Zcee 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

The instructions in Zcee are all very simple and are 16-bit encodings of existing instructions, either from the I/E ISA or from Zbb.

All proposed encodings are currently reserved for all architectures, and have no conflicts with any existing extensions.

The *c.mul* encoding uses the CR register format along with other instructions such as *c.sub*, *c.xor* etc.

NOTE *c.sext.w* is a pseudo-instruction for *c.addiw rd, 0* (RV64)

RV32	RV64	Mnemonic	Instruction
✓	✓	c.zext.b *rsd′*	Zero extend byte, 16-bit encoding
✓	✓	c.sext.b *rsd′*	Sign extend byte, 16-bit encoding
✓	✓	c.zext.h *rsd′*	Zero extend halfword, 16-bit encoding
✓	✓	c.sext.h *rsd′*	Sign extend halfword, 16-bit encoding
	✓	c.zext.w *rsd′*	Zero extend word, 16-bit encoding
✓	✓	c.mul *rsd′*, *rs2′*	Multiply, 16-bit encoding

c.zext.b

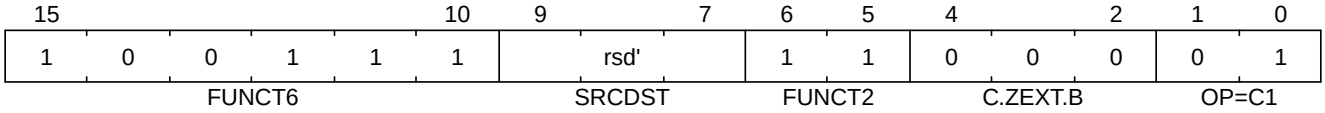
Synopsis

Zero extend byte, 16-bit encoding

Mnemonic

c.zext.b *rsd'*

Encoding (RV32, RV64)



Description

This instruction takes a single source/destination operand, from the 8-register set x8-x15. It zero-extends the least-significant byte of the operand to XLEN by inserting zeros into all of the bits more significant than 7.

Prerequisites

The C-extension must also be configured.

32-bit equivalent

```
andi rsd, rsd, 0xff
```

NOTE The SAIL module variable for *rsd'* is called *rsdc*.

Operation

```
X(rsdc) = EXTZ(X(rsdc)[7..0]);
```

Included in

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

c.sext.b

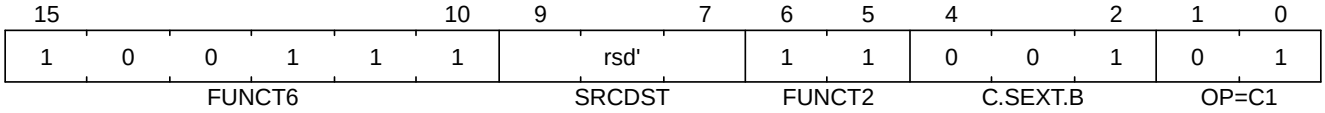
Synopsis

Sign extend byte, 16-bit encoding

Mnemonic

c.sext.b *rsd'*

Encoding (RV32, RV64)



Description

This instruction takes a single source/destination operand, from the 8-register set x8-x15. It sign-extends the least-significant byte in the operand to XLEN by copying the most-significant bit in the byte (i.e., bit 7) to all of the more-significant bits.

Prerequisites

The C-extension must also be configured.

32-bit equivalent

[insns-sext_b] from Zbb

NOTE The SAIL module variable for *rsd'* is called *rsdc*.

Operation

```
X(rsdc) = EXTS(X(rsdc)[7..0]);
```

Included in

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

c.zext.h

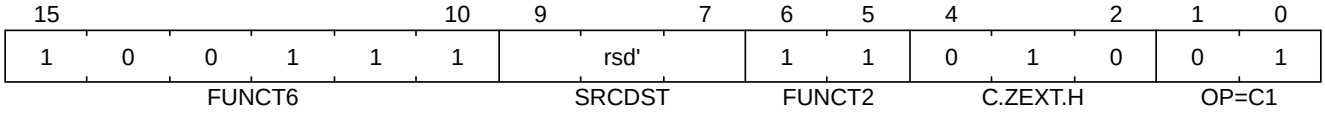
Synopsis

Zero extend halfword, 16-bit encoding

Mnemonic

c.zext.h *rsd'*

Encoding (RV32, RV64)



Description

This instruction takes a single source/destination operand, from the 8-register set x8-x15. It zero-extends the least-significant halfword of the operand to XLEN by inserting zeros into all of the bits more significant than 15.

Prerequisites

The C-extension must also be configured.

32-bit equivalent

[insns-zext_h] from Zbb

NOTE The SAIL module variable for *rsd'* is called *rsdc*.

Operation

```
X(rsdc) = EXTZ(X(rsdc)[15..0]);
```

Included in

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

c.sext.h

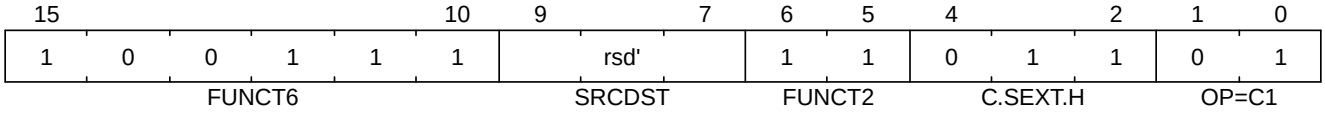
Synopsis

Sign extend halfword, 16-bit encoding

Mnemonic

c.sext.h *rsd'*

Encoding (RV32, RV64)



Description

This instruction takes a single source/destination operand, from the 8-register set x8-x15. It sign-extends the least-significant halfword in the operand to XLEN by copying the most-significant bit in the halfword (i.e., bit 15) to all of the more-significant bits.

Prerequisites

The C-extension must also be configured.

32-bit equivalent

[insns-sext_h] from Zbb

NOTE The SAIL module variable for *rsd'* is called *rsdc*.

Operation

```
X(rsdc) = EXTS(X(rsdc)[15..0]);
```

Included in

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

c.zext.w

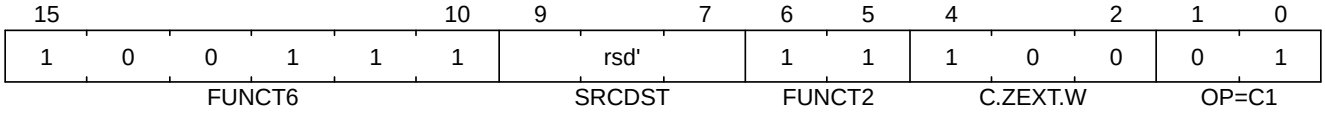
Synopsis

Zero extend word, 16-bit encoding

Mnemonic

c.zext.w *rsd'*

Encoding (RV64)



Description

This instruction takes a single source/destination operand, from the 8-register set x8-x15. It zero-extends the least-significant word of the operand to XLEN by inserting zeros into all of the bits more significant than 31.

Prerequisites

The C-extension must also be configured.

32-bit equivalent

```
add.uw rsd', rsd', zero
```

NOTE The SAIL module variable for *rsd'* is called *rsdc*.

Operation

```
X(rsdc) = EXTZ(X(rsdc)[31..0]);
```

Included in

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

c.mul

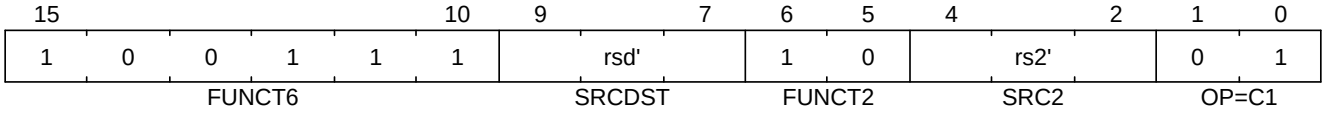
Synopsis

Multiply, 16-bit encoding

Mnemonic

c.mul *rsd'*, *rs2'*

Encoding (RV32, RV64)



Description

This instruction multiplies XLEN bits of the source operands from *rsd'* and *rs2'* and writes the lowest XLEN bits of the result to *rsd'*. Both operands are from the 8-register set x8-x15.

Prerequisites

The C-extension and either M or Zmmul must also be configured.

32-bit equivalent

[insns-mul]

NOTE The SAIL module variable for *rsd'* is called *rsdc*, and for *rs2'* is called *rs2c*.

Operation

```
let result_wide = to_bits(2 * sizeof(xlen), signed(X(rsdc)) * signed(X(rs2c)));
X(rsdc) = result_wide[(sizeof(xlen) - 1) .. 0];
```

Included in

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