 32 0 else a ← GPR(RA or RX)
if D-mode  then EA ← (a + EXTS(D))32:63
if D8-mode   then EA ← (a + EXTS(D8))32:63
if SD4-mode   then EA ← (a + (26 0 || SD4 || 2 0))32:63
MEM(EA,4) ← GPR(RS or RZ)32:63
```

Let the EA be calculated as follows:

- For **e_stw** and **e_stwu**, let EA be the sum of the contents of GPR(**r**A), or 32 0s if **r**A = 0, and the sign-extended value of the D or D8 instruction field.
- For **se_stw**, let EA be the sum of the contents of GPR(**r**X) and the zero-extended value of the SD4 instruction field shifted left by 2 bits.

The contents of bits 32–63 of GPR(**r**S) are stored into the word in memory addressed by EA.

If **e_stwu**, EA is placed into GPR(**r**A).

If **e_stwu** and **r**A = 0, the instruction form is invalid.

Special Registers Altered: None

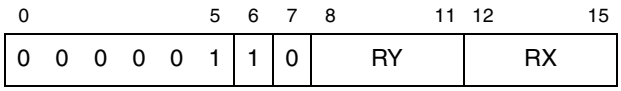
_sub

VLE	User

_sub

Subtract

se_sub **r**X,**r**Y



$sum_{32:63} \leftarrow GPR(RX) + \neg GPR(RY) + 1$
$GPR(RX) \leftarrow sum_{32:63}$

The sum of the contents of GPR(**r**X), the one's complement of contents of GPR(**r**Y), and 1 is placed into GPR(**r**X).

Special Registers Altered: None

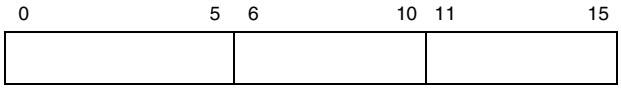
_subf*x*

VLE	User

_subf*x*

Subtract From

se_subf **r**X,**r**Y



$sum_{32:63} \leftarrow \neg GPR(RX) + GPR(RY) + 1$
$GPR(RX) \leftarrow sum_{32:63}$

The sum of the one’s complement of the contents of GPR(**r**X), the contents of GPR(**r**Y), and 1 is placed into GPR(**r**X).

Special Registers Altered: None

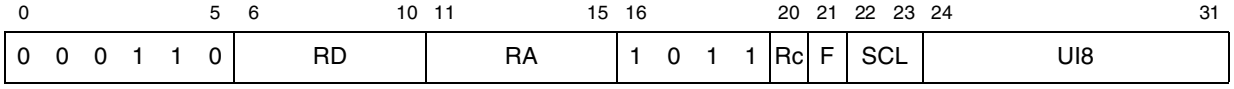
_subfic*x*

VLE	User

_subfic*x*

Subtract From Immediate Carrying [and Record]

e_subfic **r**D,**r**A,SCI8 (Rc = 0)
e_subfic. **r**D,**r**A,SCI8 (Rc = 1)




```
imm ← SCI8(F,SCL,UI8)
carry32:63 ← Carry(¬GPR(RA) + imm + 1)
sum32:63   ←       ¬GPR(RA) + imm + 1
if Rc=1 then do
   LT   ← sum32:63 < 0
   GT   ← sum32:63 > 0
   EQ   ← sum32:63 = 0
   CR0  ← LT || GT || EQ || SO
GPR(RD) ← sum32:63
CA      ← carry32
```

The sum of the one’s complement of the contents of GPR(**r**A), the value of SCI8, and 1 is placed into GPR(**r**D).

Special Registers Altered: CA CR0 (if Rc=1)

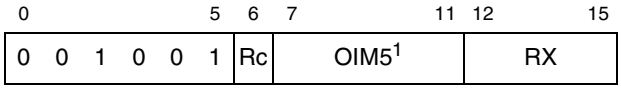
_subi*x*

VLE	User

_subi*x*

Subtract Immediate [and Record]

se_subi **r**X,OIMM (Rc = 0)
se_subi. **r**X,OIMM (Rc = 1)



[1] OIMM = OIM5 +1

```
sum32:63   ←  GPR(RX) + ¬(270 || OFFSET(OIM5)) + 1
if Rc=1 then do
   LT  ← sum32:63 < 0
   GT  ← sum32:63 > 0
   EQ  ← sum32:63 = 0
   CR0 ← LT || GT || EQ || SO
GPR(RX) ← sum32:63
```

The sum of the contents of GPR(**r**X), the one's complement of the zero-extended value of the offset OIM5 field (a final value in the range 1–32), and 1 is placed into GPR(**r**X).

Special Registers Altered: CR0 (if Rc = 1)

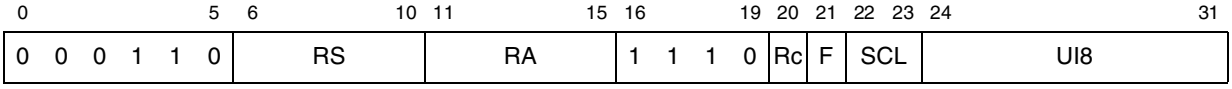
_xorx

VLE	User

_xorx

XOR [Immediate] [and Record]

e_xori **r**A,**r**S,SCI8 (Rc = 0)
e_xori. **r**A,**r**S,SCI8 (Rc = 1)




```
if 'e_xori[.]'  then b ← SCI8(F,SCL,UI8)
result32:63 ← GPR(RS) ⊕ b
if Rc=1 then do
   LT  ← result32:63 < 0
   GT  ← result32:63 > 0
   EQ  ← result32:63 = 0
   CR0 ← LT || GT || EQ || SO
GPR(RA) ← result
```

For **e_xori**[**.**], the contents of GPR(**r**S) are XORed with SCI8.

The result is placed into GPR(**r**A).

Special Registers Altered: CR0 (if Rc = 1)

Appendix A
VLE Instruction Formats

The format diagrams in this appendix show all valid combinations of instruction fields for those formats unique to VLE-defined instructions. Instruction forms that are available in VLE or non-VLE mode are described in the EREF.

A.1 Overview

VLE instructions may be 2 or 4 bytes long and are half-word–aligned in memory. Thus, whenever instruction addresses are presented to the processor (as in branch instructions), the low-order bit is treated as 0. Similarly, whenever the processor generates an instruction address, the low-order bit is 0.

In some cases, an instruction field must contain a particular value; otherwise, the instruction form is invalid and the results are as described for invalid instruction forms in the UISA.

VLE instructions use split-field notation as defined in the instruction formats appendix of the EREF.

A.2 VLE Instruction Formats

All VLE instructions to be executed are either 2 or 4 bytes long and are halfword-aligned in memory. Thus, whenever instruction addresses are presented to the processor (as in branch instructions), the low-order bit is treated as 0. Similarly, whenever the processor generates an instruction address, the low-order bit is zero.

The format diagrams show all valid combinations of instruction fields. Only those formats unique to VLE-defined instructions are included. Instruction forms that are available in VLE or non-VLE mode are described in the EREF and are not repeated here.

In some cases, an instruction field must contain a particular value. If it does not, the instruction form is invalid and the results are as described for invalid instruction forms in the UISA.

VLE instructions use split-field notation as described in the EREF.

A.2.1 Instruction Fields

In addtion to the VLE-defined instruction fields described in Table A-1, VLE uses instruction fields described in the EREF.

Table A-1. Instruction Fields

Field	Description
ARX (12:15)	Field used to specify an “alternate” GPR in the range GPR8–GPR23 to be used as a destination.
ARY (8:11)	Field used to specify an “alternate” GPR in the range GPR8–GPR23 to be used as a source.

Table A-1. Instruction Fields (continued)

Field	Description
BD8 (8:15), BD15 (16:30), BD24 (7:30)	Immediate field specifying a signed two's complement branch displacement concatenated on the right with 0 and sign-extended to 64 bits. BD15 (Used by 32-bit branch conditional class instructions) A 15-bit signed displacement sign-extended and shifted left one bit (concatenated with 0) and added to the current instruction address to form the branch target address. BD24 (Used by 32-bit branch class instructions) A 24-bit signed displacement, sign-extended and shifted left one bit (concatenated with 0) and added to the current instruction address to form the branch target address. BD8 (Used by 16-bit branch and branch conditional class instructions) An 8-bit signed displacement sign-extended and shifted left one bit (concatenated with 0) and added to the current instruction address to form the branch target address.
BI16 (6:7), BI32 (12:15)	Field used to specify one of the CR fields to be used as a condition of a Branch Conditional instruction.
BO16 (5), BO32 (10:11)	Field used to specify whether to branch if the condition is true, false, or to decrement the CTR and branch if the CTR is not zero in a Branch Conditional instruction.
BF32 (9:10)	Field used to specify one of the CR fields to be used as a target of a compare instruction.
D8 (24:31)	The D8 field is a 8-bit signed displacement sign-extended to 64 bits.
F (21)	Fill value used to fill the remaining 56 bits of a scaled-immediate 8 value.
LI20 (17:20 || 11:15 || 21:31)	A 20-bit signed immediate value sign-extended to 64 bits for the **e_li** instruction.
LK (7, 16, 31)	LINK bit. 0 Do not set the LR. 1 Set the LR. The sum of the value 2 or 4 and the address of the branch instruction is placed into the LR.
OIM5 (7:11)	Offset Immediate field used to specify a 5-bit unsigned Integer value in the range [1:32] encoded as [0:31]. Thus the binary encoding of 00000 represents an immediate value of 1, 00001 represents an immediate value of 2, and so on.
OPCD(0:3, 0:4, 0:5, 0:9, 0:14, 0:15)	Primary opcode field.
Rc (6, 7, 20, 31)	RECORD bit. 0 Do not alter the CR. 1 Set CR field 0.
RX (12:15)	Specifies a GPR in the ranges GPR0–GPR7 or GPR24–GPR31 to be used as a source or as a destination. R0 is encoded as 0000, R1 as 0001… R24 as 1000, R25 as 1001, etc.
RY (8:11)	Specifies a GPR in the ranges GPR0–GPR7 or GPR24–GPR31 to be used as a source. R0 is encoded as 0000, R1 as 0001…R24 is as 1000, R25 as 1001, etc.
RZ (8:11)	Specifies a GPR in the ranges GPR0–GPR7 or GPR24–GPR31 to be used as a source or as a destination for load/store data. R0 is encoded as 0000, R1 as 0001…R24 is as 1000, R25 as 1001, etc.
SCL (22:23)	Specifies a scale amount in SCI8-form Immediate instructions. Scaling involves left shifting by 0, 8, 16, or 24 bits.
SD4 (4:7)	Used by 16-bit load and store instructions. A 4-bit unsigned immediate value zero-extended to 64 bits, shifted left according to the size of the operation, and added to the base register to form a 64-bit EA. For byte operations, no shift is performed. For half-word operations, the immediate is shifted left one bit (concatenated with 0). For word operations, the immediate is shifted left two bits (concatenated with ‘00).

Table A-1. Instruction Fields (continued)

Field	Description
SI (6:10 || 21:31, 11:15 || 21:31)	A 16-bit signed immediate value sign-extended to 64 bits and used as one operand of the instruction.
UI (6:10 || 21:31, 11:15 || 21:31)	A 16-bit unsigned immediate value zero-extended to 64 bits or padded with 16 zeros and used as one operand of the instruction. The instruction encoding differs between the I16A and I16L instruction formats as shown in Section A.13, "I16A Form," and Section A.14, "I16L Form."
UI5 (7:11)	Immediate field used to specify a 5-bit unsigned Integer value.
UI7 (5:11)	Immediate field used to specify a 7-bit unsigned Integer value.
UI8 (24:31)	Immediate field used to specify an 8-bit unsigned Integer value.
XO (6, 6:7, 6:10, 6:11, 16, 16:19,16:23)	Extended opcode field.

NOTE (Programming)

For scaled immediate instructions using the SCI8-form, the instruction assembly syntax requires a single immediate value, sci8, that the assembler synthesizes into the appropriate F, SCL, and UI8 fields. The F, SCL, and UI8 fields must be able to be formed correctly from the given sci8 value or the assembler flags the assembly instruction as an error.

A.2.2 BD8 Form (16-Bit Branch Instructions)

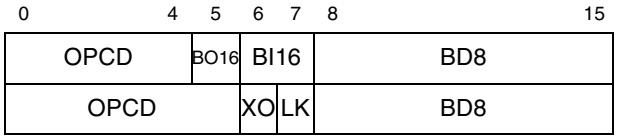


Figure A-1. BD8 Instruction Format

A.3 C Form (16-Bit Control Instructions)

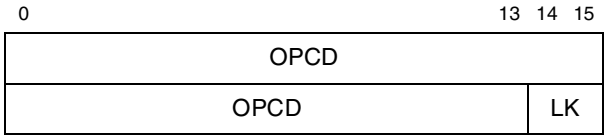


Figure A-2. C Instruction Format

A.4 IM5 Form (16-Bit register + immediate Instructions)

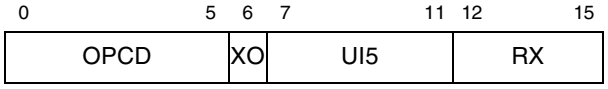


Figure A-3. IM5 Instruction Format

A.5 OIM5 Form (16-Bit Register + Offset Immediate Instructions)

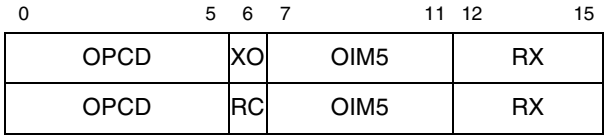


Figure A-4. OIM5 Instruction Format

A.6 IM7 Form (16-Bit Load immediate Instructions)

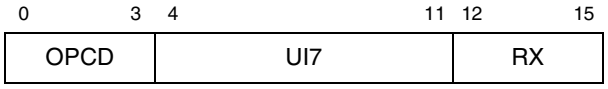


Figure A-5. IM7 Instruction Format

A.7 R Form (16-Bit Monadic Instructions)

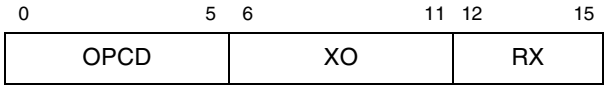


Figure A-6. R Instruction Format

A.8 RR Form (16-Bit Dyadic Instructions)

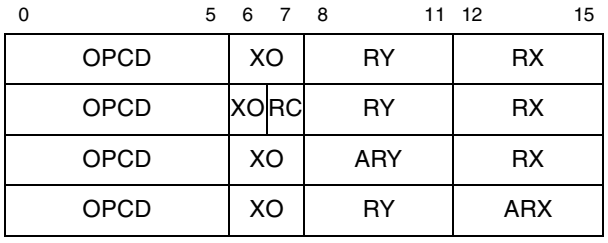


Figure A-7. RR Instruction Format

A.9 SD4 Form (16-Bit Load/Store Instructions)

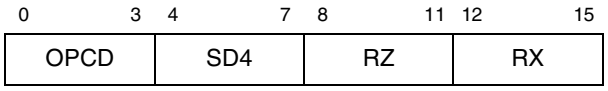


Figure A-8. SD4 Instruction Format

A.10 BD15 Form

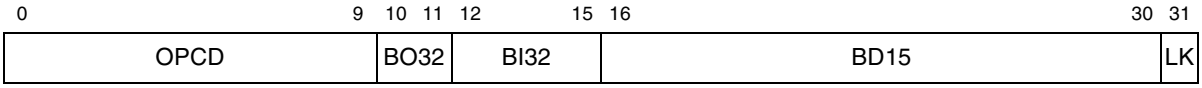


Figure A-9. BD15 Instruction Format

A.11 BD24 Form

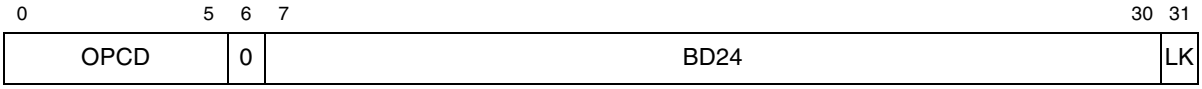


Figure A-10. BD24 Instruction Format

A.12 D8 Form

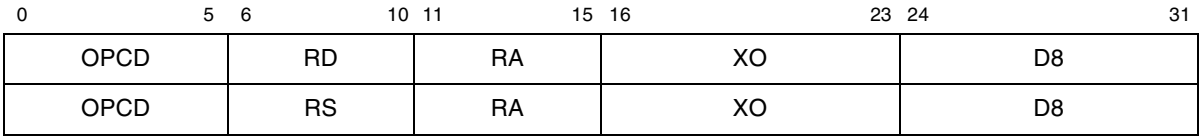


Figure A-11. D8 Instruction Format

A.13 I16A Form

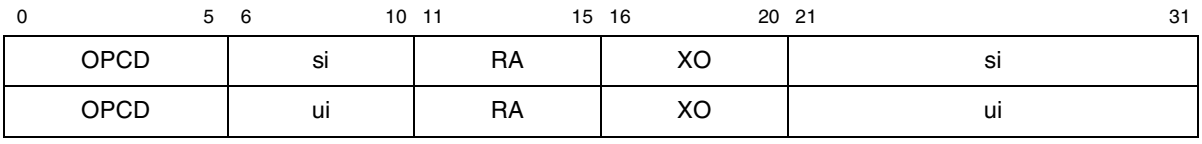


Figure A-12. I16A Instruction Format

A.14 I16L Form

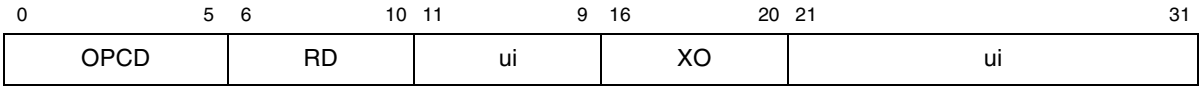


Figure A-13. I16L Instruction Format

A.15 M Form

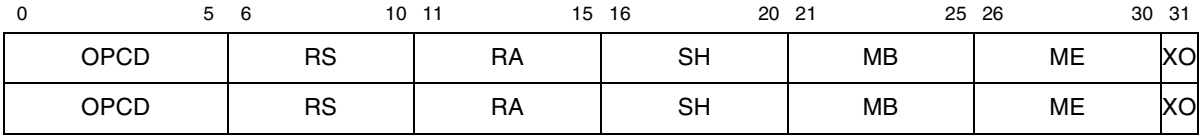


Figure A-14. M Instruction Format

A.16 SCI8 Form

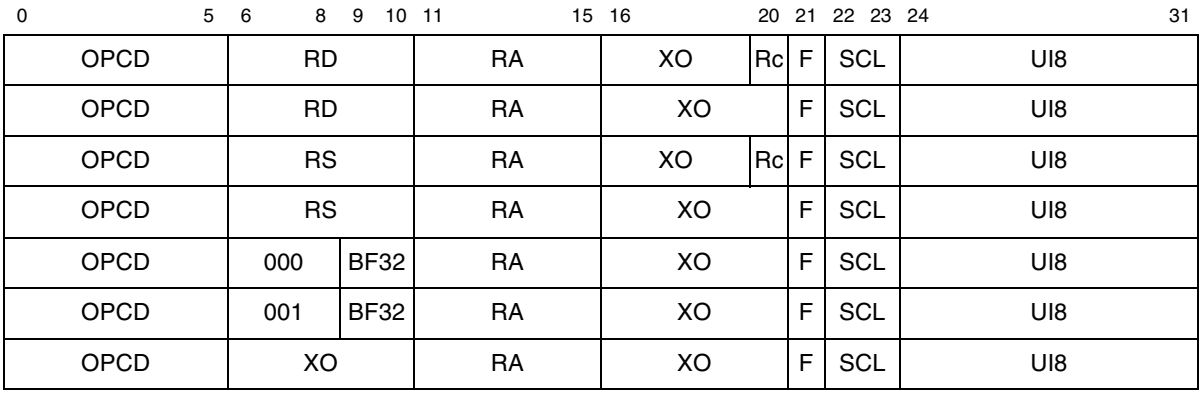


Figure A-15. SC18 Instruction Format

A.17 LI20 Form

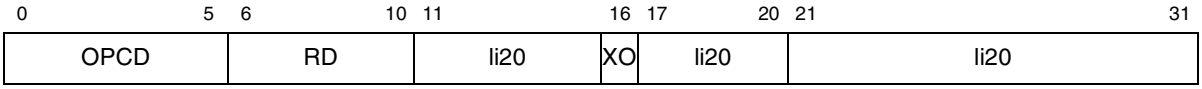


Figure A-16. LI20 Instruction Format

Appendix B
VLE Instruction Set Tables

This appendix lists VLE-supported instructions by mnemonic and by opcode.

Except as described below and in the “Effective Address Calculation” section of the EREF, all instructions are independent of whether the processor is in 32- or 64-bit mode.

Table B-1. Mode Dependency and Privilege Abbreviations

Abbreviation	Description
Mode Dependency Column	
CT	If the instruction tests the CTR, it tests the low-order 32 bits in 32-bit mode and all 64 bits in 64-bit mode.
SR	The setting of status registers (such as XER and CR0) is mode-dependent.
32	The instruction must be executed only in 32-bit mode.
64	The instruction must be executed only in 64-bit mode.
Privilege Column	
P	Denotes a privileged instruction.
O	Denotes an instruction that is treated as privileged or nonprivileged, depending on the SPR number.
M	Denotes an instruction that is treated as privileged or nonprivileged, depending on the value of the MSR[UCLE[.

B.1 VLE Instruction Set Sorted by Mnemonic

Table B-2 lists all instructions available in VLE mode in the Power ISA, in order by mnemonic. Opcodes not listed below are treated as illegal by VLE.

Table B-2. VLE Instruction Set Sorted by Mnemonic

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
XO	7C000214			B	**add**[**o**][**.**]	Add
XO	7C000014			B	**addc**[**o**][**.**]	Add Carrying
XO	7C000114	SR		B	**adde**[**o**][**.**]	Add Extended
XO	7C0001D4	SR		B	**addme**[**o**][**.**]	Add to Minus One Extended
XO	7C000194	SR		B	**addze**[**o**][**.**]	Add to Zero Extended
X	7C000038	SR		B	**and**[**.**]	AND
X	7C000078	SR		B	**andc**[**.**]	AND with Complement
EVX	1000020F			SP	**brinc**	Bit Reverse Increment

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
X	7C000000			B	**cmp**	Compare
X	7C000040			B	**cmpl**	Compare Logical
X	7C000074	SR		64	**cntlzd**[.]	Count Leading Zeros Doubleword
X	7C000034	SR		B	**cntlzw**[.]	Count Leading Zeros Word
X	7C0005EC			E	**dcba**	Data Cache Block Allocate
X	7C0000AC			B	**dcbf**	Data Cache Block Flush
X	7C0000FE		P	E.PD	**dcbfep**	Data Cache Block Flush by External Process ID
X	7C0003AC		P	E	**dcbi**	Data Cache Block Invalidate
X	7C00030C		M	E.CL	**dcblc**	Data Cache Block Lock Clear
X	7C00006C			B	**dcbst**	Data Cache Block Store
X	7C00022C			B	**dcbt**	Data Cache Block Touch
X	7C00027E		P	E.PD	**dcbtep**	Data Cache Block Touch by External Process ID
X	7C00014C		M	E.CL	**dcbtls**	Data Cache Block Touch and Lock Set
X	7C0001EC			B	**dcbtst**	Data Cache Block Touch for Store
X	7C0001FE		P	E.PD	**dcbtstep**	Data Cache Block Touch for Store by External Process ID
X	7C00010C		M	E.CL	**dcbtstls**	Data Cache Block Touch for Store and Lock Set
X	7C0007EC			B	**dcbz**	Data Cache Block set to Zero
X	7C0007FE		P	E.PD	**dcbzep**	Data Cache Block set to Zero by External Process ID
X	7C00038C		P	E.CI	**dci**	Data Cache Invalidate
X	7C00028C		P	E.CD	**dcread**	Data Cache Read
X	7C0003CC		P	E.CD	**dcread**	Data Cache Read
XO	7C0003D2	SR		64	**divd**[**o**][.]	Divide Doubleword
XO	7C000392	SR		64	**divdu**[**o**][.]	Divide Doubleword Unsigned
XO	7C0003D6	SR		B	**divw**[**o**][.]	Divide Word
XO	7C000396	SR		B	**divwu**[**o**][.]	Divide Word Unsigned
D	1C000000			VLE	**e_add16i**	Add Immediate
I16A	70008800	SR		VLE	**e_add2i.**	Add (2 operand) Immediate and Record
I16A	70009000			VLE	**e_add2is**	Add (2 operand) Immediate Shifted
SCI8	18008000	SR		VLE	**e_addi**[.]	Add Scaled Immediate
SCI8	18009000	SR		VLE	**e_addic**[.]	Add Scaled Immediate Carrying
I16L	7000C800	SR		VLE	**e_and2i.**	AND (2 operand) Immediate

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
I16L	7000E800	SR		VLE	**e_and2is.**	AND (2 operand) Immediate Shifted
SCI8	1800C000	SR		VLE	**e_andi[.]**	AND Scaled Immediate
BD24	78000000			VLE	**e_b[l]**	Branch [and Link]
BD15	7A000000	CT		VLE	**e_bc[l]**	Branch Conditional [and Link]
IA16	70009800			VLE	**e_cmp16i**	Compare Immediate Word
IA16	7000B000			VLE	**e_cmph16i**	Compare Halfword Immediate
X	7C00001C			VLE	**e_cmph**	Compare Halfword
IA16	7000B800			VLE	**e_cmphl16i**	Compare Halfword Logical Immediate
X	7C00005C			VLE	**e_cmphl**	Compare Halfword Logical
SCI8	1800A800			VLE	**e_cmpi**	Compare Scaled Immediate Word
I16A	7000A800			VLE	**e_cmpl16i**	Compare Logical Immediate Word
SCI8	1880A800			VLE	**e_cmpli**	Compare Logical Scaled Immediate Word
XL	7C000202			VLE	**e_crand**	Condition Register AND
XL	7C000102			VLE	**e_crandc**	Condition Register AND with Complement
XL	7C000242			VLE	**e_creqv**	Condition Register Equivalent
XL	7C0001C2			VLE	**e_crnand**	Condition Register NAND
XL	7C000042			VLE	**e_crnor**	Condition Register NOR
XL	7C000382			VLE	**e_cror**	Condition Register OR
XL	7C000342			VLE	**e_crorc**	Condition Register OR with Complement
XL	7C000182			VLE	**e_crxor**	Condition Register XOR
D	30000000			VLE	**e_lbz**	Load Byte and Zero
D8	18000000			VLE	**e_lbzu**	Load Byte and Zero with Update
D	38000000			VLE	**e_lha**	Load Halfword Algebraic
D8	18000300			VLE	**e_lhau**	Load Halfword Algebraic with Update
D	58000000			VLE	**e_lhz**	Load Halfword and Zero
D8	18000100			VLE	**e_lhzu**	Load Halfword and Zero with Update
LI20	70000000			VLE	**e_li**	Load Immediate
I16L	7000E000			VLE	**e_lis**	Load Immediate Shifted
D8	18000800			VLE	**e_lmw**	Load Multiple Word
D	50000000			VLE	**e_lwz**	Load Word and Zero
D8	18000200			VLE	**e_lwzu**	Load Word and Zero with Update
XL	7C000020			VLE	**e_mcrf**	Move CR Field

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
I16A	7000A000			VLE	**e_mull2i**	Multiply (2 operand) Low Immediate
SCI8	1800A000			VLE	**e_mulli**	Multiply Low Scaled Immediate
I16L	7000C000			VLE	**e_or2i**	OR (2operand) Immediate
I16L	7000D000			VLE	**e_or2is**	OR (2 operand) Immediate Shifted
SCI8	1800D000	SR		VLE	**e_ori**[.]	OR Scaled Immediate
X	7C000230	SR		VLE	**e_rlw**[.]	Rotate Left Word
X	7C000270	SR		VLE	**e_rlwi**[.]	Rotate Left Word Immediate
M	74000000			VLE	**e_rlwimi**	Rotate Left Word Immediate then Mask Insert
M	74000001			VLE	**e_rlwinm**	Rotate Left Word Immediate then AND with Mask
X	7C000070	SR		VLE	**e_slwi**[.]	Shift Left Word Immediate
X	7C000470	SR		VLE	**e_srwi**[.]	Shift Right Word Immediate
D	34000000			VLE	**e_stb**	Store Byte
D8	18000400			VLE	**e_stbu**	Store Byte with Update
D	5C000000			VLE	**e_sth**	Store Halfword
D8	18000500			VLE	**e_sthu**	Store Halfword with Update
D8	18000900			VLE	**e_stmw**	Store Multiple Word
D	54000000			VLE	**e_stw**	Store Word
D8	18000600			VLE	**e_stwu**	Store word with Update
SCI8	1800B000	SR		VLE	**e_subfic**[.]	Subtract From Scaled Immediate Carrying
SCI8	1800E000	SR		VLE	**e_xori**[.]	XOR Scaled Immediate
EVX	100002E4			SP.FD	**efdabs**	Floating-Point Double-Precision Absolute Value
EVX	100002E0			SP.FD	**efdadd**	Floating-Point Double-Precision Add
EVX	100002EF			SP.FD	**efdcfs**	Floating-Point Double-Precision Convert from Single-Precision
EVX	100002F3			SP.FD	**efdcfsf**	Convert Floating-Point Double-Precision from Signed Fraction
EVX	100002F1			SP.FD	**efdcfsi**	Convert Floating-Point Double-Precision from Signed Integer
EVX	100002E3			SP.FD	**efdcfsid**	Convert Floating-Point Double-Precision from Signed Integer Doubleword
EVX	100002F2			SP.FD	**efdcfuf**	Convert Floating-Point Double-Precision from Unsigned Fraction
EVX	100002F0			SP.FD	**efdcfui**	Convert Floating-Point Double-Precision from Unsigned Integer

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	100002E2			SP.FD	**efdcfuid**	Convert Floating-Point Double-Precision from Unsigned Integer Doubleword
EVX	100002EE			SP.FD	**efdcmpeq**	Floating-Point Double-Precision Compare Equal
EVX	100002EC			SP.FD	**efdcmpgt**	Floating-Point Double-Precision Compare Greater Than
EVX	100002ED			SP.FD	**efdcmplt**	Floating-Point Double-Precision Compare Less Than
EVX	100002F7			SP.FD	**efdctsf**	Convert Floating-Point Double-Precision to Signed Fraction
EVX	100002F5			SP.FD	**efdctsi**	Convert Floating-Point Double-Precision to Signed Integer
EVX	100002EB			SP.FD	**efdctsidz**	Convert Floating-Point Double-Precision to Signed Integer Doubleword with Round Towards Zero
EVX	100002FA			SP.FD	**efdctsiz**	Convert Floating-Point Double-Precision to Signed Integer with Round Towards Zero
EVX	100002F6			SP.FD	**efdctuf**	Convert Floating-Point Double-Precision to Unsigned Fraction
EVX	100002F4			SP.FD	**efdctui**	Convert Floating-Point Double-Precision to Unsigned Integer
EVX	100002EA			SP.FD	**efdctuidz**	Convert Floating-Point Double-Precision to Unsigned Integer Doubleword with Round Towards Zero
EVX	100002F8			SP.FD	**efdctuiz**	Convert Floating-Point Double-Precision to Unsigned Integer with Round Towards Zero
EVX	100002E9			SP.FD	**efddiv**	Floating-Point Double-Precision Divide
EVX	100002E8			SP.FD	**efdmul**	Floating-Point Double-Precision Multiply
EVX	100002E5			SP.FD	**efdnabs**	Floating-Point Double-Precision Negative Absolute Value
EVX	100002E6			SP.FD	**efdneg**	Floating-Point Double-Precision Negate
EVX	100002E1			SP.FD	**efdsub**	Floating-Point Double-Precision Subtract
EVX	100002FE			SP.FD	**efdtsteq**	Floating-Point Double-Precision Test Equal
EVX	100002FC			SP.FD	**efdtstgt**	Floating-Point Double-Precision Test Greater Than
EVX	100002FD			SP.FD	**efdtstlt**	Floating-Point Double-Precision Test Less Than
EVX	100002E4			SP.FS	**efsabs**	Floating-Point Single-Precision Absolute Value
EVX	100002E0			SP.FS	**efsadd**	Floating-Point Single-Precision Add
EVX	100002CF			SP.FD	**efscfd**	Floating-Point Single-Precision Convert from Double-Precision
EVX	100002F3			SP.FS	**efscfsf**	Convert Floating-Point Single-Precision from Signed Fraction

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	100002F1			SP.FS	**efscfsi**	Convert Floating-Point Single-Precision from Signed Integer
EVX	100002E3			SP.FS	**efscfsid**	Convert Floating-Point Single-Precision from Signed Integer Doubleword
EVX	100002F2			SP.FS	**efscfuf**	Convert Floating-Point Single-Precision from Unsigned Fraction
EVX	100002F0			SP.FS	**efscfui**	Convert Floating-Point Single-Precision from Unsigned Integer
EVX	100002E2			SP.FS	**efscfuid**	Convert Floating-Point Single-Precision from Unsigned Integer Doubleword
EVX	100002EE			SP.FS	**efscmpeq**	Floating-Point Single-Precision Compare Equal
EVX	100002EC			SP.FS	**efscmpgt**	Floating-Point Single-Precision Compare Greater Than
EVX	100002ED			SP.FS	**efscmplt**	Floating-Point Single-Precision Compare Less Than
EVX	100002F7			SP.FS	**efsctsf**	Convert Floating-Point Single-Precision to Signed Fraction
EVX	100002F5			SP.FS	**efsctsi**	Convert Floating-Point Single-Precision to Signed Integer
EVX	100002EB			SP.FS	**efsctsidz**	Convert Floating-Point Single-Precision to Signed Integer Doubleword with Round Towards Zero
EVX	100002FA			SP.FS	**efsctsiz**	Convert Floating-Point Single-Precision to Signed Integer with Round Towards Zero
EVX	100002F6			SP.FS	**efsctuf**	Convert Floating-Point Single-Precision to Unsigned Fraction
EVX	100002F4			SP.FS	**efsctui**	Convert Floating-Point Single-Precision to Unsigned Integer
EVX	100002EA			SP.FS	**efsctuidz**	Convert Floating-Point Single-Precision to Unsigned Integer Doubleword with Round Towards Zero
EVX	100002F8			SP.FS	**efsctuiz**	Convert Floating-Point Single-Precision to Unsigned Integer with Round Towards Zero
EVX	100002E9			SP.FS	**efsdiv**	Floating-Point Single-Precision Divide
EVX	100002E8			SP.FS	**efsmul**	Floating-Point Single-Precision Multiply
EVX	100002E5			SP.FS	**efsnabs**	Floating-Point Single-Precision Negative Absolute Value
EVX	100002E6			SP.FS	**efsneg**	Floating-Point Single-Precision Negate
EVX	100002E1			SP.FS	**efssub**	Floating-Point Single-Precision Subtract
EVX	100002FE			SP.FS	**efststeq**	Floating-Point Single-Precision Test Equal
EVX	100002FC			SP.FS	**efststgt**	Floating-Point Single-Precision Test Greater Than
EVX	100002FD			SP.FS	**efststlt**	Floating-Point Single-Precision Test Less Than

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
X	7C000238	SR		B	**eqv**[.]	Equivalent
EVX	10000208			SP	**evabs**	Vector Absolute Value
EVX	10000202			SP	**evaddiw**	Vector Add Immediate Word
EVX	100004C9			SP	**evaddsmiaaw**	Vector Add Signed, Modulo, Integer to Accumulator Word
EVX	100004C1			SP	**evaddssiaaw**	Vector Add Signed, Saturate, Integer to Accumulator Word
EVX	100004C8			SP	**evaddumiaaw**	Vector Add Unsigned, Modulo, Integer to Accumulator Word
EVX	100004C0			SP	**evaddusiaaw**	Vector Add Unsigned, Saturate, Integer to Accumulator Word
EVX	10000200			SP	**evaddw**	Vector Add Word
EVX	10000211			SP	**evand**	Vector AND
EVX	10000212			SP	**evandc**	Vector AND with Complement
EVX	10000234			SP	**evcmpeq**	Vector Compare Equal
EVX	10000231			SP	**evcmpgts**	Vector Compare Greater Than Signed
EVX	10000230			SP	**evcmpgtu**	Vector Compare Greater Than Unsigned
EVX	10000233			SP	**evcmplts**	Vector Compare Less Than Signed
EVX	10000232			SP	**evcmpltu**	Vector Compare Less Than Unsigned
EVX	1000020E			SP	**evcntlsw**	Vector Count Leading Sign Bits Word
EVX	1000020D			SP	**evcntlzw**	Vector Count Leading Zeros Bits Word
EVX	100004C6			SP	**evdivws**	Vector Divide Word Signed
EVX	100004C7			SP	**evdivwu**	Vector Divide Word Unsigned
EVX	10000219			SP	**eveqv**	Vector Equivalent
EVX	1000020A			SP	**evextsb**	Vector Extend Sign Byte
EVX	1000020B			SP	**evextsh**	Vector Extend Sign Halfword
EVX	10000284			SP.FV	**evfsabs**	Vector Floating-Point Single-Precision Absolute Value
EVX	10000280			SP.FV	**evfsadd**	Vector Floating-Point Single-Precision Add
EVX	10000293			SP.FV	**evfscfsf**	Vector Convert Floating-Point Single-Precision from Signed Fraction
EVX	10000291			SP.FV	**evfscfsi**	Vector Convert Floating-Point Single-Precision from Signed Integer
EVX	10000292			SP.FV	**evfscfuf**	Vector Convert Floating-Point Single-Precision from Unsigned Fraction

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	10000290			SP.FV	**evfscfui**	Vector Convert Floating-Point Single-Precision from Unsigned Integer
EVX	1000028E			SP.FV	**evfscmpeq**	Vector Floating-Point Single-Precision Compare Equal
EVX	1000028C			SP.FV	**evfscmpgt**	Vector Floating-Point Single-Precision Compare Greater Than
EVX	1000028D			SP.FV	**evfscmplt**	Vector Floating-Point Single-Precision Compare Less Than
EVX	10000297			SP.FV	**evfsctsf**	Vector Convert Floating-Point Single-Precision to Signed Fraction
EVX	10000295			SP.FV	**evfsctsi**	Vector Convert Floating-Point Single-Precision to Signed Integer
EVX	1000029A			SP.FV	**evfsctsiz**	Vector Convert Floating-Point Single-Precision to Signed Integer with Round Towards Zero
EVX	10000296			SP.FV	**evfsctuf**	Vector Convert Floating-Point Single-Precision to Unsigned Fraction
EVX	10000294			SP.FV	**evfsctui**	Vector Convert Floating-Point Single-Precision to Unsigned Integer
EVX	10000298			SP.FV	**evfsctuiz**	Vector Convert Floating-Point Single-Precision to Unsigned Integer with Round Towards Zero
EVX	10000289			SP.FV	**evfsdiv**	Vector Floating-Point Single-Precision Divide
EVX	10000288			SP.FV	**evfsmul**	Vector Floating-Point Single-Precision Multiply
EVX	10000285			SP.FV	**evfsnabs**	Vector Floating-Point Single-Precision Negative Absolute Value
EVX	10000286			SP.FV	**evfsneg**	Vector Floating-Point Single-Precision Negate
EVX	10000281			SP.FV	**evfssub**	Vector Floating-Point Single-Precision Subtract
EVX	1000029E			SP.FV	**evfststeq**	Vector Floating-Point Single-Precision Test Equal
EVX	1000029C			SP.FV	**evfststgt**	Vector Floating-Point Single-Precision Test Greater Than
EVX	1000029D			SP.FV	**evfststlt**	Vector Floating-Point Single-Precision Test Less Than
EVX	10000301			SP	**evldd**	Vector Load Doubleword into Doubleword
EVX	7C00011D		P	E.PD	**evlddepx**	Vector Load Doubleword into Doubleword by External Process ID Indexed
EVX	10000300			SP	**evlddx**	Vector Load Doubleword into Doubleword Indexed
EVX	10000305			SP	**evldh**	Vector Load Doubleword into 4 Halfwords
EVX	10000304			SP	**evldhx**	Vector Load Doubleword into 4 Halfwords Indexed
EVX	10000303			SP	**evldw**	Vector Load Doubleword into 2 Words
EVX	10000302			SP	**evldwx**	Vector Load Doubleword into 2 Words Indexed

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	10000309			SP	**evlhhesplat**	Vector Load Halfword into Halfwords Even and Splat
EVX	10000308			SP	**evlhhesplatx**	Vector Load Halfword into Halfwords Even and Splat Indexed
EVX	1000030F			SP	**evlhhossplat**	Vector Load Halfword into Halfwords Odd and Splat
EVX	1000030E			SP	**evlhhossplatx**	Vector Load Halfword into Halfwords Odd Signed and Splat Indexed
EVX	1000030D			SP	**evlhhousplat**	Vector Load Halfword into Halfwords Odd Unsigned and Splat
EVX	1000030C			SP	**evlhhousplatx**	Vector Load Halfword into Halfwords Odd Unsigned and Splat Indexed
EVX	10000311			SP	**evlwhe**	Vector Load Word into Two Halfwords Even
EVX	10000310			SP	**evlwhex**	Vector Load Word into Two Halfwords Even Indexed
EVX	10000317			SP	**evlwhos**	Vector Load Word into Two Halfwords Odd Signed
EVX	10000316			SP	**evlwhosx**	Vector Load Word into Two Halfwords Odd Signed Indexed
EVX	10000315			SP	**evlwhou**	Vector Load Word into Two Halfwords Odd Unsigned
EVX	10000314			SP	**evlwhoux**	Vector Load Word into Two Halfwords Odd Unsigned Indexed
EVX	1000031D			SP	**evlwhsplat**	Vector Load Word into Two Halfwords and Splat
EVX	1000031C			SP	**evlwhsplatx**	Vector Load Word into Two Halfwords and Splat Indexed
EVX	10000319			SP	**evlwwsplat**	Vector Load Word into Word and Splat
EVX	10000318			SP	**evlwwsplatx**	Vector Load Word into Word and Splat Indexed
EVX	1000022C			SP	**evmergehi**	Vector Merge High
EVX	1000022E			SP	**evmergehilo**	Vector Merge High/Low
EVX	1000022D			SP	**evmergelo**	Vector Merge Low
EVX	1000022F			SP	**evmergelohi**	Vector Merge Low/High
EVX	1000052B			SP	**evmhegsmfaa**	Vector Multiply Halfwords, Even, Guarded, Signed, Modulo, Fractional and Accumulate
EVX	100005AB			SP	**evmhegsmfan**	Vector Multiply Halfwords, Even, Guarded, Signed, Modulo, Fractional and Accumulate Negative
EVX	10000529			SP	**evmhegsmiaa**	Vector Multiply Halfwords, Even, Guarded, Signed, Modulo, Integer and Accumulate
EVX	100005A9			SP	**evmhegsmian**	Vector Multiply Halfwords, Even, Guarded, Signed, Modulo, Integer and Accumulate Negative
EVX	10000528			SP	**evmhegumiaa**	Vector Multiply Halfwords, Even, Guarded, Unsigned, Modulo, Integer and Accumulate

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	100005A8			SP	**evmhegumian**	Vector Multiply Halfwords, Even, Guarded, Unsigned, Modulo, Integer and Accumulate Negative
EVX	1000040B			SP	**evmhesmf**	Vector Multiply Halfwords, Even, Signed, Modulo, Fractional
EVX	1000042B			SP	**evmhesmfa**	Vector Multiply Halfwords, Even, Signed, Modulo, Fractional to Accumulate
EVX	1000050B			SP	**evmhesmfaaw**	Vector Multiply Halfwords, Even, Signed, Modulo, Fractional and Accumulate into Words
EVX	1000058B			SP	**evmhesmfanw**	Vector Multiply Halfwords, Even, Signed, Modulo, Fractional and Accumulate Negative into Words
EVX	10000409			SP	**evmhesmi**	Vector Multiply Halfwords, Even, Signed, Modulo, Integer
EVX	10000429			SP	**evmhesmia**	Vector Multiply Halfwords, Even, Signed, Modulo, Integer to Accumulator
EVX	10000509			SP	**evmhesmiaaw**	Vector Multiply Halfwords, Even, Signed, Modulo, Integer and Accumulate into Words
EVX	10000589			SP	**evmhesmianw**	Vector Multiply Halfwords, Even, Signed, Modulo, Integer and Accumulate Negative into Words
EVX	10000403			SP	**evmhessf**	Vector Multiply Halfwords, Even, Signed, Saturate, Fractional
EVX	10000423			SP	**evmhessfa**	Vector Multiply Halfwords, Even, Signed, Saturate, Fractional to Accumulator
EVX	10000503			SP	**evmhessfaaw**	Vector Multiply Halfwords, Even, Signed, Saturate, Fractional and Accumulate into Words
EVX	10000583			SP	**evmhessfanw**	Vector Multiply Halfwords, Even, Signed, Saturate, Fractional and Accumulate Negative into Words
EVX	10000501			SP	**evmhessiaaw**	Vector Multiply Halfwords, Even, Signed, Saturate, Integer and Accumulate into Words
EVX	10000581			SP	**evmhessianw**	Vector Multiply Halfwords, Even, Signed, Saturate, Integer and Accumulate Negative into Words
EVX	10000408			SP	**evmheumi**	Vector Multiply Halfwords, Even, Unsigned, Modulo, Integer
EVX	10000428			SP	**evmheumia**	Vector Multiply Halfwords, Even, Unsigned, Modulo, Integer to Accumulator
EVX	10000508			SP	**evmheumiaaw**	Vector Multiply Halfwords, Even, Unsigned, Modulo, Integer and Accumulate into Words
EVX	10000588			SP	**evmheumianw**	Vector Multiply Halfwords, Even, Unsigned, Modulo, Integer and Accumulate Negative into Words
EVX	10000500			SP	**evmheusiaaw**	Vector Multiply Halfwords, Even, Unsigned, Saturate Integer and Accumulate into Words

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	10000580			SP	**evmheusianw**	Vector Multiply Halfwords, Even, Unsigned, Saturate Integer and Accumulate Negative into Words
EVX	1000052F			SP	**evmhogsmfaa**	Vector Multiply Halfwords, Odd, Guarded, Signed, Modulo, Fractional and Accumulate
EVX	100005AF			SP	**evmhogsmfan**	Vector Multiply Halfwords, Odd, Guarded, Signed, Modulo, Fractional and Accumulate Negative
EVX	1000052D			SP	**evmhogsmiaa**	Vector Multiply Halfwords, Odd, Guarded, Signed, Modulo, Integer and Accumulate
EVX	100005AD			SP	**evmhogsmian**	Vector Multiply Halfwords, Odd, Guarded, Signed, Modulo, Integer and Accumulate Negative
EVX	1000052C			SP	**evmhogumiaa**	Vector Multiply Halfwords, Odd, Guarded, Unsigned, Modulo, Integer and Accumulate
EVX	100005AC			SP	**evmhogumian**	Vector Multiply Halfwords, Odd, Guarded, Unsigned, Modulo, Integer and Accumulate Negative
EVX	1000040F			SP	**evmhosmf**	Vector Multiply Halfwords, Odd, Signed, Modulo, Fractional
EVX	1000042F			SP	**evmhosmfa**	Vector Multiply Halfwords, Odd, Signed, Modulo, Fractional to Accumulator
EVX	1000050F			SP	**evmhosmfaaw**	Vector Multiply Halfwords, Odd, Signed, Modulo, Fractional and Accumulate into Words
EVX	1000058F			SP	**evmhosmfanw**	Vector Multiply Halfwords, Odd, Signed, Modulo, Fractional and Accumulate Negative into Words
EVX	1000040D			SP	**evmhosmi**	Vector Multiply Halfwords, Odd, Signed, Modulo, Integer
EVX	1000042D			SP	**evmhosmia**	Vector Multiply Halfwords, Odd, Signed, Modulo, Integer to Accumulator
EVX	1000050D			SP	**evmhosmiaaw**	Vector Multiply Halfwords, Odd, Signed, Modulo, Integer and Accumulate into Words
EVX	1000058D			SP	**evmhosmianw**	Vector Multiply Halfwords, Odd, Signed, Modulo, Integer and Accumulate Negative into Words
EVX	10000407			SP	**evmhossf**	Vector Multiply Halfwords, Odd, Signed, Fractional
EVX	10000427			SP	**evmhossfa**	Vector Multiply Halfwords, Odd, Signed, Fractional to Accumulator
EVX	10000507			SP	**evmhossfaaw**	Vector Multiply Halfwords, Odd, Signed, Saturate, Fractional and Accumulate into Words
EVX	10000587			SP	**evmhossfanw**	Vector Multiply Halfwords, Odd, Signed, Saturate, Fractional and Accumulate Negative into Words
EVX	10000505			SP	**evmhossiaaw**	Vector Multiply Halfwords, Odd, Signed, Saturate, Integer and Accumulate into Words

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	10000585			SP	**evmhossianw**	Vector Multiply Halfwords, Odd, Signed, Saturate, Integer and Accumulate Negative into Words
EVX	1000040C			SP	**evmhoumi**	Vector Multiply Halfwords, Odd, Unsigned, Modulo, Integer
EVX	1000042C			SP	**evmhoumia**	Vector Multiply Halfwords, Odd, Unsigned, Modulo, Integer to Accumulator
EVX	1000050C			SP	**evmhoumiaaw**	Vector Multiply Halfwords, Odd, Unsigned, Modulo, Integer and Accumulate into Words
EVX	1000058C			SP	**evmhoumianw**	Vector Multiply Halfwords, Odd, Unsigned, Modulo, Integer and Accumulate Negative into Words
EVX	10000504			SP	**evmhousiaaw**	Vector Multiply Halfwords, Odd, Unsigned, Saturate, Integer and Accumulate into Words
EVX	10000584			SP	**evmhousianw**	Vector Multiply Halfwords, Odd, Unsigned, Saturate, Integer and Accumulate Negative into Words
EVX	100004C4			SP	**evmra**	Initialize Accumulator
EVX	1000044F			SP	**evmwhsmf**	Vector Multiply Word High Signed, Modulo, Fractional
EVX	1000046F			SP	**evmwhsmfa**	Vector Multiply Word High Signed, Modulo, Fractional to Accumulator
EVX	1000054F			SP	**evmwhsmfaaw**	Vector Multiply Word High Signed, Modulo, Fractional and Accumulate into Words
EVX	100005CF			SP	**evmwhsmfanw**	Vector Multiply Word High Signed, Modulo, Fractional and Accumulate Negative into Words
EVX	1000044D			SP	**evmwhsmi**	Vector Multiply Word High Signed, Modulo, Integer
EVX	1000046D			SP	**evmwhsmia**	Vector Multiply Word High Signed, Modulo, Integer to Accumulator
EVX	1000054D			SP	**evmwhsmiaaw**	Vector Multiply Word High Signed, Modulo, Integer and Accumulate into Words
EVX	100005CD			SP	**evmwhsmianw**	Vector Multiply Word High Signed, Modulo, Integer and Accumulate Negative into Words
EVX	10000447			SP	**evmwhssf**	Vector Multiply Word High Signed, Fractional
EVX	10000467			SP	**evmwhssfa**	Vector Multiply Word High Signed, Fractional to Accumulator
EVX	10000547			SP	**evmwhssfaaw**	Vector Multiply Word High Signed, Fractional and Accumulate into Words
EVX	100005C7			SP	**evmwhssfanw**	Vector Multiply Word High Signed, Fractional and Accumulate Negative into Words
EVX	100005C5			SP	**evmwhssianw**	Vector Multiply Word High Signed, Integer and Accumulate Negative into Words
EVX	1000044C			SP	**evmwhumi**	Vector Multiply Word High Unsigned, Modulo, Integer

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	1000046C			SP	**evmwhumia**	Vector Multiply Word High Unsigned, Modulo, Integer to Accumulator
EVX	1000054C			SP	**evmwhumiaaw**	Vector Multiply Word High Unsigned, Modulo, Integer and Accumulate into Words
EVX	100005CC			SP	**evmwhumianw**	Vector Multiply Word High Unsigned, Modulo, Integer and Accumulate Negative into Words
EVX	10000544			SP	**evmwhusiaaw**	Vector Multiply Word High Unsigned, Integer and Accumulate into Words
EVX	100005C4			SP	**evmwhusianw**	Vector Multiply Word High Unsigned, Integer and Accumulate Negative into Words
EVX	10000549			SP	**evmwlsmiaaw**	Vector Multiply Word Low Signed, Modulo, Integer and Accumulate into Words
EVX	100005C9			SP	**evmwlsmianw**	Vector Multiply Word Low Signed, Modulo, Integer and Accumulate Negative into Words
EVX	10000541			SP	**evmwlssiaaw**	Vector Multiply Word Low Signed, Saturate, Integer and Accumulate into Words
EVX	100005C1			SP	**evmwlssianw**	Vector Multiply Word Low Signed, Saturate, Integer and Accumulate Negative into Words
EVX	10000448			SP	**evmwlumi**	Vector Multiply Word Low Unsigned, Modulo, Integer
EVX	10000468			SP	**evmwlumia**	Vector Multiply Word Low Unsigned, Modulo, Integer to Accumulator
EVX	10000548			SP	**evmwlumiaaw**	Vector Multiply Word Low Unsigned, Modulo, Integer and Accumulate into Words
EVX	100005C8			SP	**evmwlumianw**	Vector Multiply Word Low Unsigned, Modulo, Integer and Accumulate Negative into Words
EVX	10000540			SP	**evmwlusiaaw**	Vector Multiply Word Low Unsigned Saturate, Integer and Accumulate into Words
EVX	100005C0			SP	**evmwlusianw**	Vector Multiply Word Low Unsigned Saturate, Integer and Accumulate Negative into Words
EVX	1000045B			SP	**evmwsmf**	Vector Multiply Word Signed, Modulo, Fractional
EVX	1000047B			SP	**evmwsmfa**	Vector Multiply Word Signed, Modulo, Fractional to Accumulator
EVX	1000055B			SP	**evmwsmfaa**	Vector Multiply Word Signed, Modulo, Fractional and Accumulate
EVX	100005DB			SP	**evmwsmfan**	Vector Multiply Word Signed, Modulo, Fractional and Accumulate Negative
EVX	10000459			SP	**evmwsmi**	Vector Multiply Word Signed, Modulo, Integer
EVX	10000479			SP	**evmwsmia**	Vector Multiply Word Signed, Modulo, Integer to Accumulator

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	10000559			SP	**evmwsmiaa**	Vector Multiply Word Signed, Modulo, Integer and Accumulate
EVX	100005D9			SP	**evmwsmian**	Vector Multiply Word Signed, Modulo, Integer and Accumulate Negative
EVX	10000453			SP	**evmwssf**	Vector Multiply Word Signed, Saturate, Fractional
EVX	10000473			SP	**evmwssfa**	Vector Multiply Word Signed, Saturate, Fractional to Accumulator
EVX	10000553			SP	**evmwssfaa**	Vector Multiply Word Signed, Saturate, Fractional and Accumulate
EVX	100005D3			SP	**evmwssfan**	Vector Multiply Word Signed, Saturate, Fractional and Accumulate Negative
EVX	10000458			SP	**evmwumi**	Vector Multiply Word Unsigned, Modulo, Integer
EVX	10000478			SP	**evmwumia**	Vector Multiply Word Unsigned, Modulo, Integer to Accumulator
EVX	10000558			SP	**evmwumiaa**	Vector Multiply Word Unsigned, Modulo, Integer and Accumulate
EVX	100005D8			SP	**evmwumian**	Vector Multiply Word Unsigned, Modulo, Integer and Accumulate Negative
EVX	1000021E			SP	**evnand**	Vector NAND
EVX	10000209			SP	**evneg**	Vector Negate
EVX	10000218			SP	**evnor**	Vector NOR
EVX	10000217			SP	**evor**	Vector OR
EVX	1000021B			SP	**evorc**	Vector OR with Complement
EVX	10000228			SP	**evrlw**	Vector Rotate Left Word
EVX	1000022A			SP	**evrlwi**	Vector Rotate Left Word Immediate
EVX	1000020C			SP	**evrndw**	Vector Round Word
EVSEL	10000278			SP	**evsel**	Vector Select
EVX	10000224			SP	**evslw**	Vector Shift Left Word
EVX	10000226			SP	**evslwi**	Vector Shift Left Word Immediate
EVX	1000022B			SP	**evsplatfi**	Vector Splat Fractional Immediate
EVX	10000229			SP	**evsplati**	Vector Splat Immediate
EVX	10000223			SP	**evsrwis**	Vector Shift Right Word Immediate Signed
EVX	10000222			SP	**evsrwiu**	Vector Shift Right Word Immediate Unsigned
EVX	10000221			SP	**evsrws**	Vector Shift Right Word Signed
EVX	10000220			SP	**evsrwu**	Vector Shift Right Word Unsigned

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	10000321			SP	**evstdd**	Vector Store Doubleword of Doubleword
EVX	7C00019D		P	E.PD	**evstddepx**	Vector Store Doubleword into Doubleword by External Process ID Indexed
EVX	10000320			SP	**evstddx**	Vector Store Doubleword of Doubleword Indexed
EVX	10000325			SP	**evstdh**	Vector Store Doubleword of Four Halfwords
EVX	10000324			SP	**evstdhx**	Vector Store Doubleword of Four Halfwords Indexed
EVX	10000323			SP	**evstdw**	Vector Store Doubleword of Two Words
EVX	10000322			SP	**evstdwx**	Vector Store Doubleword of Two Words Indexed
EVX	10000331			SP	**evstwhe**	Vector Store Word of Two Halfwords from Even
EVX	10000330			SP	**evstwhex**	Vector Store Word of Two Halfwords from Even Indexed
EVX	10000335			SP	**evstwho**	Vector Store Word of Two Halfwords from Odd
EVX	10000334			SP	**evstwhox**	Vector Store Word of Two Halfwords from Odd Indexed
EVX	10000339			SP	**evstwwe**	Vector Store Word of Word from Even
EVX	10000338			SP	**evstwwex**	Vector Store Word of Word from Even Indexed
EVX	1000033D			SP	**evstwwo**	Vector Store Word of Word from Odd
EVX	1000033C			SP	**evstwwox**	Vector Store Word of Word from Odd Indexed
EVX	100004CB			SP	**evsubfsmiaaw**	Vector Subtract Signed, Modulo, Integer to Accumulator Word
EVX	100004C3			SP	**evsubfssiaaw**	Vector Subtract Signed, Saturate, Integer to Accumulator Word
EVX	100004CA			SP	**evsubfumiaaw**	Vector Subtract Unsigned, Modulo, Integer to Accumulator Word
EVX	100004C2			SP	**evsubfusiaaw**	Vector Subtract Unsigned, Saturate, Integer to Accumulator Word
EVX	10000204			SP	**evsubfw**	Vector Subtract from Word
EVX	10000206			SP	**evsubifw**	Vector Subtract Immediate from Word
EVX	10000216			SP	**evxor**	Vector XOR
X	7C000774	SR		B	**extsb**[.]	Extend Shign Byte
X	7C000734	SR		B	**extsh**[.]	Extend Sign Halfword
X	7C0007B4	SR		64	**extsw**[.]	Extend Sign Word
X	7C0007AC			B	**icbi**	Instruction Cache Block Invalidate
X	7C0007BE		P	E.PD	**icbiep**	Instruction Cache Block Invalidate by External Process ID
X	7C0001CC		M	E.CL	**icblc**	Instruction Cache Block Lock Clear

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
X	7C00002C			E	**icbt**	Instruction Cache Block Touch
X	7C0003CC		M	E.CL	**icbtls**	Instruction Cache Block Touch and Lock Set
X	7C00078C		P	E.CI	**ici**	Instruction Cache Invalidate
X	7C0007CC		P	E.CD	**icread**	Instruction Cache Read
A	7C00001E			B	**isel**	Integer Select
X	7C0000BE		P	E.PD	**lbepx**	Load Byte by External Process ID Indexed
X	7C0000EE			B	**lbzux**	Load Byte and Zero with Update Indexed
X	7C0000AE			B	**lbzx**	Load Byte and Zero Indexed
X	7C0000A8			64	**ldarx**	Load Doubleword and Reserve Indexed
X	7C00003A		P	E.PD	**ldepx**	Load Doubleword by External Process ID Indexed
X	7C00006A			64	**ldux**	Load Doubleword with Update Indexed
X	7C00002A			64	**ldx**	Load Doubleword Indexed
X	7C0004BE		P	E.PD	**lfdepx**	Load Floating-Point Double by External Process ID Indexed
X	7C0002EE			B	**lhaux**	Load Halfword Algebraic with Update Indexed
X	7C0002AE			B	**lhax**	Load Halfword Algebraic Indexed
X	7C00062C			B	**lhbrx**	Load Halfword Byte-Reversed Indexed
X	7C00023E		P	E.PD	**lhepx**	Load Halfword by External Process ID Indexed
X	7C00026E			B	**lhzux**	Load Halfword and Zero with Update Indexed
X	7C00022E			B	**lhzx**	Load Halfword and Zero Indexed
X	7C0004AA			MA	**lswi**	Load String Word Immediate
X	7C00042A			MA	**lswx**	Load String Word Indexed
X	7C00000E			VEC	**lvebx**	Load Vector Element Byte Indexed
X	7C00004E			VEC	**lvehx**	Load Vector Element Halfword Indexed
X	7C00024E		P	E.PD	**lvepx**	Load Vector by External Process ID Indexed
X	7C00020E		P	E.PD	**lvepxl**	Load Vector by External Process ID Indexed LRU
X	7C00008E			VEC	**lvewx**	Load Vector Element Word Indexed
X	7C00000C			VEC	**lvsl**	Load Vector for Shift Left Indexed
X	7C00004C			VEC	**lvsr**	Load Vector for Shift Right Indexed
X	7C0000CE			VEC	**lvx**[**l**]	Load Vector Indexed [Last]
X	7C000028			B	**lwarx**	Load Word and Reserve Indexed
X	7C0002EA			64	**lwaux**	Load Word Algebraic with Update Indexed

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
X	7C0002AA			64	**lwax**	Load Word Algebraic Indexed
X	7C00042C			B	**lwbrx**	Load Word Byte-Reversed Indexed
X	7C00003E		P	E.PD	**lwepx**	Load Word by External Process ID Indexed
X	7C00006E			B	**lwzux**	Load Word and Zero with Update Indexed
X	7C00002E			B	**lwzx**	Load Word and Zero Indexed
X	10000158	SR		LIM	**macchw**[**o**][.]	Multiply Accumulate Cross Halfword to Word Modulo Signed
X	100001D8	SR		LIM	**macchws**[**o**][.]	Multiply Accumulate Cross Halfword to Word Saturate Signed
X	10000198	SR		LIM	**macchwsu**[**o**][.]	Multiply Accumulate Cross Halfword to Word Saturate Unsigned
X	10000118	SR		LIM	**macchwu**[**o**][.]	Multiply Accumulate Cross Halfword to Word Modulo Unsigned
X	10000058	SR		LIM	**machhw**[**o**][.]	Multiply Accumulate High Halfword to Word Modulo Signed
X	100000D8	SR		LIM	**machhws**[**o**][.]	Multiply Accumulate High Halfword to Word Saturate Signed
X	10000098	SR		LIM	**machhwsu**[**o**][.]	Multiply Accumulate High Halfword to Word Saturate Unsigned
X	10000018	SR		LIM	**machhwu**[**o**][.]	Multiply Accumulate High Halfword to Word Modulo Unsigned
X	10000358	SR		LIM	**maclhw**[**o**][.]	Multiply Accumulate Low Halfword to Word Modulo Signed
X	100003D8	SR		LIM	**maclhws**[**o**][.]	Multiply Accumulate Low Halfword to Word Saturate Signed
X	10000398	SR		LIM	**maclhwsu**[**o**][.]	Multiply Accumulate Low Halfword to Word Saturate Unsigned
X	10000318	SR		LIM	**maclhwu**[**o**][.]	Multiply Accumulate Low Halfword to Word Modulo Unsigned
XFX	7C0006AC			E	**mbar**	Memory Barrier
X	7C000400			B	**mcrxr**	Move To Condition Register From XER
XFX	7C000026			B	**mfcr**	Move From Condition Register
XFX	7C000286		P	E	**mfdcr**	Move From Device Control Register
XFX	7C000246		P	E	**mfdcrux**	Move From Device Control Register User Indexed
XFX	7C000206		P	E	**mfdcrx**	Move From Device Control Register Indexed
X	7C0000A6		P	B	**mfmsr**	Move From Machine State Register
XFX	7C100026			B	**mfocrf**	Move From One Condition Register Field

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
XFX	7C00029C		O	E.PM	**mfpmr**	Move From Performance Monitor Register
XFX	7C0002A6		O	B	**mfspr**	Move From Special Purpose Register
VX	10000604			VEC	**mfvscr**	Move from Vector Status and Control Register
X	7C0001DC		P	E.PC	**msgclr**	Message Clear
X	7C00019C		P	E.PC	**msgsnd**	Message Send
XFX	7C000120			B	**mtcrf**	Move to Condition Register Fields
XFX	7C000386		P	E	**mtdcr**	Move To Device Control Register
X	7C000346			E	**mtdcrux**	Move To Device Control Register User Indexed
X	7C000306		P	E	**mtdcrx**	Move To Device Control Register Indexed
X	7C000124		P	E	**mtmsr**	Move To Machine State Register
XFX	7C100120			B	**mtocrf**	Move To One Condition Register Field
XFX	7C00039C		O	E.PM	**mtpmr**	Move To Performance Monitor Register
XFX	7C0003A6		O	B	**mtspr**	Move To Special Purpose Register
VX	10000644			VEC	**mtvscr**	Move to Vector Status and Control Register
X	10000150	SR		LIM	**mulchw**[**o**][.]	Multiply Cross Halfword to Word Signed
X	10000110	SR		LIM	**mulchwu**[**o**][.]	Multiply Cross Halfword to Word Unsigned
XO	7C000092	SR		64	**mulhd**[.]	Multiply High Doubleword
XO	7C000012	SR		64	**mulhdu**[.]	Multiply High Doubleword Unsigned
X	10000050	SR		LIM	**mulhhw**[**o**][.]	Multiply High Halfword to Word Signed
X	10000010	SR		LIM	**mulhhwu**[**o**][.]	Multiply High Halfword to Word Unsigned
XO	7C000096	SR		B	**mulhw**[.]	Multiply High Word
XO	7C000016	SR		B	**mulhwu**[.]	Multiply High Word Unsigned
XO	7C0001D2	SR		64	**mulld**[**o**][.]	Multiply Low Doubleword
XO	7C0001D6	SR		B	**mullw**[**o**][.]	Multiply Low Word
X	7C0003B8	SR		B	**nand**[.]	NAND
X	7C0000D0	SR		B	**neg**[**o**][.]	Negate
X	1000015C	SR		LIM	**nmacchw**[**o**][.]	Negative Multiply Accumulate Cross Halfword to Word Modulo Signed
X	100001DC	SR		LIM	**nmacchws**[**o**][.]	Negative Multiply Accumulate Cross Halfword to Word Saturate Signed
X	1000005C	SR		LIM	**nmachhw**[**o**][.]	Negative Multiply Accumulate High Halfword to Word Modulo Signed
X	100000DC	SR		LIM	**nmachhws**[**o**][.]	Negative Multiply Accumulate High Halfword to Word Saturate Signed

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
X	1000035C	SR		LIM	**nmaclhw**[**o**][**.**]	Negative Multiply Accumulate Low Halfword to Word Modulo Signed
X	100003DC	SR		LIM	**nmaclhws**[**o**][**.**]	Negative Multiply Accumulate Low Halfword to Word Saturate Signed
X	7C0000F8	SR		B	**nor**[**.**]	NOR
X	7C000378	SR		B	**or**[**.**]	OR
X	7C000338	SR		B	**orc**[**.**]	OR with Complement
X	7C0000F4			B	**popcntb**	Population Count Bytes
RR	0400----			VLE	**se_add**	Add Short Form
OIM5	2000----			VLE	**se_addi**	Add Immediate Short Form
RR	4600----	SR		VLE	**se_and**[**.**]	AND Short Form
RR	4500----			VLE	**se_andc**	AND with Complement Short Form
IM5	2E00----			VLE	**se_andi**	AND Immediate Short Form
BD8	E800----			VLE	**se_b**[**l**]	Branch [and Link]
BD8	E000----			VLE	**se_bc**	Branch Conditional Short Form
IM5	6000----			VLE	**se_bclri**	Bit Clear Immediate
C	0006----			VLE	**se_bctr**	Branch To Count Register [and Link]
IM5	6200----			VLE	**se_bgeni**	Bit Generate Immediate
C	0004----			VLE	**se_blr**	Branch To Link Register [and Link]
IM5	2C00----			VLE	**se_bmaski**	Bit Mask Generate Immediate
IM5	6400----			VLE	**se_bseti**	Bit Set Immediate
IM5	6600----			VLE	**se_btsti**	Bit Test Immediate
RR	0C00----			VLE	**se_cmp**	Compare Word
RR	0E00----			VLE	**se_cmph**	Compare Halfword Short Form
RR	0F00----			VLE	**se_cmphl**	Compare Halfword Logical Short Form
IM5	2A00----			VLE	**se_cmpi**	Compare Immediate Word Short Form
RR	0D00----			VLE	**se_cmpl**	Compare Logical Word
OIM5	2200----			VLE	**se_cmpli**	Compare Logical Immendiate Word
R	00D0----			VLE	**se_extsb**	Extend Sign Byte Short Form
R	00F0----			VLE	**se_extsh**	Extend Sign Halfword Short Form
R	00C0----			VLE	**se_extzb**	Extend Zero Byte
R	00E0----			VLE	**se_extzh**	Extend Zero Halfword
C	0000----			VLE	**se_illegal**	Illegal

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
C	0001----			VLE	**se_isync**	Instruction Synchronize
SD4	8000----			VLE	**se_lbz**	Load Byte and Zero Short Form
SD4	A000----			VLE	**se_lhz**	Load Halfword and Zero Short Form
IM7	4800----			VLE	**se_li**	Load Immediate Short Form
SD4	C000----			VLE	**se_lwz**	Load Word and Zero Short Form
RR	0300----			VLE	**se_mfar**	Move from Alternate Register
R	00A0----			VLE	**se_mfctr**	Move From Count Register
R	0080----			VLE	**se_mflr**	Move From Link Register
RR	0100----			VLE	**se_mr**	Move Register
RR	0200----			VLE	**se_mtar**	Move To Alternate Register
R	00B0----			VLE	**se_mtctr**	Move To Count Register
R	0090----			VLE	**se_mtlr**	Move To Link Register
RR	0500----			VLE	**se_mullw**	Multiply Low Word Short Form
R	0030----			VLE	**se_neg**	Negate Short Form
R	0020----			VLE	**se_not**	NOT Short Form
RR	4400----			VLE	**se_or**	OR SHort Form
C	0009----		P	VLE	**se_rfci**	Return From Critical Interrupt
C	000A----		P	VLE	**se_rfdi**	Return From Debug Interrupt
C	0008----		P	VLE	**se_rfi**	Return from Interrupt
C	000B----		P	VLE	**se_rfmci**	Return From Machine Check Interrupt
C	0002----			VLE	**se_sc**	System Call
RR	4200----			VLE	**se_slw**	Shift Left Word
IM5	6C00----			VLE	**se_slwi**	Shift Left Word Immediate Short Form
RR	4100----	SR		VLE	**se_sraw**	Shift Right Algebraic Word
IM5	6A00----	SR		VLE	**se_srawi**	Shift Right Algebraic Immediate
RR	4000----			VLE	**se_srw**	Shift Right Word
IM5	6800----			VLE	**se_srwi**	Shift Right Word Immediate Short Form
SD4	9000----			VLE	**se_stb**	Store Byte Short Form
SD4	B000----			VLE	**se_sth**	Store Halfword SHort Form
SD4	D000----			VLE	**se_stw**	Store Word Short Form
RR	0600----			VLE	**se_sub**	Subtract
RR	0700----			VLE	**se_subf**	Subtract From Short Form

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
OIM5	2400----	SR		VLE	**se_subi**[.]	Subtract Immediate
X	7C000036	SR		64	**sld**[.]	Shift Left Doubleword
X	7C000030	SR		B	**slw**[.]	Shift Left Word
X	7C000634	SR		64	**srad**[.]	Shift Right Algebraic Doubleword
X	7C000674	SR		64	**sradi**[.]	Shift Right Algebraic Doubleword Immediate
X	7C000630	SR		B	**sraw**[.]	Shift Right Algebraic Word
X	7C000670	SR		B	**srawi**[.]	Shift Right Algebraic Word Immediate
X	7C000436	SR		64	**srd**[.]	Shift Right Doubleword
X	7C000430	SR		B	**srw**[.]	Shift Right Word
X	7C0001BE		P	E.PD	**stbepx**	Store Byte by External Process ID Indexed
X	7C0001EE			B	**stbux**	Store Byte with Update Indexed
X	7C0001AE			B	**stbx**	Store Bye Indexed
X	7C0001AD			64	**stdcx.**	Store Doubleword Conditional Indexed
X	7C00013A		P	E.PD	**stdepx**	Store Doubleword by External Process ID Indexed
X	7C00016A			64	**stdux**	Store Doubleword with Update Indexed
X	7C00012A			64	**stdx**	Store Doubleword Indexed
X	7C0005BE		P	E.PD	**stfdepx**	Store Floating-Point Double by External Process ID Indexed
X	7C00072C			B	**sthbrx**	Store Halfword Byte-Reversed Indexed
X	7C00033E		P	E.PD	**sthepx**	Store Halfword by External Process ID Indexed
X	7C00036E			B	**sthux**	Store Halfword with Update Indexed
X	7C00032E			B	**sthx**	Store Halfword Indexed
X	7C0005AA			MA	**stswi**	Store String Word Immediate
X	7C00052A			MA	**stswx**	Store String Word Indexed
VX	7C00010E			VEC	**stvebx**	Store Vector Element Byte Indexed
VX	7C00014E			VEC	**stvehx**	Store Vector Element Halfword Indexed
X	7C00064E		P	E.PD	**stvepx**	Store Vector by External Process ID Indexed
X	7C00060E		P	E.PD	**stvepxl**	Store Vector by External Process ID Indexed LRU
VX	7C00018E			VEC	**stvewx**	Store Vector Element Word Indexed
VX	7C0001CE			VEC	**stvx**[**l**]	Store Vector Indexed [Last]
X	7C00052C			B	**stwbrx**	Store Word Byte-Reversed Indexed
X	7C00012D			B	**stwcx.**	Store Word Conditional Indexed

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
X	7C00013E		P	E.PD	**stwepx**	Store Word by External Process ID Indexed
X	7C00016E			B	**stwux**	Store Word with Update Indexed
X	7C00012E			B	**stwx**	Store Word Indexed
XO	7C000050	SR		B	**subf**[**o**][**.**]	Subtract From
XO	7C000010	SR		B	**subfc**[**o**][**.**]	Subtract From Carrying
XO	7C000110	SR		B	**subfe**[**o**][**.**]	Subtract From Extended
XO	7C0001D0	SR		B	**subfme**[**o**][**.**]	Subtract From Minus One Extended
XO	7C000190	SR		B	**subfze**[**o**][**.**]	Subtract From Zero Extended
X	7C0004AC			B	**sync**	Synchronize
X	7C000088			64	**td**	Trap Doubleword
X	7C000624		P	E	**tlbivax**	TLB Invalidate Virtual Address Indexed
X	7C000764		P	E	**tlbre**	TLB Read Entry
X	7C000724		P	E	**tlbsx**	TLB Search Indexed
X	7C00046C		P	E	**tlbsync**	TLB Synchronize
X	7C0007A4		P	E	**tlbwe**	TLB Write Entry
X	7C000008			B	**tw**	Trap Word
VX	10000180			VEC	**vaddcuw**	Vector Add Carryout Unsigned Word
VX	1000000A			VEC	**vaddfp**	Vector Add Floating-Point
VX	10000300			VEC	**vaddsbs**	Vector Add Signed Byte Saturate
VX	10000340			VEC	**vaddshs**	Vector Add Signed Halfword Saturate
VX	10000380			VEC	**vaddsws**	Vector Add Signed Word Saturate
VX	10000000			VEC	**vaddubm**	Vector Add Unsigned Byte Modulo
VX	10000200			VEC	**vaddubs**	Vector Add Unsigned Byte Saturate
VX	10000040			VEC	**vadduhm**	Vector Add Unsigned Halfword Modulo
VX	10000240			VEC	**vadduhs**	Vector Add Unsigned Halfword Saturate
VX	10000080			VEC	**vadduwm**	Vector Add Unsigned Word Modulo
VX	10000280			VEC	**vadduws**	Vector Add Unsigned Word Saturate
VX	10000404			VEC	**vand**	Vector AND
VX	10000444			VEC	**vandc**	Vector AND with Complement
VX	10000502			VEC	**vavgsb**	Vector Average Signed Byte
VX	10000542			VEC	**vavgsh**	Vector Average Signed Halfword
VX	10000582			VEC	**vavgsw**	Vector Average Signed Word

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
VX	10000402			VEC	**vavgub**	Vector Average Unsigned Byte
VX	10000442			VEC	**vavguh**	Vector Average Unsigned Halfword
VX	10000482			VEC	**vavguw**	Vector Average Unsigned Word
VX	100003CA			VEC	**vcfpsxws**	Vector Convert from Single-Precision to Signed Fixed-Point Word Saturate
VX	1000038A			VEC	**vcfpuxws**	Vector Convert from Single-Precision to Unsigned Fixed-Point Word Saturate
VX	100003C6			VEC	**vcmpbfp**[.]	Vector Compare Bounds Single-Precision
VX	100000C6			VEC	**vcmpeqfp**[.]	Vector Compare Equal To Single-Precision
VX	10000006			VEC	**vcmpequb**[.]	Vector Compare Equal To Unsigned Byte
VX	10000046			VEC	**vcmpequh**[.]	Vector Compare Equal To Unsigned Halfword
VX	10000086			VEC	**vcmpequw**[.]	Vector Compare Equal To Unsigned Word
VX	100001C6			VEC	**vcmpgefp**[.]	Vector Compare Greater Than or Equal To Single-Precision
VX	100002C6			VEC	**vcmpgtfp**[.]	Vector Compare Greater Than Single-Precision
VX	10000306			VEC	**vcmpgtsb**[.]	Vector Compare Greater Than Signed Byte
VX	10000346			VEC	**vcmpgtsh**[.]	Vector Compare Greater Than Signed Halfword
VX	10000386			VEC	**vcmpgtsw**[.]	Vector Compare Greater Than Signed Word
VX	10000206			VEC	**vcmpgtub**[.]	Vector Compare Greater Than Unsigned Byte
VX	10000246			VEC	**vcmpgtuh**[.]	Vector Compare Greater Than Unsigned Halfword
VX	10000286			VEC	**vcmpgtuw**[.]	Vector Compare Greater Than Unsigned Word
VX	1000034A			VEC	**vcsxwfp**	Vector Convert from Signed Fixed-Point Word to Single-Precision
VX	1000030A			VEC	**vcuxwfp**	Vector Convert from Unsigned Fixed-Point Word to Single-Precision
VX	1000018A			VEC	**vexptefp**	Vector 2 Raised to the Exponent Estimate Floating-Point
VX	100001CA			VEC	**vlogefp**	Vector Log Base 2 Estimate Floating-Point
VA	1000002E			VEC	**vmaddfp**	Vector Multiply-Add Single-Precision
VX	1000040A			VEC	**vmaxfp**	Vector Maximum Single-Precision
VX	10000102			VEC	**vmaxsb**	Vector Maximum Signed Byte
VX	10000142			VEC	**vmaxsh**	Vector Maximum Signed Halfword
VX	10000182			VEC	**vmaxsw**	Vector Maximum Signed Word
VX	10000002			VEC	**vmaxub**	Vector Maximum Unsigned Byte
VX	10000042			VEC	**vmaxuh**	Vector Maximum Unsigned Halfword

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
VX	10000082			VEC	**vmaxuw**	Vector Maximum Unsigned Word
VA	10000020			VEC	**vmhaddshs**	Vector Multiply-High-Add Signed Halfword Saturate
VA	10000021			VEC	**vmhraddshs**	Vector Multiply-High-Round-Add Signed Halfword Saturate
VX	1000044A			VEC	**vminfp**	Vector Minimum Single-Precision
VX	10000302			VEC	**vminsb**	Vector Minimum Signed Byte
VX	10000342			VEC	**vminsh**	Vector Minimum Signed Halfword
VX	10000382			VEC	**vminsw**	Vector Minimum Signed Word
VX	10000202			VEC	**vminub**	Vector Minimum Unsigned Byte
VX	10000242			VEC	**vminuh**	Vector Minimum Unsigned Halfword
VX	10000282			VEC	**vminuw**	Vector Minimum Unsigned Word
VA	10000022			VEC	**vmladduhm**	Vector Multiply-Low-Add Unsigned Halfword Modulo
VX	1000000C			VEC	**vmrghb**	Vector Merge High Byte
VX	1000004C			VEC	**vmrghh**	Vector Merge High Halfword
VX	1000008C			VEC	**vmrghw**	Vector Merge High Word
VX	1000010C			VEC	**vmrglb**	Vector Merge Low Byte
VX	1000014C			VEC	**vmrglh**	Vector Merge Low Halfword
VX	1000018C			VEC	**vmrglw**	Vector Merge Low Word
VA	10000025			VEC	**vmsummbm**	Vector Multiply-Sum Mixed Byte Modulo
VA	10000028			VEC	**vmsumshm**	Vector Multiply-Sum Signed Halfword Modulo
VA	10000029			VEC	**vmsumshs**	Vector Multiply-Sum Signed Halfword Saturate
VA	10000024			VEC	**vmsumubm**	Vector Multiply-Sum Unsigned Byte Modulo
VA	10000026			VEC	**vmsumuhm**	Vector Multiply-Sum Unsigned Halfword Modulo
VA	10000027			VEC	**vmsumuhs**	Vector Multiply-Sum Unsigned Halfword Saturate
VX	10000308			VEC	**vmulesb**	Vector Multiply Even Signed Byte
VX	10000348			VEC	**vmulesh**	Vector Multiply Even Signed Halfword
VX	10000208			VEC	**vmuleub**	Vector Multiply Even Unsigned Byte
VX	10000248			VEC	**vmuleuh**	Vector Multiply Even Unsigned Halfword
VX	10000108			VEC	**vmulosb**	Vector Multiply Odd Signed Byte
VX	10000148			VEC	**vmulosh**	Vector Multiply Odd Signed Halfword
VX	10000008			VEC	**vmuloub**	Vector Multiply Odd Unsigned Byte
VX	10000048			VEC	**vmulouh**	Vector Multiply Odd Unsigned Halfword

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
VA	1000002F			VEC	**vnmsubfp**	Vector Negative Multiply-Subtract Single-Precision
VX	10000504			VEC	**vnor**	Vector NOR
VX	10000484			VEC	**vor**	Vector OR
VA	1000002B			VEC	**vperm**	Vector Permute
VX	1000030E			VEC	**vpkpx**	Vector Pack Pixel
VX	1000018E			VEC	**vpkshss**	Vector Pack Signed Halfword Signed Saturate
VX	1000010E			VEC	**vpkshus**	Vector Pack Signed Halfword Unsigned Saturate
VX	100001CE			VEC	**vpkswss**	Vector Pack Signed Word Signed Saturate
VX	1000014E			VEC	**vpkswus**	Vector Pack Signed Word Unsigned Saturate
VX	1000000E			VEC	**vpkuhum**	Vector Pack Unsigned Halfword Unsigned Modulo
VX	1000008E			VEC	**vpkuhus**	Vector Pack Unsigned Halfword Unsigned Saturate
VX	1000004E			VEC	**vpkuwum**	Vector Pack Unsigned Word Unsigned Modulo
VX	100000CE			VEC	**vpkuwus**	Vector Pack Unsigned Word Unsigned Saturate
VX	1000010A			VEC	**vrefp**	Vector Reciprocal Estimate Single-Precision
VX	100002CA			VEC	**vrfim**	Vector Round to Single-Precision Integer toward Minus Infinity
VX	1000020A			VEC	**vrfin**	Vector Round to Single-Precision Integer Nearest
VX	1000028A			VEC	**vrfip**	Vector Round to Single-Precision Integer toward Positive Infinity
VX	1000024A			VEC	**vrfiz**	Vector Round to Single-Precision Integer toward Zero
VX	10000004			VEC	**vrlb**	Vector Rotate Left Byte
VX	10000044			VEC	**vrlh**	Vector Rotate Left Halfword
VX	10000084			VEC	**vrlw**	Vector Rotate Left Word
VX	1000014A			VEC	**vrsqrtefp**	Vector Reciprocal Square Root Estimate Single-Precision
VA	1000002A			VEC	**vsel**	Vector Select
VX	100001C4			VEC	**vsl**	Vector Shift Left
VX	10000104			VEC	**vslb**	Vector Shift Left Byte
VA	1000002C			VEC	**vsldoi**	Vector Shift Left Double by Octet Immediate
VX	10000144			VEC	**vslh**	Vector Shift Left Halfword
VX	1000040C			VEC	**vslo**	Vector Shift Left by Octet
VX	10000184			VEC	**vslw**	Vector Shift Left Word
VX	1000020C			VEC	**vspltb**	Vector Splat Byte

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
VX	1000024C			VEC	**vsplth**	Vector Splat Halfword
VX	1000030C			VEC	**vspltisb**	Vector Splat Immediate Signed Byte
VX	1000034C			VEC	**vspltish**	Vector Splat Immediate Signed Halfword
VX	1000038C			VEC	**vspltisw**	Vector Splat Immediate Signed Word
VX	1000028C			VEC	**vspltw**	Vector Splat Word
VX	100002C4			VEC	**vsr**	Vector Shift Right
VX	10000304			VEC	**vsrab**	Vector Shift Right Algebraic Word
VX	10000344			VEC	**vsrah**	Vector Shift Right Algebraic Word
VX	10000384			VEC	**vsraw**	Vector Shift Right Algebraic Word
VX	10000204			VEC	**vsrb**	Vector Shift Right Byte
VX	10000244			VEC	**vsrh**	Vector Shift Right Halfword
VX	1000044C			VEC	**vsro**	Vector Shift Right by Octet
VX	10000284			VEC	**vsrw**	Vector Shift Right Word
VX	10000580			VEC	**vsubcuw**	Vector Subtract and Write Carry-Out Unsigned Word
VX	1000004A			VEC	**vsubfp**	Vector Subtract Single-Precision
VX	10000700			VEC	**vsubsbs**	Vector Subtract Signed Byte Saturate
VX	10000740			VEC	**vsubshs**	Vector Subtract Signed Halfword Saturate
VX	10000780			VEC	**vsubsws**	Vector Subtract Signed Word Saturate
VX	10000400			VEC	**vsububm**	Vector Subtract Unsigned Byte Modulo
VX	10000600			VEC	**vsububs**	Vector Subtract Unsigned Byte Saturate
VX	10000440			VEC	**vsubuhm**	Vector Subtract Unsigned Byte Modulo
VX	10000640			VEC	**vsubuhs**	Vector Subtract Unsigned Halfword Saturate
VX	10000480			VEC	**vsubuwm**	Vector Subtract Unsigned Word Modulo
VX	10000680			VEC	**vsubuws**	Vector Subtract Unsigned Word Saturate
VX	10000688			VEC	**vsum2sws**	Vector Sum across Half Signed Word Saturate
VX	10000708			VEC	**vsum4sbs**	Vector Sum across Quarter Signed Byte Saturate
VX	10000648			VEC	**vsum4shs**	Vector Sum across Quarter Signed Halfword Saturate
VX	10000608			VEC	**vsum4ubs**	Vector Sum across Quarter Unsigned Byte Saturate
VX	10000788			VEC	**vsumsws**	Vector Sum across Signed Word Saturate
VX	1000034E			VEC	**vupkhpx**	Vector Unpack High Pixel
VX	1000020E			VEC	**vupkhsb**	Vector Unpack High Signed Byte
VX	1000024E			VEC	**vupkhsh**	Vector Unpack High Signed Halfword

Table B-2. VLE Instruction Set Sorted by Mnemonic (continued)

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
VX	100003CE			VEC	**vupklpx**	Vector Unpack Low Pixel
VX	1000028E			VEC	**vupklsb**	Vector Unpack Low Signed Byte
VX	100002CE			VEC	**vupklsh**	Vector Unpack Low Signed Halfword
VX	100004C4			VEC	**vxor**	Vector XOR
X	7C00007C			WT	**wait**	Wait
X	7C000106		P	E	**wrtee**	Write MSR External Enable
X	7C000146		P	E	**wrteei**	Write MSR External Enable Immediate
D	7C000278	SR		B	**xor**[.]	XOR

[1] For 16-bit instructions, this column represents the 16-bit hexadecimal instruction encoding with the opcode and extended opcode in the corresponding fields in the instruction, and with 0s in bit positions that are not opcode bits; dashes are used following the opcode to indicate the form is a 16-bit instruction. For 32-bit instructions, this column represents the 32-bit hexadecimal instruction encoding with the opcode and extended opcode in the corresponding fields in the instruction, and with 0s in bit positions that are not opcode bits.

[2] See the key to the mode dependency and privilege columns in Table B-1.

B.2 VLE Instruction Set Sorted by Opcode

Table B-3 lists the instructions available in VLE mode in the PowerPC Architecture, in order by opcode. Opcodes that are not defined below are treated as illegal by VLE.

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
C	0000----			VLE	**se_illegal**	Illegal
C	0001----			VLE	**se_isync**	Instruction Synchronize
C	0002----			VLE	**se_sc**	System Call
C	0004----			VLE	**se_blr**	Branch To Link Register [and Link]
C	0006----			VLE	**se_bctr**	Branch To Count Register [and Link]
C	0008----		P	VLE	**se_rfi**	Return from Interrupt
C	0009----		P	VLE	**se_rfci**	Return From Critical Interrupt
C	000A----		P	VLE	**se_rfdi**	Return From Debug Interrupt
C	000B----		P	VLE	**se_rfmci**	Return From Machine Check Interrupt
R	0020----			VLE	**se_not**	NOT Short Form
R	0030----			VLE	**se_neg**	Negate Short Form
R	0080----			VLE	**se_mflr**	Move From Link Register
R	0090----			VLE	**se_mtlr**	Move To Link Register

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
R	00A0----			VLE	**se_mfctr**	Move From Count Register
R	00B0----			VLE	**se_mtctr**	Move To Count Register
R	00C0----			VLE	**se_extzb**	Extend Zero Byte
R	00D0----			VLE	**se_extsb**	Extend Sign Byte Short Form
R	00E0----			VLE	**se_extzh**	Extend Zero Halfword
R	00F0----			VLE	**se_extsh**	Extend Sign Halfword Short Form
RR	0100----			VLE	**se_mr**	Move Register
RR	0200----			VLE	**se_mtar**	Move To Alternate Register
RR	0300----			VLE	**se_mfar**	Move from Alternate Register
RR	0400----			VLE	**se_add**	Add Short Form
RR	0500----			VLE	**se_mullw**	Multiply Low Word Short Form
RR	0600----			VLE	**se_sub**	Subtract
RR	0700----			VLE	**se_subf**	Subtract From Short Form
RR	0C00----			VLE	**se_cmp**	Compare Word
RR	0D00----			VLE	**se_cmpl**	Compare Logical Word
RR	0E00----			VLE	**se_cmph**	Compare Halfword Short Form
RR	0F00----			VLE	**se_cmphl**	Compare Halfword Logical Short Form
VX	10000000			VEC	**vaddubm**	Vector Add Unsigned Byte Modulo
VX	10000002			VEC	**vmaxub**	Vector Maximum Unsigned Byte
VX	10000004			VEC	**vrlb**	Vector Rotate Left Byte
VX	10000006			VEC	**vcmpequb**[.]	Vector Compare Equal To Unsigned Byte
VX	10000008			VEC	**vmuloub**	Vector Multiply Odd Unsigned Byte
VX	1000000A			VEC	**vaddfp**	Vector Add Floating-Point
VX	1000000C			VEC	**vmrghb**	Vector Merge High Byte
VX	1000000E			VEC	**vpkuhum**	Vector Pack Unsigned Halfword Unsigned Modulo
X	10000010	SR		LIM	**mulhhwu**[**o**][.]	Multiply High Halfword to Word Unsigned
X	10000018	SR		LIM	**machhwu**[**o**][.]	Multiply Accumulate High Halfword to Word Modulo Unsigned
VA	10000020			VEC	**vmhaddshs**	Vector Multiply-High-Add Signed Halfword Saturate
VA	10000021			VEC	**vmhraddshs**	Vector Multiply-High-Round-Add Signed Halfword Saturate
VA	10000022			VEC	**vmladduhm**	Vector Multiply-Low-Add Unsigned Halfword Modulo
VA	10000024			VEC	**vmsumubm**	Vector Multiply-Sum Unsigned Byte Modulo

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
VA	10000025			VEC	**vmsummbm**	Vector Multiply-Sum Mixed Byte Modulo
VA	10000026			VEC	**vmsumuhm**	Vector Multiply-Sum Unsigned Halfword Modulo
VA	10000027			VEC	**vmsumuhs**	Vector Multiply-Sum Unsigned Halfword Saturate
VA	10000028			VEC	**vmsumshm**	Vector Multiply-Sum Signed Halfword Modulo
VA	10000029			VEC	**vmsumshs**	Vector Multiply-Sum Signed Halfword Saturate
VA	1000002A			VEC	**vsel**	Vector Select
VA	1000002B			VEC	**vperm**	Vector Permute
VA	1000002C			VEC	**vsldoi**	Vector Shift Left Double by Octet Immediate
VA	1000002E			VEC	**vmaddfp**	Vector Multiply-Add Single-Precision
VA	1000002F			VEC	**vnmsubfp**	Vector Negative Multiply-Subtract Single-Precision
VX	10000040			VEC	**vadduhm**	Vector Add Unsigned Halfword Modulo
VX	10000042			VEC	**vmaxuh**	Vector Maximum Unsigned Halfword
VX	10000044			VEC	**vrlh**	Vector Rotate Left Halfword
VX	10000046			VEC	**vcmpequh**[.]	Vector Compare Equal To Unsigned Halfword
VX	10000048			VEC	**vmulouh**	Vector Multiply Odd Unsigned Halfword
VX	1000004A			VEC	**vsubfp**	Vector Subtract Single-Precision
VX	1000004C			VEC	**vmrghh**	Vector Merge High Halfword
VX	1000004E			VEC	**vpkuwum**	Vector Pack Unsigned Word Unsigned Modulo
X	10000050	SR		LIM	**mulhhw**[**o**][.]	Multiply High Halfword to Word Signed
X	10000058	SR		LIM	**machhw**[**o**][.]	Multiply Accumulate High Halfword to Word Modulo Signed
X	1000005C	SR		LIM	**nmachhw**[**o**][.]	Negative Multiply Accumulate High Halfword to Word Modulo Signed
VX	10000080			VEC	**vadduwm**	Vector Add Unsigned Word Modulo
VX	10000082			VEC	**vmaxuw**	Vector Maximum Unsigned Word
VX	10000084			VEC	**vrlw**	Vector Rotate Left Word
VX	10000086			VEC	**vcmpequw**[.]	Vector Compare Equal To Unsigned Word
VX	1000008C			VEC	**vmrghw**	Vector Merge High Word
VX	1000008E			VEC	**vpkuhus**	Vector Pack Unsigned Halfword Unsigned Saturate
X	10000098	SR		LIM	**machhwsu**[**o**][.]	Multiply Accumulate High Halfword to Word Saturate Unsigned
VX	100000C6			VEC	**vcmpeqfp**[.]	Vector Compare Equal To Single-Precision
VX	100000CE			VEC	**vpkuwus**	Vector Pack Unsigned Word Unsigned Saturate

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
X	100000D8	SR		LIM	**machhws**[**o**][**.**]	Multiply Accumulate High Halfword to Word Saturate Signed
X	100000DC	SR		LIM	**nmachhws**[**o**][**.**]	Negative Multiply Accumulate High Halfword to Word Saturate Signed
VX	10000102			VEC	**vmaxsb**	Vector Maximum Signed Byte
VX	10000104			VEC	**vslb**	Vector Shift Left Byte
VX	10000108			VEC	**vmulosb**	Vector Multiply Odd Signed Byte
VX	1000010A			VEC	**vrefp**	Vector Reciprocal Estimate Single-Precision
VX	1000010C			VEC	**vmrglb**	Vector Merge Low Byte
VX	1000010E			VEC	**vpkshus**	Vector Pack Signed Halfword Unsigned Saturate
X	10000110	SR		LIM	**mulchwu**[**o**][**.**]	Multiply Cross Halfword to Word Unsigned
X	10000118	SR		LIM	**macchwu**[**o**][**.**]	Multiply Accumulate Cross Halfword to Word Modulo Unsigned
VX	10000142			VEC	**vmaxsh**	Vector Maximum Signed Halfword
VX	10000144			VEC	**vslh**	Vector Shift Left Halfword
VX	10000148			VEC	**vmulosh**	Vector Multiply Odd Signed Halfword
VX	1000014A			VEC	**vrsqrtefp**	Vector Reciprocal Square Root Estimate Single-Precision
VX	1000014C			VEC	**vmrglh**	Vector Merge Low Halfword
VX	1000014E			VEC	**vpkswus**	Vector Pack Signed Word Unsigned Saturate
X	10000150	SR		LIM	**mulchw**[**o**][**.**]	Multiply Cross Halfword to Word Signed
X	10000158	SR		LIM	**macchw**[**o**][**.**]	Multiply Accumulate Cross Halfword to Word Modulo Signed
X	1000015C	SR		LIM	**nmacchw**[**o**][**.**]	Negative Multiply Accumulate Cross Halfword to Word Modulo Signed
VX	10000180			VEC	**vaddcuw**	Vector Add Carryout Unsigned Word
VX	10000182			VEC	**vmaxsw**	Vector Maximum Signed Word
VX	10000184			VEC	**vslw**	Vector Shift Left Word
VX	1000018A			VEC	**vexptefp**	Vector 2 Raised to the Exponent Estimate Floating-Point
VX	1000018C			VEC	**vmrglw**	Vector Merge Low Word
VX	1000018E			VEC	**vpkshss**	Vector Pack Signed Halfword Signed Saturate
X	10000198	SR		LIM	**macchwsu**[**o**][**.**]	Multiply Accumulate Cross Halfword to Word Saturate Unsigned
VX	100001C4			VEC	**vsl**	Vector Shift Left

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
VX	100001C6			VEC	**vcmpgefp**[.]	Vector Compare Greater Than or Equal To Single-Precision
VX	100001CA			VEC	**vlogefp**	Vector Log Base 2 Estimate Floating-Point
VX	100001CE			VEC	**vpkswss**	Vector Pack Signed Word Signed Saturate
X	100001D8	SR		LIM	**macchws**[**o**][.]	Multiply Accumulate Cross Halfword to Word Saturate Signed
X	100001DC	SR		LIM	**nmacchws**[**o**][.]	Negative Multiply Accumulate Cross Halfword to Word Saturate Signed
EVX	10000200			SP	**evaddw**	Vector Add Word
VX	10000200			VEC	**vaddubs**	Vector Add Unsigned Byte Saturate
EVX	10000202			SP	**evaddiw**	Vector Add Immediate Word
VX	10000202			VEC	**vminub**	Vector Minimum Unsigned Byte
EVX	10000204			SP	**evsubfw**	Vector Subtract from Word
VX	10000204			VEC	**vsrb**	Vector Shift Right Byte
EVX	10000206			SP	**evsubifw**	Vector Subtract Immediate from Word
VX	10000206			VEC	**vcmpgtub**[.]	Vector Compare Greater Than Unsigned Byte
EVX	10000208			SP	**evabs**	Vector Absolute Value
VX	10000208			VEC	**vmuleub**	Vector Multiply Even Unsigned Byte
EVX	10000209			SP	**evneg**	Vector Negate
EVX	1000020A			SP	**evextsb**	Vector Extend Sign Byte
VX	1000020A			VEC	**vrfin**	Vector Round to Single-Precision Integer Nearest
EVX	1000020B			SP	**evextsh**	Vector Extend Sign Halfword
EVX	1000020C			SP	**evrndw**	Vector Round Word
VX	1000020C			VEC	**vspltb**	Vector Splat Byte
EVX	1000020D			SP	**evcntlzw**	Vector Count Leading Zeros Bits Word
EVX	1000020E			SP	**evcntlsw**	Vector Count Leading Sign Bits Word
VX	1000020E			VEC	**vupkhsb**	Vector Unpack High Signed Byte
EVX	1000020F			SP	**brinc**	Bit Reverse Increment
EVX	10000211			SP	**evand**	Vector AND
EVX	10000212			SP	**evandc**	Vector AND with Complement
EVX	10000216			SP	**evxor**	Vector XOR
EVX	10000217			SP	**evor**	Vector OR
EVX	10000218			SP	**evnor**	Vector NOR

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	10000219			SP	**eveqv**	Vector Equivalent
EVX	1000021B			SP	**evorc**	Vector OR with Complement
EVX	1000021E			SP	**evnand**	Vector NAND
EVX	10000220			SP	**evsrwu**	Vector Shift Right Word Unsigned
EVX	10000221			SP	**evsrws**	Vector Shift Right Word Signed
EVX	10000222			SP	**evsrwiu**	Vector Shift Right Word Immediate Unsigned
EVX	10000223			SP	**evsrwis**	Vector Shift Right Word Immediate Signed
EVX	10000224			SP	**evslw**	Vector Shift Left Word
EVX	10000226			SP	**evslwi**	Vector Shift Left Word Immediate
EVX	10000228			SP	**evrlw**	Vector Rotate Left Word
EVX	10000229			SP	**evsplati**	Vector Splat Immediate
EVX	1000022A			SP	**evrlwi**	Vector Rotate Left Word Immediate
EVX	1000022B			SP	**evsplatfi**	Vector Splat Fractional Immediate
EVX	1000022C			SP	**evmergehi**	Vector Merge High
EVX	1000022D			SP	**evmergelo**	Vector Merge Low
EVX	1000022E			SP	**evmergehilo**	Vector Merge High/Low
EVX	1000022F			SP	**evmergelohi**	Vector Merge Low/High
EVX	10000230			SP	**evcmpgtu**	Vector Compare Greater Than Unsigned
EVX	10000231			SP	**evcmpgts**	Vector Compare Greater Than Signed
EVX	10000232			SP	**evcmpltu**	Vector Compare Less Than Unsigned
EVX	10000233			SP	**evcmplts**	Vector Compare Less Than Signed
EVX	10000234			SP	**evcmpeq**	Vector Compare Equal
VX	10000240			VEC	**vadduhs**	Vector Add Unsigned Halfword Saturate
VX	10000242			VEC	**vminuh**	Vector Minimum Unsigned Halfword
VX	10000244			VEC	**vsrh**	Vector Shift Right Halfword
VX	10000246			VEC	**vcmpgtuh**[.]	Vector Compare Greater Than Unsigned Halfword
VX	10000248			VEC	**vmuleuh**	Vector Multiply Even Unsigned Halfword
VX	1000024A			VEC	**vrfiz**	Vector Round to Single-Precision Integer toward Zero
VX	1000024C			VEC	**vsplth**	Vector Splat Halfword
VX	1000024E			VEC	**vupkhsh**	Vector Unpack High Signed Halfword
EVSEL	10000278			SP	**evsel**	Vector Select
EVX	10000280			SP.FV	**evfsadd**	Vector Floating-Point Single-Precision Add

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
VX	10000280			VEC	**vadduws**	Vector Add Unsigned Word Saturate
EVX	10000281			SP.FV	**evfssub**	Vector Floating-Point Single-Precision Subtract
VX	10000282			VEC	**vminuw**	Vector Minimum Unsigned Word
EVX	10000284			SP.FV	**evfsabs**	Vector Floating-Point Single-Precision Absolute Value
VX	10000284			VEC	**vsrw**	Vector Shift Right Word
EVX	10000285			SP.FV	**evfsnabs**	Vector Floating-Point Single-Precision Negative Absolute Value
EVX	10000286			SP.FV	**evfsneg**	Vector Floating-Point Single-Precision Negate
VX	10000286			VEC	**vcmpgtuw**[.]	Vector Compare Greater Than Unsigned Word
EVX	10000288			SP.FV	**evfsmul**	Vector Floating-Point Single-Precision Multiply
EVX	10000289			SP.FV	**evfsdiv**	Vector Floating-Point Single-Precision Divide
VX	1000028A			VEC	**vrfip**	Vector Round to Single-Precision Integer toward Positive Infinity
EVX	1000028C			SP.FV	**evfscmpgt**	Vector Floating-Point Single-Precision Compare Greater Than
VX	1000028C			VEC	**vspltw**	Vector Splat Word
EVX	1000028D			SP.FV	**evfscmplt**	Vector Floating-Point Single-Precision Compare Less Than
EVX	1000028E			SP.FV	**evfscmpeq**	Vector Floating-Point Single-Precision Compare Equal
VX	1000028E			VEC	**vupklsb**	Vector Unpack Low Signed Byte
EVX	10000290			SP.FV	**evfscfui**	Vector Convert Floating-Point Single-Precision from Unsigned Integer
EVX	10000291			SP.FV	**evfscfsi**	Vector Convert Floating-Point Single-Precision from Signed Integer
EVX	10000292			SP.FV	**evfscfuf**	Vector Convert Floating-Point Single-Precision from Unsigned Fraction
EVX	10000293			SP.FV	**evfscfsf**	Vector Convert Floating-Point Single-Precision from Signed Fraction
EVX	10000294			SP.FV	**evfsctui**	Vector Convert Floating-Point Single-Precision to Unsigned Integer
EVX	10000295			SP.FV	**evfsctsi**	Vector Convert Floating-Point Single-Precision to Signed Integer
EVX	10000296			SP.FV	**evfsctuf**	Vector Convert Floating-Point Single-Precision to Unsigned Fraction
EVX	10000297			SP.FV	**evfsctsf**	Vector Convert Floating-Point Single-Precision to Signed Fraction

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	10000298			SP.FV	**evfsctuiz**	Vector Convert Floating-Point Single-Precision to Unsigned Integer with Round Towards Zero
EVX	1000029A			SP.FV	**evfsctsiz**	Vector Convert Floating-Point Single-Precision to Signed Integer with Round Towards Zero
EVX	1000029C			SP.FV	**evfststgt**	Vector Floating-Point Single-Precision Test Greater Than
EVX	1000029D			SP.FV	**evfststlt**	Vector Floating-Point Single-Precision Test Less Than
EVX	1000029E			SP.FV	**evfststeq**	Vector Floating-Point Single-Precision Test Equal
VX	100002C4			VEC	**vsr**	Vector Shift Right
VX	100002C6			VEC	**vcmpgtfp**[.]	Vector Compare Greater Than Single-Precision
VX	100002CA			VEC	**vrfim**	Vector Round to Single-Precision Integer toward Minus Infinity
VX	100002CE			VEC	**vupklsh**	Vector Unpack Low Signed Halfword
EVX	100002CF			SP.FD	**efscfd**	Floating-Point Single-Precision Convert from Double-Precision
EVX	100002E0			SP.FD	**efdadd**	Floating-Point Double-Precision Add
EVX	100002E0			SP.FS	**efsadd**	Floating-Point Single-Precision Add
EVX	100002E1			SP.FD	**efdsub**	Floating-Point Double-Precision Subtract
EVX	100002E1			SP.FS	**efssub**	Floating-Point Single-Precision Subtract
EVX	100002E2			SP.FD	**efdcfuid**	Convert Floating-Point Double-Precision from Unsigned Integer Doubleword
EVX	100002E2			SP.FS	**efscfuid**	Convert Floating-Point Single-Precision from Unsigned Integer Doubleword
EVX	100002E3			SP.FD	**efdcfsid**	Convert Floating-Point Double-Precision from Signed Integer Doubleword
EVX	100002E3			SP.FS	**efscfsid**	Convert Floating-Point Single-Precision from Signed Integer Doubleword
EVX	100002E4			SP.FD	**efdabs**	Floating-Point Double-Precision Absolute Value
EVX	100002E4			SP.FS	**efsabs**	Floating-Point Single-Precision Absolute Value
EVX	100002E5			SP.FD	**efdnabs**	Floating-Point Double-Precision Negative Absolute Value
EVX	100002E5			SP.FS	**efsnabs**	Floating-Point Single-Precision Negative Absolute Value
EVX	100002E6			SP.FD	**efdneg**	Floating-Point Double-Precision Negate
EVX	100002E6			SP.FS	**efsneg**	Floating-Point Single-Precision Negate
EVX	100002E8			SP.FD	**efdmul**	Floating-Point Double-Precision Multiply
EVX	100002E8			SP.FS	**efsmul**	Floating-Point Single-Precision Multiply
EVX	100002E9			SP.FD	**efddiv**	Floating-Point Double-Precision Divide

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	100002E9			SP.FS	**efsdiv**	Floating-Point Single-Precision Divide
EVX	100002EA			SP.FD	**efdctuidz**	Convert Floating-Point Double-Precision to Unsigned Integer Doubleword with Round Towards Zero
EVX	100002EA			SP.FS	**efsctuidz**	Convert Floating-Point Single-Precision to Unsigned Integer Doubleword with Round Towards Zero
EVX	100002EB			SP.FD	**efdctsidz**	Convert Floating-Point Double-Precision to Signed Integer Doubleword with Round Towards Zero
EVX	100002EB			SP.FS	**efsctsidz**	Convert Floating-Point Single-Precision to Signed Integer Doubleword with Round Towards Zero
EVX	100002EC			SP.FD	**efdcmpgt**	Floating-Point Double-Precision Compare Greater Than
EVX	100002EC			SP.FS	**efscmpgt**	Floating-Point Single-Precision Compare Greater Than
EVX	100002ED			SP.FD	**efdcmplt**	Floating-Point Double-Precision Compare Less Than
EVX	100002ED			SP.FS	**efscmplt**	Floating-Point Single-Precision Compare Less Than
EVX	100002EE			SP.FD	**efdcmpeq**	Floating-Point Double-Precision Compare Equal
EVX	100002EE			SP.FS	**efscmpeq**	Floating-Point Single-Precision Compare Equal
EVX	100002EF			SP.FD	**efdcfs**	Floating-Point Double-Precision Convert from Single-Precision
EVX	100002F0			SP.FD	**efdcfui**	Convert Floating-Point Double-Precision from Unsigned Integer
EVX	100002F0			SP.FS	**efscfui**	Convert Floating-Point Single-Precision from Unsigned Integer
EVX	100002F1			SP.FD	**efdcfsi**	Convert Floating-Point Double-Precision from Signed Integer
EVX	100002F1			SP.FS	**efscfsi**	Convert Floating-Point Single-Precision from Signed Integer
EVX	100002F2			SP.FD	**efdcfuf**	Convert Floating-Point Double-Precision from Unsigned Fraction
EVX	100002F2			SP.FS	**efscfuf**	Convert Floating-Point Single-Precision from Unsigned Fraction
EVX	100002F3			SP.FD	**efdcfsf**	Convert Floating-Point Double-Precision from Signed Fraction
EVX	100002F3			SP.FS	**efscfsf**	Convert Floating-Point Single-Precision from Signed Fraction
EVX	100002F4			SP.FD	**efdctui**	Convert Floating-Point Double-Precision to Unsigned Integer
EVX	100002F4			SP.FS	**efsctui**	Convert Floating-Point Single-Precision to Unsigned Integer

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	100002F5			SP.FD	**efdctsi**	Convert Floating-Point Double-Precision to Signed Integer
EVX	100002F5			SP.FS	**efsctsi**	Convert Floating-Point Single-Precision to Signed Integer
EVX	100002F6			SP.FD	**efdctuf**	Convert Floating-Point Double-Precision to Unsigned Fraction
EVX	100002F6			SP.FS	**efsctuf**	Convert Floating-Point Single-Precision to Unsigned Fraction
EVX	100002F7			SP.FD	**efdctsf**	Convert Floating-Point Double-Precision to Signed Fraction
EVX	100002F7			SP.FS	**efsctsf**	Convert Floating-Point Single-Precision to Signed Fraction
EVX	100002F8			SP.FD	**efdctuiz**	Convert Floating-Point Double-Precision to Unsigned Integer with Round Towards Zero
EVX	100002F8			SP.FS	**efsctuiz**	Convert Floating-Point Single-Precision to Unsigned Integer with Round Towards Zero
EVX	100002FA			SP.FD	**efdctsiz**	Convert Floating-Point Double-Precision to Signed Integer with Round Towards Zero
EVX	100002FA			SP.FS	**efsctsiz**	Convert Floating-Point Single-Precision to Signed Integer with Round Towards Zero
EVX	100002FC			SP.FD	**efdtstgt**	Floating-Point Double-Precision Test Greater Than
EVX	100002FC			SP.FS	**efststgt**	Floating-Point Single-Precision Test Greater Than
EVX	100002FD			SP.FD	**efdtstlt**	Floating-Point Double-Precision Test Less Than
EVX	100002FD			SP.FS	**efststlt**	Floating-Point Single-Precision Test Less Than
EVX	100002FE			SP.FD	**efdtsteq**	Floating-Point Double-Precision Test Equal
EVX	100002FE			SP.FS	**efststeq**	Floating-Point Single-Precision Test Equal
EVX	10000300			SP	**evlddx**	Vector Load Doubleword into Doubleword Indexed
VX	10000300			VEC	**vaddsbs**	Vector Add Signed Byte Saturate
EVX	10000301			SP	**evldd**	Vector Load Doubleword into Doubleword
EVX	10000302			SP	**evldwx**	Vector Load Doubleword into 2 Words Indexed
VX	10000302			VEC	**vminsb**	Vector Minimum Signed Byte
EVX	10000303			SP	**evldw**	Vector Load Doubleword into 2 Words
EVX	10000304			SP	**evldhx**	Vector Load Doubleword into 4 Halfwords Indexed
VX	10000304			VEC	**vsrab**	Vector Shift Right Algebraic Word
EVX	10000305			SP	**evldh**	Vector Load Doubleword into 4 Halfwords
VX	10000306			VEC	**vcmpgtsb**[.]	Vector Compare Greater Than Signed Byte

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	10000308			SP	**evlhhesplatx**	Vector Load Halfword into Halfwords Even and Splat Indexed
VX	10000308			VEC	**vmulesb**	Vector Multiply Even Signed Byte
EVX	10000309			SP	**evlhhesplat**	Vector Load Halfword into Halfwords Even and Splat
VX	1000030A			VEC	**vcuxwfp**	Vector Convert from Unsigned Fixed-Point Word to Single-Precision
EVX	1000030C			SP	**evlhhousplatx**	Vector Load Halfword into Halfwords Odd Unsigned and Splat Indexed
VX	1000030C			VEC	**vspltisb**	Vector Splat Immediate Signed Byte
EVX	1000030D			SP	**evlhhousplat**	Vector Load Halfword into Halfwords Odd Unsigned and Splat
EVX	1000030E			SP	**evlhhossplatx**	Vector Load Halfword into Halfwords Odd Signed and Splat Indexed
VX	1000030E			VEC	**vpkpx**	Vector Pack Pixel
EVX	1000030F			SP	**evlhhossplat**	Vector Load Halfword into Halfwords Odd and Splat
EVX	10000310			SP	**evlwhex**	Vector Load Word into Two Halfwords Even Indexed
EVX	10000311			SP	**evlwhe**	Vector Load Word into Two Halfwords Even
EVX	10000314			SP	**evlwhoux**	Vector Load Word into Two Halfwords Odd Unsigned Indexed
EVX	10000315			SP	**evlwhou**	Vector Load Word into Two Halfwords Odd Unsigned
EVX	10000316			SP	**evlwhosx**	Vector Load Word into Two Halfwords Odd Signed Indexed
EVX	10000317			SP	**evlwhos**	Vector Load Word into Two Halfwords Odd Signed
EVX	10000318			SP	**evlwwsplatx**	Vector Load Word into Word and Splat Indexed
X	10000318	SR		LIM	**maclhwu**[**o**][.]	Multiply Accumulate Low Halfword to Word Modulo Unsigned
EVX	10000319			SP	**evlwwsplat**	Vector Load Word into Word and Splat
EVX	1000031C			SP	**evlwhsplatx**	Vector Load Word into Two Halfwords and Splat Indexed
EVX	1000031D			SP	**evlwhsplat**	Vector Load Word into Two Halfwords and Splat
EVX	10000320			SP	**evstddx**	Vector Store Doubleword of Doubleword Indexed
EVX	10000321			SP	**evstdd**	Vector Store Doubleword of Doubleword
EVX	10000322			SP	**evstdwx**	Vector Store Doubleword of Two Words Indexed
EVX	10000323			SP	**evstdw**	Vector Store Doubleword of Two Words
EVX	10000324			SP	**evstdhx**	Vector Store Doubleword of Four Halfwords Indexed
EVX	10000325			SP	**evstdh**	Vector Store Doubleword of Four Halfwords

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	10000330			SP	**evstwhex**	Vector Store Word of Two Halfwords from Even Indexed
EVX	10000331			SP	**evstwhe**	Vector Store Word of Two Halfwords from Even
EVX	10000334			SP	**evstwhox**	Vector Store Word of Two Halfwords from Odd Indexed
EVX	10000335			SP	**evstwho**	Vector Store Word of Two Halfwords from Odd
EVX	10000338			SP	**evstwwex**	Vector Store Word of Word from Even Indexed
EVX	10000339			SP	**evstwwe**	Vector Store Word of Word from Even
EVX	1000033C			SP	**evstwwox**	Vector Store Word of Word from Odd Indexed
EVX	1000033D			SP	**evstwwo**	Vector Store Word of Word from Odd
VX	10000340			VEC	**vaddshs**	Vector Add Signed Halfword Saturate
VX	10000342			VEC	**vminsh**	Vector Minimum Signed Halfword
VX	10000344			VEC	**vsrah**	Vector Shift Right Algebraic Word
VX	10000346			VEC	**vcmpgtsh**[.]	Vector Compare Greater Than Signed Halfword
VX	10000348			VEC	**vmulesh**	Vector Multiply Even Signed Halfword
VX	1000034A			VEC	**vcsxwfp**	Vector Convert from Signed Fixed-Point Word to Single-Precision
VX	1000034C			VEC	**vspltish**	Vector Splat Immediate Signed Halfword
VX	1000034E			VEC	**vupkhpx**	Vector Unpack High Pixel
X	10000358	SR		LIM	**maclhw**[**o**][.]	Multiply Accumulate Low Halfword to Word Modulo Signed
X	1000035C	SR		LIM	**nmaclhw**[**o**][.]	Negative Multiply Accumulate Low Halfword to Word Modulo Signed
VX	10000380			VEC	**vaddsws**	Vector Add Signed Word Saturate
VX	10000382			VEC	**vminsw**	Vector Minimum Signed Word
VX	10000384			VEC	**vsraw**	Vector Shift Right Algebraic Word
VX	10000386			VEC	**vcmpgtsw**[.]	Vector Compare Greater Than Signed Word
VX	1000038A			VEC	**vcfpuxws**	Vector Convert from Single-Precision to Unsigned Fixed-Point Word Saturate
VX	1000038C			VEC	**vspltisw**	Vector Splat Immediate Signed Word
X	10000398	SR		LIM	**maclhwsu**[**o**][.]	Multiply Accumulate Low Halfword to Word Saturate Unsigned
VX	100003C6			VEC	**vcmpbfp**[.]	Vector Compare Bounds Single-Precision
VX	100003CA			VEC	**vcfpsxws**	Vector Convert from Single-Precision to Signed Fixed-Point Word Saturate
VX	100003CE			VEC	**vupklpx**	Vector Unpack Low Pixel

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
X	100003D8	SR		LIM	**maclhws**[**o**][**.**]	Multiply Accumulate Low Halfword to Word Saturate Signed
X	100003DC	SR		LIM	**nmaclhws**[**o**][**.**]	Negative Multiply Accumulate Low Halfword to Word Saturate Signed
VX	10000400			VEC	**vsububm**	Vector Subtract Unsigned Byte Modulo
VX	10000402			VEC	**vavgub**	Vector Average Unsigned Byte
EVX	10000403			SP	**evmhessf**	Vector Multiply Halfwords, Even, Signed, Saturate, Fractional
VX	10000404			VEC	**vand**	Vector AND
EVX	10000407			SP	**evmhossf**	Vector Multiply Halfwords, Odd, Signed, Fractional
EVX	10000408			SP	**evmheumi**	Vector Multiply Halfwords, Even, Unsigned, Modulo, Integer
EVX	10000409			SP	**evmhesmi**	Vector Multiply Halfwords, Even, Signed, Modulo, Integer
VX	1000040A			VEC	**vmaxfp**	Vector Maximum Single-Precision
EVX	1000040B			SP	**evmhesmf**	Vector Multiply Halfwords, Even, Signed, Modulo, Fractional
EVX	1000040C			SP	**evmhoumi**	Vector Multiply Halfwords, Odd, Unsigned, Modulo, Integer
VX	1000040C			VEC	**vslo**	Vector Shift Left by Octet
EVX	1000040D			SP	**evmhosmi**	Vector Multiply Halfwords, Odd, Signed, Modulo, Integer
EVX	1000040F			SP	**evmhosmf**	Vector Multiply Halfwords, Odd, Signed, Modulo, Fractional
EVX	10000423			SP	**evmhessfa**	Vector Multiply Halfwords, Even, Signed, Saturate, Fractional to Accumulator
EVX	10000427			SP	**evmhossfa**	Vector Multiply Halfwords, Odd, Signed, Fractional to Accumulator
EVX	10000428			SP	**evmheumia**	Vector Multiply Halfwords, Even, Unsigned, Modulo, Integer to Accumulator
EVX	10000429			SP	**evmhesmia**	Vector Multiply Halfwords, Even, Signed, Modulo, Integer to Accumulator
EVX	1000042B			SP	**evmhesmfa**	Vector Multiply Halfwords, Even, Signed, Modulo, Fractional to Accumulate
EVX	1000042C			SP	**evmhoumia**	Vector Multiply Halfwords, Odd, Unsigned, Modulo, Integer to Accumulator
EVX	1000042D			SP	**evmhosmia**	Vector Multiply Halfwords, Odd, Signed, Modulo, Integer to Accumulator
EVX	1000042F			SP	**evmhosmfa**	Vector Multiply Halfwords, Odd, Signed, Modulo, Fractional to Accumulator

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
VX	10000440			VEC	**vsubuhm**	Vector Subtract Unsigned Byte Modulo
VX	10000442			VEC	**vavguh**	Vector Average Unsigned Halfword
VX	10000444			VEC	**vandc**	Vector AND with Complement
EVX	10000447			SP	**evmwhssf**	Vector Multiply Word High Signed, Fractional
EVX	10000448			SP	**evmwlumi**	Vector Multiply Word Low Unsigned, Modulo, Integer
VX	1000044A			VEC	**vminfp**	Vector Minimum Single-Precision
EVX	1000044C			SP	**evmwhumi**	Vector Multiply Word High Unsigned, Modulo, Integer
VX	1000044C			VEC	**vsro**	Vector Shift Right by Octet
EVX	1000044D			SP	**evmwhsmi**	Vector Multiply Word High Signed, Modulo, Integer
EVX	1000044F			SP	**evmwhsmf**	Vector Multiply Word High Signed, Modulo, Fractional
EVX	10000453			SP	**evmwssf**	Vector Multiply Word Signed, Saturate, Fractional
EVX	10000458			SP	**evmwumi**	Vector Multiply Word Unsigned, Modulo, Integer
EVX	10000459			SP	**evmwsmi**	Vector Multiply Word Signed, Modulo, Integer
EVX	1000045B			SP	**evmwsmf**	Vector Multiply Word Signed, Modulo, Fractional
EVX	10000467			SP	**evmwhssfa**	Vector Multiply Word High Signed, Fractional to Accumulator
EVX	10000468			SP	**evmwlumia**	Vector Multiply Word Low Unsigned, Modulo, Integer to Accumulator
EVX	1000046C			SP	**evmwhumia**	Vector Multiply Word High Unsigned, Modulo, Integer to Accumulator
EVX	1000046D			SP	**evmwhsmia**	Vector Multiply Word High Signed, Modulo, Integer to Accumulator
EVX	1000046F			SP	**evmwhsmfa**	Vector Multiply Word High Signed, Modulo, Fractional to Accumulator
EVX	10000473			SP	**evmwssfa**	Vector Multiply Word Signed, Saturate, Fractional to Accumulator
EVX	10000478			SP	**evmwumia**	Vector Multiply Word Unsigned, Modulo, Integer to Accumulator
EVX	10000479			SP	**evmwsmia**	Vector Multiply Word Signed, Modulo, Integer to Accumulator
EVX	1000047B			SP	**evmwsmfa**	Vector Multiply Word Signed, Modulo, Fractional to Accumulator
VX	10000480			VEC	**vsubuwm**	Vector Subtract Unsigned Word Modulo
VX	10000482			VEC	**vavguw**	Vector Average Unsigned Word
VX	10000484			VEC	**vor**	Vector OR

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	100004C0			SP	**evaddusiaaw**	Vector Add Unsigned, Saturate, Integer to Accumulator Word
EVX	100004C1			SP	**evaddssiaaw**	Vector Add Signed, Saturate, Integer to Accumulator Word
EVX	100004C2			SP	**evsubfusiaaw**	Vector Subtract Unsigned, Saturate, Integer to Accumulator Word
EVX	100004C3			SP	**evsubfssiaaw**	Vector Subtract Signed, Saturate, Integer to Accumulator Word
EVX	100004C4			SP	**evmra**	Initialize Accumulator
VX	100004C4			VEC	**vxor**	Vector XOR
EVX	100004C6			SP	**evdivws**	Vector Divide Word Signed
EVX	100004C7			SP	**evdivwu**	Vector Divide Word Unsigned
EVX	100004C8			SP	**evaddumiaaw**	Vector Add Unsigned, Modulo, Integer to Accumulator Word
EVX	100004C9			SP	**evaddsmiaaw**	Vector Add Signed, Modulo, Integer to Accumulator Word
EVX	100004CA			SP	**evsubfumiaaw**	Vector Subtract Unsigned, Modulo, Integer to Accumulator Word
EVX	100004CB			SP	**evsubfsmiaaw**	Vector Subtract Signed, Modulo, Integer to Accumulator Word
EVX	10000500			SP	**evmheusiaaw**	Vector Multiply Halfwords, Even, Unsigned, Saturate Integer and Accumulate into Words
EVX	10000501			SP	**evmhessiaaw**	Vector Multiply Halfwords, Even, Signed, Saturate, Integer and Accumulate into Words
VX	10000502			VEC	**vavgsb**	Vector Average Signed Byte
EVX	10000503			SP	**evmhessfaaw**	Vector Multiply Halfwords, Even, Signed, Saturate, Fractional and Accumulate into Words
EVX	10000504			SP	**evmhousiaaw**	Vector Multiply Halfwords, Odd, Unsigned, Saturate, Integer and Accumulate into Words
VX	10000504			VEC	**vnor**	Vector NOR
EVX	10000505			SP	**evmhossiaaw**	Vector Multiply Halfwords, Odd, Signed, Saturate, Integer and Accumulate into Words
EVX	10000507			SP	**evmhossfaaw**	Vector Multiply Halfwords, Odd, Signed, Saturate, Fractional and Accumulate into Words
EVX	10000508			SP	**evmheumiaaw**	Vector Multiply Halfwords, Even, Unsigned, Modulo, Integer and Accumulate into Words
EVX	10000509			SP	**evmhesmiaaw**	Vector Multiply Halfwords, Even, Signed, Modulo, Integer and Accumulate into Words

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	1000050B			SP	**evmhesmfaaw**	Vector Multiply Halfwords, Even, Signed, Modulo, Fractional and Accumulate into Words
EVX	1000050C			SP	**evmhoumiaaw**	Vector Multiply Halfwords, Odd, Unsigned, Modulo, Integer and Accumulate into Words
EVX	1000050D			SP	**evmhosmiaaw**	Vector Multiply Halfwords, Odd, Signed, Modulo, Integer and Accumulate into Words
EVX	1000050F			SP	**evmhosmfaaw**	Vector Multiply Halfwords, Odd, Signed, Modulo, Fractional and Accumulate into Words
EVX	10000528			SP	**evmhegumiaa**	Vector Multiply Halfwords, Even, Guarded, Unsigned, Modulo, Integer and Accumulate
EVX	10000529			SP	**evmhegsmiaa**	Vector Multiply Halfwords, Even, Guarded, Signed, Modulo, Integer and Accumulate
EVX	1000052B			SP	**evmhegsmfaa**	Vector Multiply Halfwords, Even, Guarded, Signed, Modulo, Fractional and Accumulate
EVX	1000052C			SP	**evmhogumiaa**	Vector Multiply Halfwords, Odd, Guarded, Unsigned, Modulo, Integer and Accumulate
EVX	1000052D			SP	**evmhogsmiaa**	Vector Multiply Halfwords, Odd, Guarded, Signed, Modulo, Integer and Accumulate
EVX	1000052F			SP	**evmhogsmfaa**	Vector Multiply Halfwords, Odd, Guarded, Signed, Modulo, Fractional and Accumulate
EVX	10000540			SP	**evmwlusiaaw**	Vector Multiply Word Low Unsigned Saturate, Integer and Accumulate into Words
EVX	10000541			SP	**evmwlssiaaw**	Vector Multiply Word Low Signed, Saturate, Integer and Accumulate into Words
VX	10000542			VEC	**vavgsh**	Vector Average Signed Halfword
EVX	10000544			SP	**evmwhusiaaw**	Vector Multiply Word High Unsigned, Integer and Accumulate into Words
EVX	10000547			SP	**evmwhssfaaw**	Vector Multiply Word High Signed, Fractional and Accumulate into Words
EVX	10000548			SP	**evmwlumiaaw**	Vector Multiply Word Low Unsigned, Modulo, Integer and Accumulate into Words
EVX	10000549			SP	**evmwlsmiaaw**	Vector Multiply Word Low Signed, Modulo, Integer and Accumulate into Words
EVX	1000054C			SP	**evmwhumiaaw**	Vector Multiply Word High Unsigned, Modulo, Integer and Accumulate into Words
EVX	1000054D			SP	**evmwhsmiaaw**	Vector Multiply Word High Signed, Modulo, Integer and Accumulate into Words
EVX	1000054F			SP	**evmwhsmfaaw**	Vector Multiply Word High Signed, Modulo, Fractional and Accumulate into Words

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	10000553			SP	**evmwssfaa**	Vector Multiply Word Signed, Saturate, Fractional and Accumulate
EVX	10000558			SP	**evmwumiaa**	Vector Multiply Word Unsigned, Modulo, Integer and Accumulate
EVX	10000559			SP	**evmwsmiaa**	Vector Multiply Word Signed, Modulo, Integer and Accumulate
EVX	1000055B			SP	**evmwsmfaa**	Vector Multiply Word Signed, Modulo, Fractional and Accumulate
EVX	10000580			SP	**evmheusianw**	Vector Multiply Halfwords, Even, Unsigned, Saturate Integer and Accumulate Negative into Words
VX	10000580			VEC	**vsubcuw**	Vector Subtract and Write Carry-Out Unsigned Word
EVX	10000581			SP	**evmhessianw**	Vector Multiply Halfwords, Even, Signed, Saturate, Integer and Accumulate Negative into Words
VX	10000582			VEC	**vavgsw**	Vector Average Signed Word
EVX	10000583			SP	**evmhessfanw**	Vector Multiply Halfwords, Even, Signed, Saturate, Fractional and Accumulate Negative into Words
EVX	10000584			SP	**evmhousianw**	Vector Multiply Halfwords, Odd, Unsigned, Saturate, Integer and Accumulate Negative into Words
EVX	10000585			SP	**evmhossianw**	Vector Multiply Halfwords, Odd, Signed, Saturate, Integer and Accumulate Negative into Words
EVX	10000587			SP	**evmhossfanw**	Vector Multiply Halfwords, Odd, Signed, Saturate, Fractional and Accumulate Negative into Words
EVX	10000588			SP	**evmheumianw**	Vector Multiply Halfwords, Even, Unsigned, Modulo, Integer and Accumulate Negative into Words
EVX	10000589			SP	**evmhesmianw**	Vector Multiply Halfwords, Even, Signed, Modulo, Integer and Accumulate Negative into Words
EVX	1000058B			SP	**evmhesmfanw**	Vector Multiply Halfwords, Even, Signed, Modulo, Fractional and Accumulate Negative into Words
EVX	1000058C			SP	**evmhoumianw**	Vector Multiply Halfwords, Odd, Unsigned, Modulo, Integer and Accumulate Negative into Words
EVX	1000058D			SP	**evmhosmianw**	Vector Multiply Halfwords, Odd, Signed, Modulo, Integer and Accumulate Negative into Words
EVX	1000058F			SP	**evmhosmfanw**	Vector Multiply Halfwords, Odd, Signed, Modulo, Fractional and Accumulate Negative into Words
EVX	100005A8			SP	**evmhegumian**	Vector Multiply Halfwords, Even, Guarded, Unsigned, Modulo, Integer and Accumulate Negative
EVX	100005A9			SP	**evmhegsmian**	Vector Multiply Halfwords, Even, Guarded, Signed, Modulo, Integer and Accumulate Negative

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
EVX	100005AB			SP	**evmhegsmfan**	Vector Multiply Halfwords, Even, Guarded, Signed, Modulo, Fractional and Accumulate Negative
EVX	100005AC			SP	**evmhogumian**	Vector Multiply Halfwords, Odd, Guarded, Unsigned, Modulo, Integer and Accumulate Negative
EVX	100005AD			SP	**evmhogsmian**	Vector Multiply Halfwords, Odd, Guarded, Signed, Modulo, Integer and Accumulate Negative
EVX	100005AF			SP	**evmhogsmfan**	Vector Multiply Halfwords, Odd, Guarded, Signed, Modulo, Fractional and Accumulate Negative
EVX	100005C0			SP	**evmwlusianw**	Vector Multiply Word Low Unsigned Saturate, Integer and Accumulate Negative into Words
EVX	100005C1			SP	**evmwlssianw**	Vector Multiply Word Low Signed, Saturate, Integer and Accumulate Negative into Words
EVX	100005C4			SP	**evmwhusianw**	Vector Multiply Word High Unsigned, Integer and Accumulate Negative into Words
EVX	100005C5			SP	**evmwhssianw**	Vector Multiply Word High Signed, Integer and Accumulate Negative into Words
EVX	100005C7			SP	**evmwhssfanw**	Vector Multiply Word High Signed, Fractional and Accumulate Negative into Words
EVX	100005C8			SP	**evmwlumianw**	Vector Multiply Word Low Unsigned, Modulo, Integer and Accumulate Negative into Words
EVX	100005C9			SP	**evmwlsmianw**	Vector Multiply Word Low Signed, Modulo, Integer and Accumulate Negative into Words
EVX	100005CC			SP	**evmwhumianw**	Vector Multiply Word High Unsigned, Modulo, Integer and Accumulate Negative into Words
EVX	100005CD			SP	**evmwhsmianw**	Vector Multiply Word High Signed, Modulo, Integer and Accumulate Negative into Words
EVX	100005CF			SP	**evmwhsmfanw**	Vector Multiply Word High Signed, Modulo, Fractional and Accumulate Negative into Words
EVX	100005D3			SP	**evmwssfan**	Vector Multiply Word Signed, Saturate, Fractional and Accumulate Negative
EVX	100005D8			SP	**evmwumian**	Vector Multiply Word Unsigned, Modulo, Integer and Accumulate Negative
EVX	100005D9			SP	**evmwsmian**	Vector Multiply Word Signed, Modulo, Integer and Accumulate Negative
EVX	100005DB			SP	**evmwsmfan**	Vector Multiply Word Signed, Modulo, Fractional and Accumulate Negative
VX	10000600			VEC	**vsububs**	Vector Subtract Unsigned Byte Saturate
VX	10000604			VEC	**mfvscr**	Move from Vector Status and Control Register
VX	10000608			VEC	**vsum4ubs**	Vector Sum across Quarter Unsigned Byte Saturate

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
VX	10000640			VEC	**vsubuhs**	Vector Subtract Unsigned Halfword Saturate
VX	10000644			VEC	**mtvscr**	Move to Vector Status and Control Register
VX	10000648			VEC	**vsum4shs**	Vector Sum across Quarter Signed Halfword Saturate
VX	10000680			VEC	**vsubuws**	Vector Subtract Unsigned Word Saturate
VX	10000688			VEC	**vsum2sws**	Vector Sum across Half Signed Word Saturate
VX	10000700			VEC	**vsubsbs**	Vector Subtract Signed Byte Saturate
VX	10000708			VEC	**vsum4sbs**	Vector Sum across Quarter Signed Byte Saturate
VX	10000740			VEC	**vsubshs**	Vector Subtract Signed Halfword Saturate
VX	10000780			VEC	**vsubsws**	Vector Subtract Signed Word Saturate
VX	10000788			VEC	**vsumsws**	Vector Sum across Signed Word Saturate
D8	18000000			VLE	**e_lbzu**	Load Byte and Zero with Update
D8	18000100			VLE	**e_lhzu**	Load Halfword and Zero with Update
D8	18000200			VLE	**e_lwzu**	Load Word and Zero with Update
D8	18000300			VLE	**e_lhau**	Load Halfword Algebraic with Update
D8	18000400			VLE	**e_stbu**	Store Byte with Update
D8	18000500			VLE	**e_sthu**	Store Halfword with Update
D8	18000600			VLE	**e_stwu**	Store word with Update
D8	18000800			VLE	**e_lmw**	Load Multiple Word
D8	18000900			VLE	**e_stmw**	Store Multiple Word
SCI8	18008000	SR		VLE	**e_addi**[.]	Add Scaled Immediate
SCI8	18009000	SR		VLE	**e_addic**[.]	Add Scaled Immediate Carrying
SCI8	1800A000			VLE	**e_mulli**	Multiply Low Scaled Immediate
SCI8	1800A800			VLE	**e_cmpi**	Compare Scaled Immediate Word
SCI8	1800B000	SR		VLE	**e_subfic**[.]	Subtract From Scaled Immediate Carrying
SCI8	1800C000	SR		VLE	**e_andi**[.]	AND Scaled Immediate
SCI8	1800D000	SR		VLE	**e_ori**[.]	OR Scaled Immediate
SCI8	1800E000	SR		VLE	**e_xori**[.]	XOR Scaled Immediate
SCI8	1880A800			VLE	**e_cmpli**	Compare Logical Scaled Immediate Word
D	1C000000			VLE	**e_add16i**	Add Immediate
OIM5	2000----			VLE	**se_addi**	Add Immediate Short Form
OIM5	2200----			VLE	**se_cmpli**	Compare Logical Immediate Word
OIM5	2400----	SR		VLE	**se_subi**[.]	Subtract Immediate

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
IM5	2A00----			VLE	**se_cmpi**	Compare Immediate Word Short Form
IM5	2C00----			VLE	**se_bmaski**	Bit Mask Generate Immediate
IM5	2E00----			VLE	**se_andi**	AND Immediate Short Form
D	30000000			VLE	**e_lbz**	Load Byte and Zero
D	34000000			VLE	**e_stb**	Store Byte
D	38000000			VLE	**e_lha**	Load Halfword Algebraic
RR	4000----			VLE	**se_srw**	Shift Right Word
RR	4100----	SR		VLE	**se_sraw**	Shift Right Algebraic Word
RR	4200----			VLE	**se_slw**	Shift Left Word
RR	4400----			VLE	**se_or**	OR SHort Form
RR	4500----			VLE	**se_andc**	AND with Complement Short Form
RR	4600----	SR		VLE	**se_and**[.]	AND Short Form
IM7	4800----			VLE	**se_li**	Load Immediate Short Form
D	50000000			VLE	**e_lwz**	Load Word and Zero
D	54000000			VLE	**e_stw**	Store Word
D	58000000			VLE	**e_lhz**	Load Halfword and Zero
D	5C000000			VLE	**e_sth**	Store Halfword
IM5	6000----			VLE	**se_bclri**	Bit Clear Immediate
IM5	6200----			VLE	**se_bgeni**	Bit Generate Immediate
IM5	6400----			VLE	**se_bseti**	Bit Set Immediate
IM5	6600----			VLE	**se_btsti**	Bit Test Immediate
IM5	6800----			VLE	**se_srwi**	Shift Right Word Immediate Short Form
IM5	6A00----	SR		VLE	**se_srawi**	Shift Right Algebraic Immediate
IM5	6C00----			VLE	**se_slwi**	Shift Left Word Immediate Short Form
LI20	70000000			VLE	**e_li**	Load Immediate
I16A	70008800	SR		VLE	**e_add2i.**	Add (2 operand) Immediate and Record
I16A	70009000			VLE	**e_add2is**	Add (2 operand) Immediate Shifted
IA16	70009800			VLE	**e_cmp16i**	Compare Immediate Word
I16A	7000A000			VLE	**e_mull2i**	Multiply (2 operand) Low Immediate
I16A	7000A800			VLE	**e_cmpl16i**	Compare Logical Immediate Word
IA16	7000B000			VLE	**e_cmph16i**	Compare Halfword Immediate
IA16	7000B800			VLE	**e_cmphl16i**	Compare Halfword Logical Immediate

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
I16L	7000C000			VLE	**e_or2i**	OR (2operand) Immediate
I16L	7000C800	SR		VLE	**e_and2i.**	AND (2 operand) Immediate
I16L	7000D000			VLE	**e_or2is**	OR (2 operand) Immediate Shifted
I16L	7000E000			VLE	**e_lis**	Load Immediate Shifted
I16L	7000E800	SR		VLE	**e_and2is.**	AND (2 operand) Immediate Shifted
M	74000000			VLE	**e_rlwimi**	Rotate Left Word Immediate then Mask Insert
M	74000001			VLE	**e_rlwinm**	Rotate Left Word Immediate then AND with Mask
BD24	78000000			VLE	**e_b**[**l**]	Branch [and Link]
BD15	7A000000	CT		VLE	**e_bc**[**l**]	Branch Conditional [and Link]
X	7C000000			B	**cmp**	Compare
X	7C000008			B	**tw**	Trap Word
X	7C00000C			VEC	**lvsl**	Load Vector for Shift Left Indexed
X	7C00000E			VEC	**lvebx**	Load Vector Element Byte Indexed
XO	7C000010	SR		B	**subfc**[**o**][**.**]	Subtract From Carrying
XO	7C000012	SR		64	**mulhdu**[**.**]	Multiply High Doubleword Unsigned
XO	7C000014			B	**addc**[**o**][**.**]	Add Carrying
XO	7C000016	SR		B	**mulhwu**[**.**]	Multiply High Word Unsigned
X	7C00001C			VLE	**e_cmph**	Compare Halfword
A	7C00001E			B	**isel**	Integer Select
XL	7C000020			VLE	**e_mcrf**	Move CR Field
XFX	7C000026			B	**mfcr**	Move From Condition Register
X	7C000028			B	**lwarx**	Load Word and Reserve Indexed
X	7C00002A			64	**ldx**	Load Doubleword Indexed
X	7C00002C			E	**icbt**	Instruction Cache Block Touch
X	7C00002E			B	**lwzx**	Load Word and Zero Indexed
X	7C000030	SR		B	**slw**[**.**]	Shift Left Word
X	7C000034	SR		B	**cntlzw**[**.**]	Count Leading Zeros Word
X	7C000036	SR		64	**sld**[**.**]	Shift Left Doubleword
X	7C000038	SR		B	**and**[**.**]	AND
X	7C00003A		P	E.PD	**ldepx**	Load Doubleword by External Process ID Indexed
X	7C00003E		P	E.PD	**lwepx**	Load Word by External Process ID Indexed
X	7C000040			B	**cmpl**	Compare Logical

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
XL	7C000042			VLE	**e_crnor**	Condition Register NOR
X	7C00004C			VEC	**lvsr**	Load Vector for Shift Right Indexed
X	7C00004E			VEC	**lvehx**	Load Vector Element Halfword Indexed
XO	7C000050	SR		B	**subf**[**o**][**.**]	Subtract From
X	7C00005C			VLE	**e_cmphl**	Compare Halfword Logical
X	7C00006A			64	**ldux**	Load Doubleword with Update Indexed
X	7C00006C			B	**dcbst**	Data Cache Block Store
X	7C00006E			B	**lwzux**	Load Word and Zero with Update Indexed
X	7C000070	SR		VLE	**e_slwi**[**.**]	Shift Left Word Immediate
X	7C000074	SR		64	**cntlzd**[**.**]	Count Leading Zeros Doubleword
X	7C000078	SR		B	**andc**[**.**]	AND with Complement
X	7C00007C			WT	**wait**	Wait
X	7C000088			64	**td**	Trap Doubleword
X	7C00008E			VEC	**lvewx**	Load Vector Element Word Indexed
XO	7C000092	SR		64	**mulhd**[**.**]	Multiply High Doubleword
XO	7C000096	SR		B	**mulhw**[**.**]	Multiply High Word
X	7C0000A6		P	B	**mfmsr**	Move From Machine State Register
X	7C0000A8			64	**ldarx**	Load Doubleword and Reserve Indexed
X	7C0000AC			B	**dcbf**	Data Cache Block Flush
X	7C0000AE			B	**lbzx**	Load Byte and Zero Indexed
X	7C0000BE		P	E.PD	**lbepx**	Load Byte by External Process ID Indexed
X	7C0000CE			VEC	**lvx**[**l**]	Load Vector Indexed [Last]
X	7C0000D0	SR		B	**neg**[**o**][**.**]	Negate
X	7C0000EE			B	**lbzux**	Load Byte and Zero with Update Indexed
X	7C0000F4			B	**popcntb**	Population Count Bytes
X	7C0000F8	SR		B	**nor**[**.**]	NOR
X	7C0000FE		P	E.PD	**dcbfep**	Data Cache Block Flush by External Process ID
XL	7C000102			VLE	**e_crandc**	Condition Register AND with Completement
X	7C000106		P	E	**wrtee**	Write MSR External Enable
X	7C00010C		M	E.CL	**dcbtstls**	Data Cache Block Touch for Store and Lock Set
VX	7C00010E			VEC	**stvebx**	Store Vector Element Byte Indexed
XO	7C000110	SR		B	**subfe**[**o**][**.**]	Subtract From Extended

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
XO	7C000114	SR		B	**adde**[**o**][**.**]	Add Extended
EVX	7C00011D		P	E.PD	**evlddepx**	Vector Load Doubleword into Doubleword by External Process ID Indexed
XFX	7C000120			B	**mtcrf**	Move to Condition Register Fields
X	7C000124		P	E	**mtmsr**	Move To Machine State Register
X	7C00012A			64	**stdx**	Store Doubleword Indexed
X	7C00012D			B	**stwcx.**	Store Word Conditional Indexed
X	7C00012E			B	**stwx**	Store Word Indexed
X	7C00013A		P	E.PD	**stdepx**	Store Doubleword by External Process ID Indexed
X	7C00013E		P	E.PD	**stwepx**	Store Word by External Process ID Indexed
X	7C000146		P	E	**wrteei**	Write MSR External Enable Immediate
X	7C00014C		M	E.CL	**dcbtls**	Data Cache Block Touch and Lock Set
VX	7C00014E			VEC	**stvehx**	Store Vector Element Halfword Indexed
X	7C00016A			64	**stdux**	Store Doubleword with Update Indexed
X	7C00016E			B	**stwux**	Store Word with Update Indexed
XL	7C000182			VLE	**e_crxor**	Condition Register XOR
VX	7C00018E			VEC	**stvewx**	Store Vector Element Word Indexed
XO	7C000190	SR		B	**subfze**[**o**][**.**]	Subtract From Zero Extended
XO	7C000194	SR		B	**addze**[**o**][**.**]	Add to Zero Extended
X	7C00019C		P	E.PC	**msgsnd**	Message Send
EVX	7C00019D		P	E.PD	**evstddepx**	Vector Store Doubleword into Doubleword by External Process ID Indexed
X	7C0001AD			64	**stdcx.**	Store Doubleword Conditional Indexed
X	7C0001AE			B	**stbx**	Store Bye Indexed
X	7C0001BE		P	E.PD	**stbepx**	Store Byte by External Process ID Indexed
XL	7C0001C2			VLE	**e_crnand**	Condition Register NAND
X	7C0001CC		M	E.CL	**icblc**	Instruction Cache Block Lock Clear
VX	7C0001CE			VEC	**stvx**[**l**]	Store Vector Indexed [Last]
XO	7C0001D0	SR		B	**subfme**[**o**][**.**]	Subtract From Minus One Extended
XO	7C0001D2	SR		64	**mulld**[**o**][**.**]	Multiply Low Doubleword
XO	7C0001D4	SR		B	**addme**[**o**][**.**]	Add to Minus One Extended
XO	7C0001D6	SR		B	**mullw**[**o**][**.**]	Multiply Low Word
X	7C0001DC		P	E.PC	**msgclr**	Message Clear

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
X	7C0001EC			B	**dcbtst**	Data Cache Block Touch for Store
X	7C0001EE			B	**stbux**	Store Byte with Update Indexed
X	7C0001FE		P	E.PD	**dcbtstep**	Data Cache Block Touch for Store by External Process ID
XL	7C000202			VLE	**e_crand**	Condition Register AND
XFX	7C000206		P	E	**mfdcrx**	Move From Device Control Register Indexed
X	7C00020E		P	E.PD	**lvepxl**	Load Vector by External Process ID Indexed LRU
XO	7C000214			B	**add**[**o**][**.**]	Add
X	7C00022C			B	**dcbt**	Data Cache Block Touch
X	7C00022E			B	**lhzx**	Load Halfword and Zero Indexed
X	7C000230	SR		VLE	**e_rlw**[**.**]	Rotate Left Word
X	7C000238	SR		B	**eqv**[**.**]	Equivalent
X	7C00023E		P	E.PD	**lhepx**	Load Halfword by External Process ID Indexed
XL	7C000242			VLE	**e_creqv**	Condition Register Equivalent
XFX	7C000246		P	E	**mfdcrux**	Move From Device Control Register User Indexed
X	7C00024E		P	E.PD	**lvepx**	Load Vector by External Process ID Indexed
X	7C00026E			B	**lhzux**	Load Halfword and Zero with Update Indexed
X	7C000270	SR		VLE	**e_rlwi**[**.**]	Rotate Left Word Immediate
D	7C000278	SR		B	**xor**[**.**]	XOR
X	7C00027E		P	E.PD	**dcbtep**	Data Cache Block Touch by External Process ID
XFX	7C000286		P	E	**mfdcr**	Move From Device Control Register
X	7C00028C		P	E.CD	**dcread**	Data Cache Read
XFX	7C00029C		O	E.PM	**mfpmr**	Move From Performance Monitor Register
XFX	7C0002A6		O	B	**mfspr**	Move From Special Purpose Register
X	7C0002AA			64	**lwax**	Load Word Algebraic Indexed
X	7C0002AE			B	**lhax**	Load Halfword Algebraic Indexed
X	7C0002EA			64	**lwaux**	Load Word Algebraic with Update Indexed
X	7C0002EE			B	**lhaux**	Load Halfword Algebraic with Update Indexed
X	7C000306		P	E	**mtdcrx**	Move To Device Control Register Indexed
X	7C00030C		M	E.CL	**dcblc**	Data Cache Block Lock Clear
X	7C00032E			B	**sthx**	Store Halfword Indexed
X	7C000338	SR		B	**orc**[**.**]	OR with Complement
X	7C00033E		P	E.PD	**sthepx**	Store Halfword by External Process ID Indexed

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
XL	7C000342			VLE	**e_crorc**	Condition Register OR with Complement
X	7C000346			E	**mtdcrux**	Move To Device Control Register User Indexed
X	7C00036E			B	**sthux**	Store Halfword with Update Indexed
X	7C000378	SR		B	**or**[.]	OR
XL	7C000382			VLE	**e_cror**	Condition Register OR
XFX	7C000386		P	E	**mtdcr**	Move To Device Control Register
X	7C00038C		P	E.CI	**dci**	Data Cache Invalidate
XO	7C000392	SR		64	**divdu**[**o**][.]	Divide Doubleword Unsigned
XO	7C000396	SR		B	**divwu**[**o**][.]	Divide Word Unsigned
XFX	7C00039C		O	E.PM	**mtpmr**	Move To Performance Monitor Register
XFX	7C0003A6		O	B	**mtspr**	Move To Special Purpose Register
X	7C0003AC		P	E	**dcbi**	Data Cache Block Invalidate
X	7C0003B8	SR		B	**nand**[.]	NAND
X	7C0003CC		M	E.CL	**icbtls**	Instruction Cache Block Touch and Lock Set
X	7C0003CC		P	E.CD	**dcread**	Data Cache Read
XO	7C0003D2	SR		64	**divd**[**o**][.]	Divide Doubleword
XO	7C0003D6	SR		B	**divw**[**o**][.]	Divide Word
X	7C000400			B	**mcrxr**	Move To Condition Register From XER
X	7C00042A			MA	**lswx**	Load String Word Indexed
X	7C00042C			B	**lwbrx**	Load Word Byte-Reversed Indexed
X	7C000430	SR		B	**srw**[.]	Shift Right Word
X	7C000436	SR		64	**srd**[.]	Shift Right Doubleword
X	7C00046C		P	E	**tlbsync**	TLB Synchronize
X	7C000470	SR		VLE	**e_srwi**[.]	Shift Right Word Immediate
X	7C0004AA			MA	**lswi**	Load String Word Immediate
X	7C0004AC			B	**sync**	Synchronize
X	7C0004BE		P	E.PD	**lfdepx**	Load Floating-Point Double by External Process ID Indexed
X	7C00052A			MA	**stswx**	Store String Word Indexed
X	7C00052C			B	**stwbrx**	Store Word Byte-Reversed Indexed
X	7C0005AA			MA	**stswi**	Store String Word Immediate
X	7C0005BE		P	E.PD	**stfdepx**	Store Floating-Point Double by External Process ID Indexed

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
X	7C0005EC			E	**dcba**	Data Cache Block Allocate
X	7C00060E		P	E.PD	**stvepxl**	Store Vector by External Process ID Indexed LRU
X	7C000624		P	E	**tlbivax**	TLB Invalidate Virtual Address Indexed
X	7C00062C			B	**lhbrx**	Load Halfword Byte-Reversed Indexed
X	7C000630	SR		B	**sraw**[.]	Shift Right Algebraic Word
X	7C000634	SR		64	**srad**[.]	Shift Right Algebraic Doubleword
X	7C00064E		P	E.PD	**stvepx**	Store Vector by External Process ID Indexed
X	7C000670	SR		B	**srawi**[.]	Shift Right Algebraic Word Immediate
X	7C000674	SR		64	**sradi**[.]	Shift Right Algebraic Doubleword Immediate
XFX	7C0006AC			E	**mbar**	Memory Barrier
X	7C000724		P	E	**tlbsx**	TLB Search Indexed
X	7C00072C			B	**sthbrx**	Store Halfword Byte-Reversed Indexed
X	7C000734	SR		B	**extsh**[.]	Extend Sign Halfword
X	7C000764		P	E	**tlbre**	TLB Read Entry
X	7C000774	SR		B	**extsb**[.]	Extend Shign Byte
X	7C00078C		P	E.CI	**ici**	Instruction Cache Invalidate
X	7C0007A4		P	E	**tlbwe**	TLB Write Entry
X	7C0007AC			B	**icbi**	Instruction Cache Block Invalidate
X	7C0007B4	SR		64	**extsw**[.]	Extend Sign Word
X	7C0007BE		P	E.PD	**icbiep**	Instruction Cache Block Invalidate by External Process ID
X	7C0007CC		P	E.CD	**icread**	Instruction Cache Read
X	7C0007EC			B	**dcbz**	Data Cache Block set to Zero
X	7C0007FE		P	E.PD	**dcbzep**	Data Cache Block set to Zero by External Process ID
XFX	7C100026			B	**mfocrf**	Move From One Condition Register Field
XFX	7C100120			B	**mtocrf**	Move To One Condition Register Field
SD4	8000----			VLE	**se_lbz**	Load Byte and Zero Short Form
SD4	9000----			VLE	**se_stb**	Store Byte Short Form
SD4	A000----			VLE	**se_lhz**	Load Halfword and Zero Short Form
SD4	B000----			VLE	**se_sth**	Store Halfword SHort Form
SD4	C000----			VLE	**se_lwz**	Load Word and Zero Short Form
SD4	D000----			VLE	**se_stw**	Store Word Short Form

Table B-3. VLE Instruction Set Sorted by Opcode

Form	Opcode (hexadecimal) [1]	Mode Dep.[2]	Priv[2]	Cat[2]	Mnemonic	Instruction
BD8	E000----			VLE	**se_bc**	Branch Conditional Short Form
BD8	E800----			VLE	**se_b**[**l**]	Branch [and Link]

1 For 16-bit instructions, this column represents the 16-bit hexadecimal instruction encoding with the opcode and extended opcode in the corresponding fields in the instruction, and with 0s in bit positions that are not opcode bits; dashes are used following the opcode to indicate the form is a 16-bit instruction. For 32-bit instructions, this column represents the 32-bit hexadecimal instruction encoding with the opcode and extended opcode in the corresponding fields in the instruction, and with 0s in bit positions that are not opcode bits.

2 [1]See the key to the mode dependency and privilege column inTable B-1.: