This technical update reports the following issue of G4MH w/ FXU, G3M, and G3KH core:

1. [Phenomenon]
FMA(a*b+c) instructions can cause a minute error (less than ulp) in the calculation result normalization with wrong normalization of the mantissa in floating-point value.

normalization: The MSB of the mantissa is always 1 (IEEE754 standard)
ulp (unit in the last place): the LSB of the mantissa

2. [Modified Description]
The following descriptions will be changed in each User’s Manual: Software (Red character)

2-1. RH850G4MH User’s Manual: Software

< Before >
2.4.4.47 FMAF.S
[Description]
The operation is executed as if it were of infinite accuracy. The result of the multiply operation is not rounded, but the result of the add operation is rounded, in accordance with the current rounding mode.
[Supplement]
The operation is executed as if it were of infinite accuracy and the result is rounded in accordance with the current rounding mode.

< After >
2.4.4.47 FMAF.S
[Description]
The operation is executed as if it were of infinite accuracy. The result of the multiply operation is not rounded.
but the result of the add operation is rounded, in accordance with the current rounding mode.

[Supplement]

<table>
<thead>
<tr>
<th>Before</th>
<th>2.4.4.48 FMSF.S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The operation is executed as if it were of infinite accuracy. The result of the multiply operation is not rounded, but the result of the subtract operation is rounded, in accordance with the current rounding mode.</td>
</tr>
<tr>
<td>Supplement</td>
<td>The operation is executed as if it were of infinite accuracy and the result is rounded in accordance with the current rounding mode.</td>
</tr>
<tr>
<td>After</td>
<td>2.4.4.48 FMSF.S</td>
</tr>
<tr>
<td>Description</td>
<td>The operation is executed as if it were of infinite accuracy and the result is rounded in accordance with the current rounding mode.</td>
</tr>
<tr>
<td>Supplement</td>
<td>The operation is executed as if it were of infinite accuracy and the result is rounded in accordance with the current rounding mode.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Before</th>
<th>2.4.4.49 FNMAF.S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The operation is executed as if it were of infinite accuracy. The result of the multiply operation is not rounded, but the result of the add operation is rounded, in accordance with the current rounding mode.</td>
</tr>
<tr>
<td>Supplement</td>
<td>The operation is executed as if it were of infinite accuracy and the result is rounded in accordance with the current rounding mode.</td>
</tr>
<tr>
<td>After</td>
<td>2.4.4.49 FNMAF.S</td>
</tr>
<tr>
<td>Description</td>
<td>The operation is executed as if it were of infinite accuracy. The result of the multiply operation is not rounded, but the result of the add operation is rounded, in accordance with the current rounding mode.</td>
</tr>
<tr>
<td>Supplement</td>
<td>The operation is executed as if it were of infinite accuracy and the result is rounded in accordance with the current rounding mode.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Before</th>
<th>2.4.4.50 FNMSF.S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The operation is executed as if it were of infinite accuracy. The result of the multiply operation is not rounded, but the result of the add operation is rounded, in accordance with the current rounding mode.</td>
</tr>
<tr>
<td>Supplement</td>
<td>The operation is executed as if it were of infinite accuracy and the result is rounded in accordance with the current rounding mode.</td>
</tr>
</tbody>
</table>
The operation is executed as if it were of infinite accuracy. The result of the multiply operation is not rounded, but the result of the subtract operation is rounded, in accordance with the current rounding mode.

The operation is executed as if it were of infinite accuracy. The result is rounded in accordance with the current rounding mode.

The operation is executed as if it were of infinite accuracy. The results of the multiply operation is not rounded, but the results of the add operation is rounded in accordance with the current rounding mode.

The operation is executed as if it were of infinite accuracy. The results of the multiply operation is not rounded, but the results of the subtract operation is rounded in accordance with the current rounding mode.

The operation is executed as if it were of infinite accuracy. The results of the multiply operation is not rounded, but the results of the fused-multiply-add operation are rounded in accordance with the current rounding mode.

The operation is executed as if it were of infinite accuracy. The results of the multiply operation is not rounded, but the results of the fused-multiply-add operation are rounded in accordance with the current rounding mode.
The operation is executed as if it were of infinite accuracy. The results of the multiply operation is not rounded, but the results of the subtract operation is rounded in accordance with the current rounding mode.

The operation is executed as if the results of multiplication were of infinite accuracy and the results of the fused-multiply-subtract operation are rounded in accordance with the current rounding mode.

< Before >
2.5.4.25 FNMAF.S4

The operation is executed as if it were of infinite accuracy. The results of the multiply operation is not rounded, but the results of the add operation is rounded in accordance with the current rounding mode.

The operation is executed as if the results of multiplication were of infinite accuracy and the results of the fused-multiply-add operation are rounded in accordance with the current rounding mode.

< After >
2.5.4.25 FNMAF.S4

The operation is executed as if it were of infinite accuracy. The results of the multiply operation is not rounded, but the results of the subtract operation is rounded in accordance with the current rounding mode.

The operation is executed as if the results of multiplication were of infinite accuracy and the results of the fused-multiply-subtract operation are rounded in accordance with the current rounding mode.

< Before >
2.5.4.26 FNMSF.S4

The operation is executed as if it were of infinite accuracy. The results of the multiply operation is not rounded, but the results of the add operation is rounded in accordance with the current rounding mode.

The operation is executed as if the results of multiplication were of infinite accuracy and the results of the fused-multiply-add operation are rounded in accordance with the current rounding mode.

< After >
2.5.4.26 FNMSF.S4

The operation is executed as if it were of infinite accuracy. The results of the multiply operation is not rounded, but the results of the subtract operation is rounded in accordance with the current rounding mode.

The operation is executed as if the results of multiplication were of infinite accuracy and the results of the fused-multiply-subtract operation are rounded in accordance with the current rounding mode.
7.4.4 Floating-Point Instruction Set
FMAF.S(P402,403), FNMAF.S(P406,407)

< Before >
[Description]
The operation is executed as if it were of infinite accuracy. The result of the multiply operation is not rounded, but the result of the add operation is rounded, in accordance with the current rounding mode.

[Supplement]
The operation is executed as if it were of infinite accuracy and the result is rounded in accordance with the current rounding mode.

< after >
[Description]
The rounding behavior of this operation depends on the CPU version as follows.
When PID7-0 = 01H : The operation is executed as if it were of infinite accuracy. The result of the multiply operation is not rounded, but the result of the add operation is rounded, in accordance with the current rounding mode.
When PID7-0 = 02H,03H,12H,13H,14H : The result of the multiply operation is not rounded, but the result of the add operation is rounded, in accordance with the current rounding mode.

[Supplement]
The rounding behavior of this operation depends on the CPU version as follows.
When PID7-0 = 01H : The operation is executed as if it were of infinite accuracy and the result is rounded in accordance with the current rounding mode.
When PID7-0 = 02H,03H,12H,13H,14H : The result of the multiply operation is not rounded during this operation, but the result of the add operation is rounded, in accordance with the current rounding mode.
FMSF.S(P404,405)、FNMSF.S(P408,409)

< Before >

[Description]
The operation is executed as if it were of infinite accuracy. The result of the multiply operation is not rounded, but the result of the subtract operation is rounded, in accordance with the current rounding mode.

[Supplement]
The operation is executed as if it were of infinite accuracy and the result is rounded in accordance with the current rounding mode.

< after >

[Description]
The rounding behavior of this operation depends on the CPU version as follows.

When PID7-0 = 01H: The operation is executed as if it were of infinite accuracy. The result of the multiply operation is not rounded, but the result of the subtract operation is rounded, in accordance with the current rounding mode.

When PID7-0 = 02H,03H,12H,13H,14H: The result of the multiply operation is not rounded, but the result of the subtract operation is rounded, in accordance with the current rounding mode.

[Supplement]
The rounding behavior of this operation depends on the CPU version as follows.

When PID7-0 = 01H: The operation is executed as if it were of infinite accuracy and the result is rounded in accordance with the current rounding mode.

When PID7-0 = 02H,03H,12H,13H,14H: The result of the multiply operation is not rounded, but the result of the subtract operation is rounded, in accordance with the current rounding mode.
7.4.4 Floating-Point Instruction Set

**FMAF.S(P341,342), FNMAF.S(P345,346)**

< Before >

**[Description]**
The operation is executed as if it were of infinite accuracy. The results of the multiply operation is not rounded, but the results of the add operation is rounded in accordance with the current rounding mode.

**[Supplement]**
The operation is executed as if the results of multiplication were of infinite accuracy and the results of the fused-multiply-add operation are rounded in accordance with the current rounding mode.

< After >

**[Description]**
The operation is executed as if it were of infinite accuracy. The results of the multiply operation is not rounded, but the results of the add operation is rounded in accordance with the current rounding mode.

**[Supplement]**
The operation is executed as if the results of multiplication were of infinite accuracy and the results of the fused-multiply-add operation are rounded in accordance with the current rounding mode.

**FMSF.S(P343,344), FNMSF.S(P347,348)**

< Before >

**[Description]**
The operation is executed as if it were of infinite accuracy. The results of the multiply operation is not rounded, but the results of the subtract operation is rounded in accordance with the current rounding mode.

**[Supplement]**
The operation is executed as if the results of multiplication were of infinite accuracy and the results of the fused-multiply-subtract operation are rounded in accordance with the current rounding mode.

< After >

**[Description]**
The operation is executed as if it were of infinite accuracy. The results of the multiply operation is not rounded, but the results of the subtract operation is rounded in accordance with the current rounding mode.

**[Supplement]**
The operation is executed as if the results of multiplication were of infinite accuracy and the results of the fused-multiply-subtract operation are rounded in accordance with the current rounding mode.
3. [Judgement flow]

(A) Are FMA instructions used? (by assembler and compiler*)

1. Renesas CC-RH compiler generates FMA instructions by below option

   When -Xuse_fma or option is applied,
   FMA instructions are generated

   Supported from CC-RH V2.00.00

   When -relaxed_math option is applied,
   FMA instructions are generated

2. Green Hills Software (GHS) compiler generates FMA instructions by below option

   When one of -O* option is applied
   except -Onone, -Omaxdebug, and -Olink option,
   FMA instructions are generated

   When -fused_madd option (default) is applied,
   FMA instructions are generated,
   if -O* except -Onone, -Omaxdebug, and -Olink option is applied

   Supported from 2016.5.5

   When -no_fused_madd option is applied,
   FMA instructions are not generated,
   even if -O* except -Onone, -Omaxdebug, and -Olink option is applied

3. If another compiler is used and need judgement, please contact Renesas with compiler information.
   Also, if you want to use the version released after July 2022, please contact us.
   (The newest version on 19th July 2022, CC-RH: V20.40.00, GHS: 2022.1.4)

4. [Future Action]

   For the user's manual, the descriptions of red characters will be released by an errata.

<Reference Documents>

<table>
<thead>
<tr>
<th>Series</th>
<th>Group</th>
<th>Document Title</th>
<th>Rev.</th>
<th>Document Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>RH850</td>
<td></td>
<td>RH850G3KH User’s Manual: Software</td>
<td>1.20</td>
<td>R01US0165EJ0120</td>
</tr>
</tbody>
</table>