# Floating Point

## Operations Supported

Only the most basic floating point operations are supported with hardware. Supported operations include addition, subtraction, multiplication, division, absolute value, integer to float and float to integer conversions. Also supported are comparison operations. There are also a number of control and status instructions.

**Supported Operations:**

|  |  |  |  |
| --- | --- | --- | --- |
| Mnemonic | Precision | Clocks | Operation |
| FADD | S,D | 4 | addition |
| FSUB | S,D | 4 | subtraction |
| FMUL | S,D | 4 | multiplication |
| FDIV | S,D | 12,21 | division |
| FABS | S,D | 1 | absolute value |
| FNEG | S,D | 1 | negation |
| FTOI | S,D | 2 | float to integer |
| ITOF | S,D | 2 | integer to float |
| FSIGN | S,D | 1 | sign of value |
| FMAN | S,D | 1 | mantissa of value |
| FSTAT | - | 1 | get status register |
| FRM | - | 1 | set rounding mode |
| FTX | - | 1 | trigger exception |
| TCX | - | 1 | clear exception |
| TDX | - | 1 | disable exception |
| FEX | - | 1 | enable exception |
| FCMP | S, D | 1 | comparison |
| FTST | S, D | 1 | test against zero |

## Representation

The floating point format is an IEEE-754 representation for both single and double precision. Briefly,

**Double Precision Format:**

|  |  |  |  |
| --- | --- | --- | --- |
| 63 | 62 | 61 52 | 51 0 |
| SM | SE | Exponent | Mantissa |

**Single Precision Format:**

|  |  |  |  |
| --- | --- | --- | --- |
| 31 | 30 | 29 23 | 22 0 |
| SM | SE | Exponent | Mantissa |

Quad Precision Format:

|  |  |  |  |
| --- | --- | --- | --- |
| 127 | 126 | 125 112 | 111 0 |
| SM | SE | Exponent | Mantissa |

SM – sign of mantissa

SE – sign of exponent

The exponent and mantissa are both represented as two’s complement numbers, however the sign bit of the exponent is inverted.

|  |  |
| --- | --- |
| SeEEEEEEEEEE |  |
| 11111111111 | Maximum exponent |
| …. |  |
| 01111111111 | exponent of zero |
| …. |  |
| 00000000000 | Minimum exponent |

The exponent ranges from -1024 to +1023 for double precision numbers

If the core is built with the 32 bit data-bus 64 bit double precision floating point is unavailable.

Floating point comparisons and tests are executed on the integer ALU. This allows a comparison operation to proceed in parallel with another floating point operation.

## Performance

Generally, double precision operations are just as fast as single precision operations with the exception of the divide operation which takes multiple clock cycles.

The floating point divider uses a radix 8 division. (three bits are processed each clock cycle).

# Floating Point Instruction Set

### FABS – Absolute Value

**Description:**

This instruction takes the absolute value of a double precision floating point number contained in a general purpose register. The sign bit of the number is cleared. The precision of the number is not affected and the number is not rounded.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 54 | Rt6 | Ra6 | 778 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All Floating Point

**Operation:**

Rt = Ra

### FABS.S – Single Precision Absolute Value

**Description:**

This instruction takes the absolute value of a single precision floating point number contained in a general purpose register. The sign bit of the number is cleared.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 54 | Rt6 | Ra6 | 798 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All Floating Point

**Operation:**

Rt = Ra

### FADD – Floating point addition

**Description:**

Add two double precision floating point numbers in registers Ra and Rb and place the result into target register Rt.

**Instruction Format:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 39 34 | 33 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 86 | Rt6 | Rb6 | Ra6 | 78h8 | Pn4 | Pc4 |

**Clock Cycles: 4**

**Execution Units:** All Floating Point

### FADD.S – Floating Point Single Precision addition

**Description:**

Add two single precision floating point numbers in registers Ra and Rb and place the result into target register Rt.

**Instruction Format:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 39 34 | 33 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 186 | Rt6 | Rb6 | Ra6 | 78h8 | Pn4 | Pc4 |

**Clock Cycles: 4**

**Execution Units:** All Floating Point

### FCMP - Float Compare

**Description:**

The register compare instruction compares two registers as floating point doubles and sets the flags in the target predict register as a result. While this is a floating point operation it is executed on the integer ALU.

**Instruction Format:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3128 | 27 22 | 21 16 | 15 12 | 11 8 | 7 0 | |
| 24 | Rb6 | Ra6 | 14 | Pt4 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All ALU’s

**Operation:**

if Ra < Rb

P.lt = true

else

P.lt = false

if mag Ra < mag Rb

P.ltu = true

else

P.ltu = false

if Ra = Rb

P.eq = true

else

P.eq = false

if unordered

P.un = true

else

P.un = false

### FCMP.S - Float Compare Single

**Description:**

The register compare instruction compares two registers as floating point singles and sets the flags in the target predict register as a result. While this is a floating point operation it is executed on the integer ALU.

**Instruction Format:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3128 | 27 22 | 21 16 | 15 12 | 11 8 | 7 0 | |
| 14 | Rb6 | Ra6 | 14 | Pt4 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All ALU’s

**Operation:**

if Ra < Rb

P.lt = true

else

P.lt = false

if mag Ra < mag Rb

P.ltu = true

else

P.ltu = false

if Ra = Rb

P.eq = true

else

P.eq = false

if unordered

P.un = true

else

P.un = false

### FDIV – Floating point division

**Description:**

Divide two double precision floating point numbers in registers Ra and Rb and place the result into target register Rt.

**Instruction Format:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 39 34 | 33 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| Bh6 | Rt6 | Rb6 | Ra6 | 78h8 | Pn4 | Pc4 |

**Clock Cycles: 21**

**Execution Units:** All Floating Point

### FDIV.S – Single Precision Floating point division

**Description:**

Divide two single precision floating point numbers in registers Ra and Rb and place the result into target register Rt.

**Instruction Format:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 39 34 | 33 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 1Bh6 | Rt6 | Rb6 | Ra6 | 78h8 | Pn4 | Pc4 |

**Clock Cycles: 12**

**Execution Units:** All Floating Point

### FCX – Clear Floating Point Exceptions

**Description:**

This instruction clears floating point exceptions. The Exceptions to clear are identified as the bits set in the union of register Ra and an immediate field in the instruction. Either the immediate or Ra should be zero.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| D4 | Immed6 | Ra6 | 798 | Pn4 | Pc4 |

**Execution Units:** All Floating Point

**Operation:**

**Exceptions:**

|  |  |
| --- | --- |
| Bit | Exception Enabled |
| 0 | global invalid operation clears the following:   * division of infinities * zero divided by zero * subtraction of infinities * infinity times zero * NaN comparison * division by zero |
| 1 | overflow |
| 2 | underflow |
| 3 | divide by zero |
| 4 | inexact operation |
| 5 | summary exception |

### FDX – Disable Floating Point Exceptions

**Description:**

This instruction disables floating point exceptions. The Exceptions disabled are identified as the bits set in the union of register Ra and an immediate field in the instruction. Either the immediate or Ra should be zero.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| F4 | Immed6 | Ra6 | 798 | Pn4 | Pc4 |

**Execution Units:** All Floating Point

**Operation:**

**Exceptions:**

|  |  |
| --- | --- |
| Bit | Exception Disabled |
| 0 | invalid operation |
| 1 | overflow |
| 2 | underflow |
| 3 | divide by zero |
| 4 | inexact operation |
| 5 | reserved |

### FEX – Enable Floating Point Exceptions

**Description:**

This instruction enables floating point exceptions. The Exceptions enabled are identified as the bits set in the union of register Ra and an immediate field in the instruction. Either the immediate or Ra should be zero.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| E4 | Immed6 | Ra6 | 798 | Pn4 | Pc4 |

**Execution Units:** All Floating Point

**Operation:**

**Exceptions:**

|  |  |
| --- | --- |
| Bit | Exception Enabled |
| 0 | invalid operation |
| 1 | overflow |
| 2 | underflow |
| 3 | divide by zero |
| 4 | inexact operation |
| 5 | reserved |

### FTX – Trigger Floating Point Exceptions

**Description:**

This instruction triggers floating point exceptions. The Exceptions to trigger are identified as the bits set in the union of register Ra and an immediate field in the instruction. Either the immediate or Ra should be zero.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| C4 | Immed6 | Ra6 | 798 | Pn4 | Pc4 |

**Execution Units:** All Floating Point

**Operation:**

**Exceptions:**

|  |  |
| --- | --- |
| Bit | Exception Enabled |
| 0 | global invalid operation |
| 1 | overflow |
| 2 | underflow |
| 3 | divide by zero |
| 4 | inexact operation |
| 5 | reserved |

### FMAC – Floating Point Multiply Accumulate (planned)

**Description:**

Multiply two floating point numbers in registers Ra and Rb add a third number from register Rc and place the result into target register Rt.

**Instruction Format:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4745 | 44 40 | 39 34 | 33 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| ~3 | O5 | Rt6 | Rc6 | Rb6 | Ra6 | 76h8 | Pn4 | Pc4 |

**Clock Cycles: 8**

**Execution Units:** All Floating Point

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| O5 | Precision | Mnemonic | Operation |  |
| 8 | S | FMAC.S | Rt = (Ra \* Rb) + Rc | multiply accumulate |
| 9 | S | FMAS.S | Rt = (Ra \* Rb) - Rc | multiply subtract |
| 10 | S | FNMAC.S | Rt = -((Ra \* Rb) + Rc) | negate multiply accumulate |
| 11 | S | FNMAS.S | Rt = -((Ra \* Rb) - Rc) | negate multiply subtract |
| 16 | D | FMAC | Rt = (Ra \* Rb) + Rc | multiply accumulate |
| 17 | D | FMAS | Rt = (Ra \* Rb) - Rc | multiply subtract |
| 18 | D | FNMAC | Rt = -((Ra \* Rb) + Rc) | negate multiply accumulate |
| 19 | D | FNMAS | Rt = -((Ra \* Rb) - Rc) | negate multiply subtract |

### FMAN – Mantissa of Number

**Description:**

This instruction provides the mantissa of a double precision floating point number contained in a general purpose register as a 52 bit zero extended result. The hidden bit of the floating point number remains hidden.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 74 | Rt6 | Ra6 | 778 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All Floating Point

**Operation:**

Rt = Ra

### FMAN.S – Mantissa of Number

**Description:**

This instruction provides the mantissa of a single precision floating point number contained in a general purpose register as a 23 bit zero extended result. The hidden bit of the floating point number remains hidden.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 74 | Rt6 | Ra6 | 798 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All Floating Point

**Operation:**

Rt = Ra

### FMOV – Move Double Precision

**Description:**

This instruction moves one general purpose register to another. This instruction is shorter and uses one less register port than using the OR instruction to move between registers. See also the [MOV](#_MOV_-_Register-Register) instruction. This instruction currently performs the same operation as the MOV instruction.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 04 | Rt6 | Ra6 | 778 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All Floating Point

**Operation:**

Rt = Ra

### FMOV.S – Move Single Precision

**Description:**

This instruction moves one general purpose register to another. This instruction is shorter and uses one less register port than using the OR instruction to move between registers. See also the [MOV](#_MOV_-_Register-Register) instruction. This instruction currently performs the same operation as the MOV instruction.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 04 | Rt6 | Ra6 | 798 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All Floating Point

**Operation:**

Rt = Ra

### FMUL – Floating point multiplication

**Description:**

Multiply two double precision floating point numbers in registers Ra and Rb and place the result into target register Rt.

**Instruction Format:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 39 34 | 33 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| Ah6 | Rt6 | Rb6 | Ra6 | 78h8 | Pn4 | Pc4 |

**Clock Cycles: 4**

**Execution Units:** All Floating Point

### FMUL.S – Single Precision Floating point multiplication

**Description:**

Multiply two single precision floating point numbers in registers Ra and Rb and place the result into target register Rt.

**Instruction Format:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 39 34 | 33 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 1Ah6 | Rt6 | Rb6 | Ra6 | 78h8 | Pn4 | Pc4 |

**Clock Cycles: 4**

**Execution Units:** All Floating Point

### FNEG – Negate Register

**Description:**

This instruction negates a double precision floating point number contained in a general purpose register. The sign bit of the number is inverted.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 44 | Rt6 | Ra6 | 778 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All Floating Point

**Operation:**

Rt = Ra

### FNEG.S – Negate Single Precision

**Description:**

This instruction negates a single precision floating point number contained in a general purpose register. The sign bit of the number is inverted.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 44 | Rt6 | Ra6 | 798 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All Floating Point

**Operation:**

Rt = Ra

### FRM – Set Floating Point Rounding Mode

**Description:**

This instruction sets the rounding mode bits in the floating point control register (FPSCR). The rounding mode bits are set to the bitwise ‘or’ of an immediate field in the instruction and the contents of register Ra. Either Ra or the immediate field should be zero.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| D4 | Imm6 | Ra6 | 778 | Pn4 | Pc4 |

**Execution Units:** All Floating Point

**Operation:**

FPSCR.RM = Ra | Immediate

### FSIGN – Sign of Number

**Description:**

This instruction provides the sign of a double precision floating point number contained in a general purpose register as a floating point double result. The result is +1.0 if the number is positive, 0.0 if the number is zero, and -1.0 if the number is negative.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 64 | Rt6 | Ra6 | 778 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All Floating Point

**Operation:**

Rt = Ra

### FSIGN.S – Single Precision Sign of Number

**Description:**

This instruction provides the sign of a single precision floating point number contained in a general purpose register as a floating point single result. The result is +1.0 if the number is positive, 0.0 if the number is zero, and -1.0 if the number is negative.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 64 | Rt6 | Ra6 | 798 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All Floating Point

**Operation:**

Rt = Ra

### FSTAT – Get Floating Point Status and Control

**Description:**

The floating point status and control register may be read using the FSTAT instruction. The format of the FPSCR register is outlined on the next page.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| C4 | Rt6 | ~6 | 778 | Pn4 | Pc4 |

**Execution Units:** All Floating Point

**Operation:**

Rt = FPSCR

**Floating Point Status And Control Register Format:**

|  |  |  |  |
| --- | --- | --- | --- |
| Bit |  | Symbol | Description |
| 31:29 | **RM** | rm | rounding mode (unimplemented) |
| 28 | **E5** | inexe | - inexact exception enable |
| 27 | **E4** | dbzxe | - divide by zero exception enable |
| 26 | **E3** | underxe | - underflow exception enable |
| 25 | **E2** | overxe | - overflow exception enable |
| 24 | **E1** | invopxe | - invalid operation exception enable |
| 23 | **NS** | ns | - non standard floating point indicator |
| **Result Status** | | | |
| 22 |  | fractie | - the last instruction (arithmetic or conversion) rounded intermediate result (or caused a disabled overflow exception) |
| 21 | **RA** | rawayz | rounded away from zero (fraction incremented) |
| 20 | **SC** | C | denormalized, negative zero, or quiet NaN |
| 19 | **SL** | neg < | the result is negative (and not zero) |
| 18 | **SG** | pos > | the result is positive (and not zero) |
| 17 | **SE** | zero = | the result is zero (negative or positive) |
| 16 | **SI** | inf ? | the result is infinite or quiet NaN |
| **Exception Occurrence** | | | |
| 15 | **X6** | swt | {reserved} - set this bit using software to trigger an invalid operation |
| 14 | **X5** | inerx | - inexact result exception occurred (sticky) |
| 13 | **X4** | dbzx | - divide by zero exception occurred |
| 12 | **X3** | underx | - underflow exception occurred |
| 11 | **X2** | overx | - overflow exception occurred |
| 10 | **X1** | giopx | - global invalid operation exception – set if any invalid operation exception has occurred |
| 9 | **GX** | gx | - global exception indicator – set if any enabled exception has happened |
| 8 | **SX** | sumx | - summary exception – set if any exception could occur if it was enabled  - can only be cleared by software |
| **Exception Type Resolution** | | | |
| 7 | **X1T** | cvt | - attempt to convert NaN or too large to integer |
| 6 | **X1T** | sqrtx | - square root of non-zero negative |
| 5 | **X1T** | NaNCmp | - comparison of NaN not using unordered comparison instructions |
| 4 | **X1T** | infzero | - multiply infinity by zero |
| 3 | **X1T** | zerozero | - division of zero by zero |
| 2 | **X1T** | infdiv | - division of infinities |
| 1 | **X1T** | subinfx | - subtraction of infinities |
| 0 | **X1T** | snanx | - signaling NaN |

Greyed out items are not implemented.

### FSUB – Floating point subtraction

**Description:**

**Instruction Format:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 39 34 | 33 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 96 | Rt6 | Rb6 | Ra6 | 78h8 | Pn4 | Pc4 |

**Clock Cycles: 4**

**Execution Units:** All Floating Point

### FSUB.S – Single Precision Floating point subtraction

**Description:**

**Instruction Format:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 39 34 | 33 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 196 | Rt6 | Rb6 | Ra6 | 78h8 | Pn4 | Pc4 |

**Clock Cycles: 4**

**Execution Units:** All Floating Point

### FTOI – Float to Integer

**Description:**

This instruction converts a floating point double value to an integer value.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 24 | Rt6 | Ra6 | 77h8 | Pn4 | Pc4 |

**Clock Cycles:** 2

**Execution Units:** All Floating Point

### FTOI.S – Single Precision Float to Integer

**Description:**

This instruction converts a floating point single value to an integer value.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 24 | Rt6 | Ra6 | 79h8 | Pn4 | Pc4 |

**Clock Cycles:** 2

**Execution Units:** All Floating Point

### FTST – Float Register Test Compare

**Description:**

The register test compare compares floating point double in a register against the value zero and sets the predicate flags appropriately. This instruction is executed on the integer ALU.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 2322 | 21 16 | 15 12 | 11 8 | 7 0 | |
| 22 | Ra6 | 04 | Pt4 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All ALU’s

**Operation:**

if Ra < 0

Pt.lt = 1

else

Pt.lt = 0

if Ra = 0

Pt.eq = 1

else

Pt.eq = 0

if unordered

Pt.un = 1

else

Pt.un = 0

Pt.ltu = 0

**Exceptions:** none

### FTST.S – Float Single Test Compare

**Description:**

The register test compare compares floating point single in a register against the value zero and sets the predicate flags appropriately. This instruction is executed on the integer ALU.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 2322 | 21 16 | 15 12 | 11 8 | 7 0 | |
| 12 | Ra6 | 04 | Pt4 | Pn4 | Pc4 |

**Clock Cycles:** 1

**Execution Units:** All ALU’s

**Operation:**

if Ra < 0

Pt.lt = 1

else

Pt.lt = 0

if Ra = 0

Pt.eq = 1

else

Pt.eq = 0

if unordered

Pt.un = 1

else

Pt.un = 0

Pt.ltu = 0

**Exceptions:** none

### ITOF – Integer to Float

**Description:**

This instruction converts an integer value to a double precision floating point representation.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 34 | Rt6 | Ra6 | 77h8 | Pn4 | Pc4 |

**Clock Cycles:** 2

**Execution Units:** All Floating Point

### ITOF.S – Integer to Float Single

**Description:**

This instruction converts an integer value to a single precision floating point representation.

**Instruction Format:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 31 28 | 27 22 | 21 16 | 15 8 | 7 0 | |
| 34 | Rt6 | Ra6 | 79h8 | Pn4 | Pc4 |

**Clock Cycles:** 2

**Execution Units:** All Floating Point