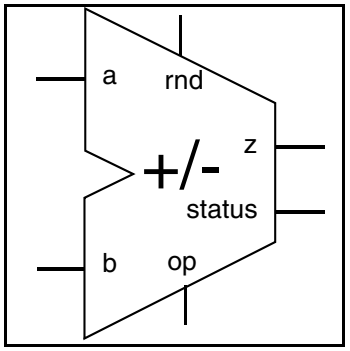
DW_fp_addsub

Floating-Point Adder/Subtractor

Version, STAR and Download Information: IP Directory

Features and Benefits



- The precision is controlled by parameters, and covers formats in the IEEE standard
- Exponents can range from 3 to 31 bits
- Fractional part of the floating-point number can range from 2 to 253 bits
- Fully compatible with the IEEE 754 Floating-point standard[1] with proper set of parameters
- DesignWare datapath generator is employed for better power and QoR

Description

DW_fp_addsub is a floating-point component that is capable of adding or subtracting two floating-point values, `a` and `b`, to produce a floating-point result `z`. The control over the arithmetic operation is done through the input `op`. The input `rnd` is a 3-bit rounding mode (see Rounding Modes in the *Datapath Floating-Point Overview*) and the output `status` is an 8-bit status flag.

Table 1-1 Pin Description

Pin Name	Width	Direction	Function
a	*sig_width* +*exp_width* +1 bits	Input	Input data
b	*sig_width* +*exp_width* +1 bits	Input	Input data
op	1 bit	Input	Defines the operation: 0: Addition 1: Subtraction
z	*sig_width* +*exp_width* +1 bits	Output	a `op` b
status	8 bits	Output	See STATUS Flags in the *Datapath Floating-Point Overview*
rnd	3 bits	Input	Rounding mode

1. For more information, see IEEE 754 Compatibility in the *Datapath Floating-Point Overview*.

Table 1-2 Parameter Description

Parameter	Values	Description
sig_width	2 to 253 bits Default: 23	Word length of fraction field of floating-point numbers `a`, `b`, and `z`
exp_width	3 to 31 bits Default: 8	Word length of biased exponent of floating-point numbers `a`, `b`, and `z`
ieee_compliance	0 or 1 Default: 0	When 1, the generated architecture is fully compliant with IEEE 754 standard, including the use of denormals and NaNs.

Table 1-3 Synthesis Implementations

Implementation Name	Function	License Feature Required
rtl	Area-optimized synthesis model	DesignWare
str	Delay-optimized synthesis model	DesignWare

Table 1-4 Simulation Models

Model	Function
DW02.DW_FP_ADDSUB_CFG_SIM	Design unit name for VHDL simulation
dw/dw02/src/DW_fp_addsub_sim.vhd	VHDL simulation model source code
dw/sim_ver/DW_fp_addsub.v	Verilog simulation model source code

Table 1-5 Functional Description

a	b	op	status[a]	z[b]
a (floating-point)	b (floating-point)	0	*	`a` + `b` (floating-point)
a (floating-point)	b (floating-point)	1	*	`a` - `b` (floating-point)

a. The details of `status` flags, if used, can be found in Table 9 of the Datapath Floating-Point Overview.
b. The actual value of the result is defined by the rounding mode.

The parameter *ieee_compliance* controls the functionality of this component. When the parameter is 0, the component is backward compatible with the DW_add_fp component (previously available in this library). The DW_add_fp does not work with NaNs and denormals. NaNs are considered infinities and denormals are considered zeros.

When the *ieee_compliance* parameter is set to 1, the component is fully compliant with the IEEE 754 standard, and therefore operates with NaNs and denormals.

For more information about the floating-point system defined for all the DW_fp components, including `status` flag bits, and integer and floating-point formats, refer to the topic titled *Datapath Floating-Point Overview*.

Related Topics

- Datapath Floating-Point Overview
- DesignWare Building Block IP Documentation Overview

HDL Usage Through Component Instantiation - Verilog

```
module DW_fp_addsub_inst( inst_a, inst_b, inst_rnd, inst_op, z_inst,
          status_inst );

parameter sig_width = 23;
parameter exp_width = 8;
parameter ieee_compliance = 0;


input [sig_width+exp_width : 0] inst_a;
input [sig_width+exp_width : 0] inst_b;
input [2 : 0] inst_rnd;
input inst_op;
output [sig_width+exp_width : 0] z_inst;
output [7 : 0] status_inst;

    // Instance of DW_fp_addsub
    DW_fp_addsub #(sig_width, exp_width, ieee_compliance)
      U1 ( .a(inst_a), .b(inst_b), .rnd(inst_rnd),
               .op(inst_op), .z(z_inst), .status(status_inst) );

endmodule
```

HDL Usage Through Component Instantiation - VHDL

```
library IEEE,DWARE;
use IEEE.std_logic_1164.all;
use DWARE.dw_foundation_comp.all;
-- If using numeric types from std_logic_arith package,
-- comment the preceding line and uncomment the following line:
-- use DWARE.DW_Foundation_comp_arith.all;

entity DW_fp_addsub_inst is
      generic (
        inst_sig_width : POSITIVE := 23;
        inst_exp_width : POSITIVE := 8;
        inst_ieee_compliance : INTEGER := 0
        );
      port (
        inst_a : in std_logic_vector(inst_sig_width+inst_exp_width downto 0);
        inst_b : in std_logic_vector(inst_sig_width+inst_exp_width downto 0);
        inst_rnd : in std_logic_vector(2 downto 0);
        inst_op : in std_logic;
        z_inst : out std_logic_vector(inst_sig_width+inst_exp_width downto 0);
        status_inst : out std_logic_vector(7 downto 0)
        );
    end DW_fp_addsub_inst;

architecture inst of DW_fp_addsub_inst is

begin
    -- Instance of DW_fp_addsub
    U1 : DW_fp_addsub
    generic map ( sig_width => inst_sig_width,
                  exp_width => inst_exp_width,
                  ieee_compliance => inst_ieee_compliance )
    port map ( a => inst_a, b => inst_b, rnd => inst_rnd,
               op => inst_op, z => z_inst, status => status_inst );

end inst;

-- pragma translate_off
configuration DW_fp_addsub_inst_cfg_inst of DW_fp_addsub_inst is
 for inst
 end for; -- inst
end DW_fp_addsub_inst_cfg_inst;
-- pragma translate_on
```

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