Zceb 0.53.3

This document is in the Stable state. Assume anything could still change, but limited change should be expected. For more information see: https://riscv.org/spec-state

This extension reuses encodings from the D-extension. Therefore it is *incompatible* with D. It is fully compatible with F and also with Zdinx.

The instructions are all 16-bit versions of existing 32-bit load/store instructions.

RV32	RV64	Mnemonic	Instruction
✓	✓	c.lbu *rd'*, uimm(*rs1'*)	Load unsigned byte, 16-bit encoding
✓	✓	c.lhu *rd'*, uimm(*rs1'*)	Load unsigned halfword, 16-bit encoding
✓	✓	c.lb *rd'*, uimm(*rs1'*)	Load signed byte, 16-bit encoding
✓	✓	c.lh *rd'*, uimm(*rs1'*)	Load signed halfword, 16-bit encoding
✓	✓	c.sb *rs2'*, uimm(*rs1'*)	Store byte, 16-bit encoding
✓	✓	c.sh *rs2'*, uimm(*rs1'*)	Store halfword, 16-bit encoding

c.lbu

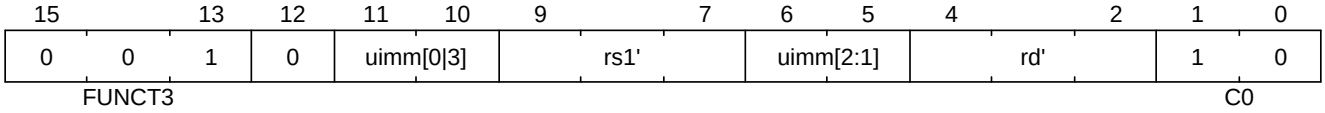
Synopsis

Load unsigned byte, 16-bit encoding

Mnemonic

c.lbu *rd'*, *uimm*(*rs1'*)

Encoding (RV32, RV64)



The immediate offset is formed as follows:

```
uimm[31:4] = 0;
uimm[3]    = encoding[10];
uimm[2:1]  = encoding[6:5];
uimm[0]    = encoding[11];
```

Description

This instruction loads a byte from the memory address formed by adding *rs1'* to the zero extended immediate *uimm*. The resulting byte is zero extended to XLEN bits and is written to *rd'*.

NOTE *rd'* and *rs1'* are from the standard 8-register set x8-x15.

Prerequisites

The C-extension. This encoding conflicts with the D-extension, but there is no conflict with Zdinx if double-precision arithmetic is required.

32-bit equivalent

[insns-lbu]

Operation

```
//This is not SAIL, it's pseudo-code. The SAIL hasn't been written yet.

X(rdc) = EXTZ(mem[X(rs1c)+EXTZ(uimm)][7..0]);
```

Included in

Extension	Minimum version	Lifecycle state
Zceb (Zceb 0.53.3)	0.53.3	Stable

c.lhu

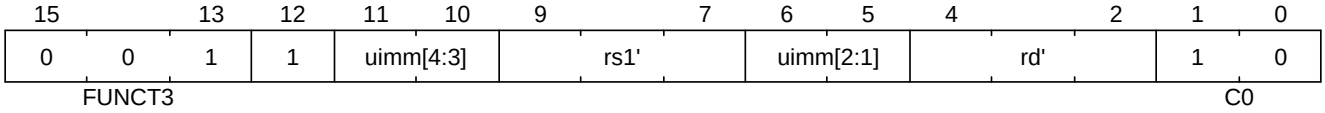
Synopsis

Load unsigned halfword, 16-bit encoding

Mnemonic

c.lhu *rd'*, *uimm*(*rs1'*)

Encoding (RV32, RV64)



The immediate offset is formed as follows:

```
uimm[31:5] = 0;
uimm[4:3]  = encoding[11:10];
uimm[2:1]  = encoding[6:5];
uimm[0]    = 0;
```

Description

This instruction loads a halfword from the memory address formed by adding *rs1'* to the zero extended immediate *uimm*. The resulting halfword is zero extended to XLEN bits and is written to *rd'*.

NOTE *rd'* and *rs1'* are from the standard 8-register set x8-x15.

Prerequisites

The C-extension. This encoding conflicts with the D-extension, but there is no conflict with Zdinx if double-precision arithmetic is required.

32-bit equivalent

[insns-lhu]

Operation

```
//This is not SAIL, it's pseudo-code. The SAIL hasn't been written yet.

X(rdc) = EXTZ(load_mem[X(rs1c)+EXTZ(uimm)][15..0]);
```

Included in

Extension	Minimum version	Lifecycle state
Zceb (Zceb 0.53.3)	0.53.3	Stable

c.lb

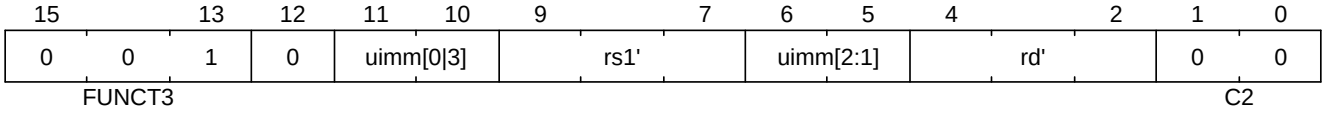
Synopsis

Load signed byte, 16-bit encoding

Mnemonic

c.lb *rd'*, *uimm*(*rs1'*)

Encoding (RV32, RV64)



The immediate offset is formed as follows:

```
uimm[31:4] = 0;
uimm[3]    = encoding[10];
uimm[2:1]  = encoding[6:5];
uimm[0]    = encoding[11];
```

Description

This instruction loads a byte from the memory address formed by adding *rs1'* to the zero extended immediate *uimm*. The resulting byte is sign extended to XLEN bits and is written to *rd'*.

NOTE *rd'* and *rs1'* are from the standard 8-register set x8-x15.

Prerequisites

The C-extension. This encoding conflicts with the D-extension, but there is no conflict with Zdinx if double-precision arithmetic is required.

32-bit equivalent

[insns-lb]

Operation

```
//This is not SAIL, it's pseudo-code. The SAIL hasn't been written yet.

X(rdc) = EXTS(mem[X(rs1c)+EXTZ(uimm)][7..0]);
```

Included in

Extension	Minimum version	Lifecycle state
Zceb (Zceb 0.53.3)	0.53.3	Stable

c.lh

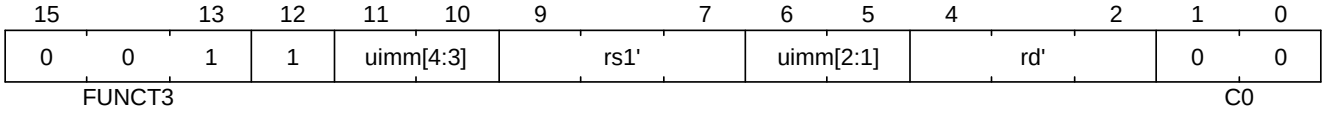
Synopsis

Load signed halfword, 16-bit encoding

Mnemonic

c.lh *rd'*, *uimm*(*rs1'*)

Encoding (RV32, RV64)



The immediate offset is formed as follows:

```
uimm[31:5] = 0;
uimm[4:3]  = encoding[11:10];
uimm[2:1]  = encoding[6:5];
uimm[0]    = 0;
```

Description

This instruction loads a halfword from the memory address formed by adding *rs1'* to the zero extended immediate *uimm*. The resulting halfword is sign extended to XLEN bits and is written to *rd'*.

NOTE *rd'* and *rs1'* are from the standard 8-register set x8-x15.

Prerequisites

The C-extension. This encoding conflicts with the D-extension, but there is no conflict with Zdinx if double-precision arithmetic is required.

32-bit equivalent

[insns-lh]

Operation

```
//This is not SAIL, it's pseudo-code. The SAIL hasn't been written yet.

X(rdc) = EXTS(load_mem[X(rs1c)+EXTZ(uimm)][15..0]);
```

Included in

Extension	Minimum version	Lifecycle state
Zceb (Zceb 0.53.3)	0.53.3	Stable

c.sb

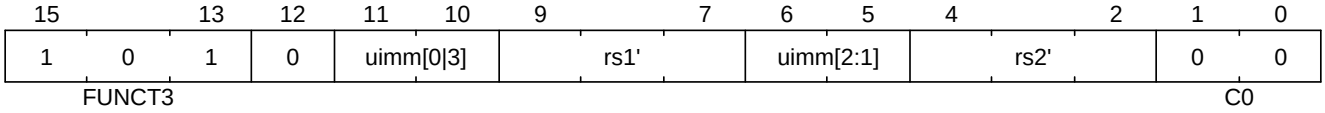
Synopsis

Store byte, 16-bit encoding

Mnemonic

c.sb *r2'*, *uimm*(*rs1'*)

Encoding (RV32, RV64)



The immediate offset is formed as follows:

```
uimm[31:4] = 0;
uimm[3]    = encoding[10];
uimm[2:1]  = encoding[6:5];
uimm[0]    = encoding[11];
```

Description

This instruction stores the least significant byte of *rs2'* to the memory address formed by adding *rs1'* to the zero extended immediate *uimm*.

NOTE *rd'* and *rs1'* are from the standard 8-register set x8-x15.

Prerequisites

The C-extension. This encoding conflicts with the D-extension, but there is no conflict with Zdinx if double-precision arithmetic is required.

32-bit equivalent

[insns-sb]

Operation

```
//This is not SAIL, it's pseudo-code. The SAIL hasn't been written yet.

mem[X(rs1c)+EXTZ(uimm)][7..0] = X(rs2c)
```

Included in

Extension	Minimum version	Lifecycle state
Zceb (Zceb 0.53.3)	0.53.3	Stable

c.sh

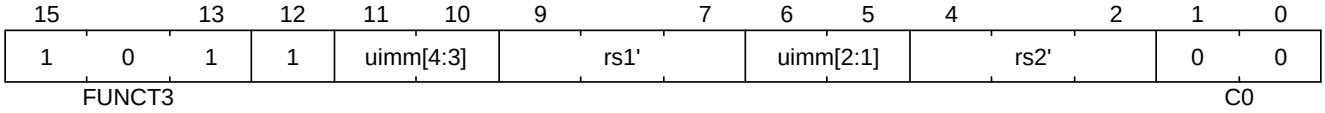
Synopsis

Store halfword, 16-bit encoding

Mnemonic

c.sh *r2'*, *uimm*(*rs1'*)

Encoding (RV32, RV64)



The immediate offset is formed as follows:

```
uimm[31:5] = 0;
uimm[4:3]  = encoding[11:10];
uimm[2:1]  = encoding[6:5];
uimm[0]    = 0;
```

Description

This instruction stores the least significant halfword of *rs2'* to the memory address formed by adding *rs1'* to the zero extended immediate *uimm*.

NOTE *rd'* and *rs1'* are from the standard 8-register set x8-x15.

Prerequisites

The C-extension. This encoding conflicts with the D-extension, but there is no conflict with Zdinx if double-precision arithmetic is required.

32-bit equivalent

[insns-sh]

Operation

```
//This is not SAIL, it's pseudo-code. The SAIL hasn't been written yet.

mem[X(rs1c)+EXTZ(uimm)][15..0] = X(rs2c)
```

Included in

Extension	Minimum version	Lifecycle state
Zceb (Zceb 0.53.3)	0.53.3	Stable