# FIR manual

File update records

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# directory

# Overview

## 1.1 Functional Features

1) Data bit width configurable
2) pipeline input/output
3) All data output precision
4) Filter order number can be configured
5) Filter coefficients can be dynamic configuration
6) Support filter coefficients pre-storage

# Module principle

FIR Principle:

$$y[k] = \sum_{n=0}^{N-1} a[n]x(k-n), k = 0,1,\dots,N-1$$

The user can choose the implementation architecture according to whether the filter coefficients are symmetric or not. FIR with symmetric coefficients can save half of the multipliers and lower output delay.

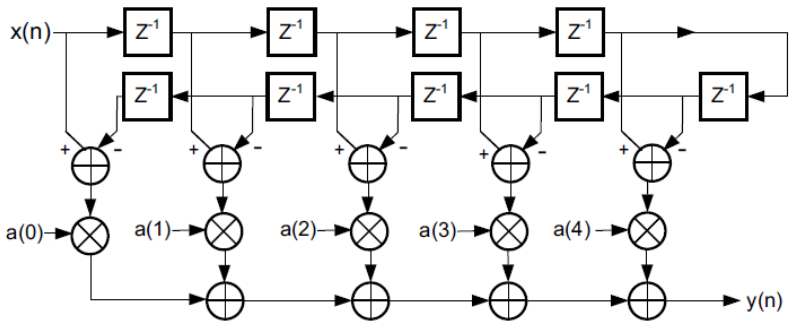


Figure 1 1coefficient of symmetric structure (10)

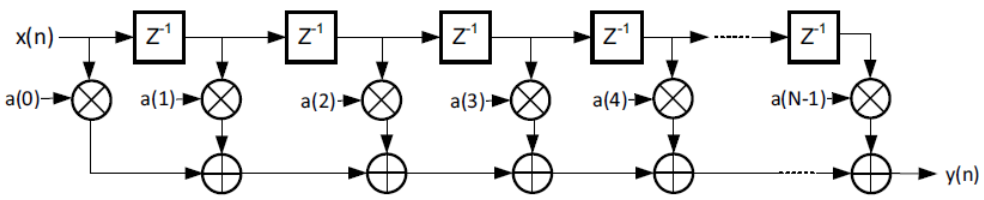

Figure 2 2Coefficient asymmetric architecture (nth-order)

## Parameters are defined

Table 1 Definition of parameters1

| Parameter names | Default | Instructions |
|---|---|---|
| SPEED_FAST | 1 | Depending on the fir clock frequency setting, this value can be set to 1 when the timing is tight.<br>1-multiply-accumulate is completed in two beats<br>0- Multiply and accumulate in one beat |
| DATA_IN_WIDTH | 16 | Data input bit width |
| DATA_OUT_WIDTH | 16 + 16 + 2 | Data output bit width,<br>Calculation method:<br>DATA_IN_WIDTH + COE_WIDTH + ceil(log2(COE_TAPS)) |
| COE_WIDTH | 16 | Filter coefficient bit width |
| COE_TAPS | 3 | Filter order |
| COE_SYMMETRY | 0 | Whether the filter coefficients are symmetrical or not, FIR with symmetrical coefficient structure can save half of the multipliers and lower output delay.<br>1- Symmetrical structure<br>0- Asymmetric structures |
| COE_LOCAL_NUM | 2 | Number of filter coefficient prememory banks |
| COE_SEL_WIDTH | 2 | Choose the bit width for the filter coefficient bank<br>Calculation:<br>ceil(log2(COE_LOCAL_NUM + 1)) |
| COE_FILE | {16'd11, 16'd12, 16'd13, 16'd21, 16'd22, 16'd33} | Filter coefficient prestored values, format:<br>{index0_1,index0_2,... ,index0_COE_TAPS,<br>index1_1,index1_2,... ,index1_COE_TAPS,<br>... } |

## Interface definition

Table 2 Interface Signal Definition2

| Signal Name | Directions | Clock domain | Description |
|---|---|---|---|
| clk | Input | -- | Master clock |
| rst_n | Input | clk | Reset signal |
| coe_sel_vld_i | Input | clk | Filter coefficient selection enabled. |
| coe_sel_index_i[COE_SEL_WIDTH-1:0] | Input | clk | Filter coefficients select index.<br>Choose a value of 0 - (COE_LOCAL_NUM-1), which corresponds to the prestored coefficients.<br>Choose the value COE_LOCAL_NUM, which corresponds to the dynamic configuration factor.<br>Other values, invalid |
| coe_reload_vld_i | Input | clk | Filter coefficients dynamic configuration enabled |
| coe_reload_data_i[COE_WIDTH-1:0] | Input | clk | 滤波器系数动态数据，滤波器系数需要以流的形式持续输入 COE_TAPS 个数据。 |
| data_vld_i | The input | clk | Data input can make |
| data_i[DATA_IN_WIDTH-1:0] | Input | clk | Data entry |

| | | | |
|---|---|---|---|
| data_vld_o | Output | clk | Filtered data output enabled |
| data_o[DATA_IN_WIDTH-1:0] | The output | clk | Filtered data output |

## Interface timing

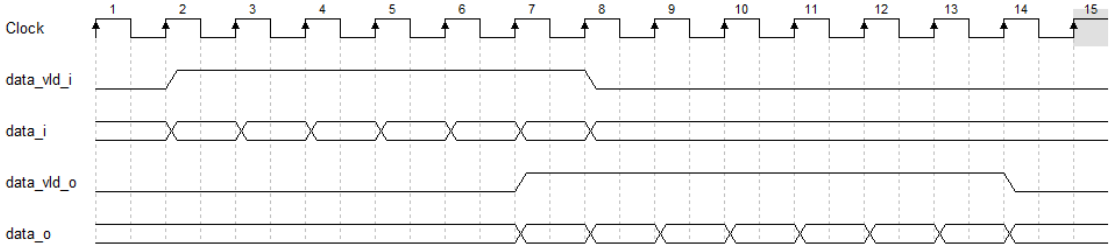


FIG. 3 3Data input and output timing

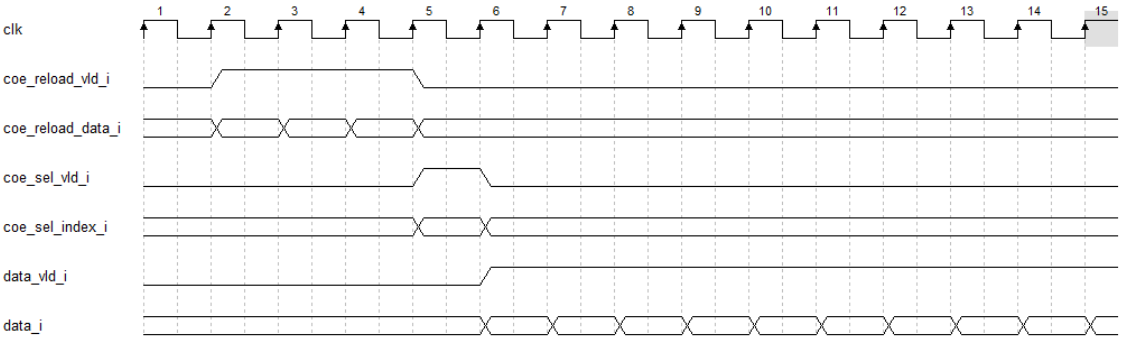


Figure 4 4dynamic configuration and coefficient of gravity separation sequence

Note 1: When reselection of filter coefficients is performed

| | |
|---|---|
| 0 ≤ coe_sel_index_i < COE_LOCAL_NUM | The group of prestored coefficients for the index value |
| coe_sel_index_i == COE_LOCAL_NUM | Corresponding to dynamically configured coefficient groups |
| coe_sel_index_i == others | Invalid |

Note 2: the filter coefficients re-election, need to make sure that FIR module for data processing, otherwise the output data is wrong. (because the filter coefficients are changed in the process of calculation)