The number represented by the single-precision format is:

## *3.2 Exceptions*

### 3.2.4 Underflow

Two events cause the underflo

The standard specifies four rounding modes:

### 3.3.1 Round to nearest even

This is the standard default rounding. The value is rounded up or down to the nearest infinitely precise result. If the value is exactly halfway between two infinitely precise results, then it should be rounded up to the nearest infinitely precise even.

For example:

| Unrounded | RC | *P* |
|---|---|---|

**Step 1**: multiply fractions and calculate the result exponent.

$$\begin{array}{rl} & 1.1001 \\ \times & 1.0010 \\ \hline & 1.11000010 \end{array}$$

## *4.3 Division*

The division was done serially using t1 Tbasic al

The FPU core was designed to be as modular as possible. The current core supports five arithmetic operations:

1. Add

## 4.2 Compilation and Synthesis

The FPU core was compiled and synthesized successfully with *Altera Quartus II v.5* and *Synplify Pro 8.1*. The *Cyclone I–EP1C6Q240C6* was the intended FPGA.
The order in which the files shall be compiled are:

```
fpupack.vhd
pre_norm_addsub.vhd
addsub_28.vhd
post_norm_addsub.vhd
pre_norm_mul.vhd
mul_24.vhd
post_norm_mul.vhd
pre_norm_div.vhd
serial_div.vhd
post_norm_div.vhd
pre_norm_sqrt.vhd
sqrt.vhd
post_norm_sqrt.vhd
comppack.vhd
fpu.vhd
```

The number of Logic elements needed for each unit is shown below.

Altera Quartus II v.5

**$f_{max}$**: 100 MHz

**Number of logic elements**:

| | |
|---|---|
| Addition unit: | 684 |
| Multiplication unit: | 1530 |
| Division unit: | 928 |
| Square-root unit: | 919 |
| Top unit: | 326 |
| **Total:** | 4387 |

## 4.3 Test and verification

The FPU was tested with test cases created using SoftFloat (http://www.jhauser.us/arithmetic/SoftFloat.html). SoftFloat is a software implementation of floating-point that conforms to the IEC/IEEE Standard for Binary Floating-Point Arithmetic. The FPU was tested in ModelSim with 100000 test cases for each arithmetic operation and for each rounding mode. This comes up to 2 million test cases. The instructions for how to

## 7. Updates