High-Speed Adaptive FIR Filter Megafunction

Target Applications:
Communications,
Digital Signal Processing

Family:
FLEX 10K

Vendor:

I S S

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Features

- High-speed adaptive finite impulse response (FIR) filter megafunction
- Fully parameterized
- Optimized for performance and density
- Supports 90-MHz filter performance

General Description

The FIR filter megafunction implements a FIR filter targeted for speech, audio, image, and video processing applications. The megafunction is optimized for the Altera® FLEX® 10K architecture and can be cascaded, which enables designers to create large, high-speed FIR filters that can be partitioned over multiple devices. To reduce hardware and control circuitry when developing high-performance FIR filters, the megafunction is available with an ID port, allowing each device to be identified individually. A single coefficient bus and a single address bus can be used, dramatically reducing design complexity. See Figure 1. A single license entitles the customer to use one FIR filter megafunction to create a range of FIR filters. In addition, the FIR filter megafunction can be customized at no additional cost.

Figure 1. FIR Filter Megafunction Block Diagram
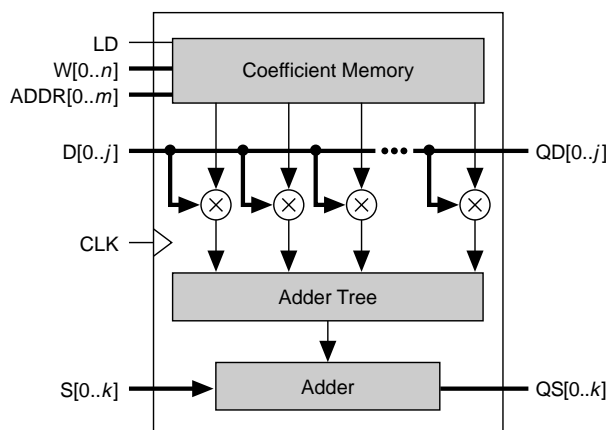
The FIR filter megafunction implements the function described by the formula:

$$qs_t = \sum_{i=0}^{n-1} w_i d_{(t-i)}$$

where: qs_t = Filter output at time t n = Number of filter taps
                 w_i = Coefficient of tap i d_{t-i} = Input data at time $(t - i)$

Coefficient Programmability

The coefficients in the FIR filter megafunction are programmable—an important factor in many applications—which allows the designer to determine how the coefficients in the megafunction are accessed. Although fixed coefficient programming utilizes fewer logic resources, programming coefficients on-the-fly offers a more flexible solution.

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ALTERA MEGAFUNCTION PARTNERS PROGRAM

On-the-fly coefficient programming can be performed in a single clock cycle for each coefficient, thereby allowing coefficients to be modified without disrupting the data flow. Two different options of on-the-fly coefficient programming are available:

■ *Simple programmability*—Requires the coefficients to be loaded in serial word format. All coefficients must be loaded each time a coefficient is changed.

■ *Full programmability*—Allows the coefficients to be addressed individually. The designer can program the coefficient to meet design requirements.

Performance & Implementation

Customizing the FIR filter megafunction provides various advantages:

■ Megafunction optimized to satisfy the specific design requirements
■ Ability to determine data wordlengths and data word (i.e., accuracy) formats, rather than being restricted to the accuracy of off-the-shelf devices
■ Performance matches the designer's real-time processing requirements
■ Simple interface (i.e., customer-specified, logic minimized, fully parameterized)
■ Sample rates from 20 kHz to over 90 MHz
■ One-dimensional (1-D) and two-dimensional (2-D) variants
■ Fast, on-the-fly coefficient programming, which is ideal for adaptive filtering
■ Megafunction can be cascaded to create large filters

Customizing the FIR filter megafunction produces megafunctions with a wide range of performances. For example, high-performance FIR filters can achieve sample rates in excess of 90 megasamples per second (MSPS). Table 1 lists the FIR filter megafunction parameters that can be customized, and shows a typical example of a FIR filter implementation, including variable parameters, performance, and implementation size. The data demonstrates that the megafunction achieves high performance and maintains a moderate implementation area. In this example, changing all of the coefficients at the given sample rate would take less than 145 ns.

Table 1. FIR Filter Parameters & Implementation Example

Parameter	Values	Example Implementation
Input data wordlength	8 to 24 bits	8 bits
Output data wordlength	8 to 32 bits	8 bits
Coefficient wordlength	8 to 24 bits	8 bits
Address bus	3 to 12 bits	4 bits
Number of taps	8 to 512 taps	8 taps
Data word formats	Two's complement, signed binary	Two's complement, bit parallel
Number of dimensions	1-D or 2-D	1-D
Performance	20 kHz to 90 MHz	55 MHz
Internal accuracy	8 to 32 bits	20 bits
Coefficient programmability options	Fixed coefficients, simple programmability, full programmability	On-the-fly coefficient programming, full programmability
Logic elements (LEs) used	Filter dependent	2,750
Percentage of EPF10K50 device utilized	–	66%

The FIR filter megafunction can be customized at no additional cost; the designer can specify the data wordlengths, the number of filter taps, data word formats, number of dimensions (i.e., 1-D or 2-D), and performance (e.g., pipelining). Contact ISS technical support for information on choosing the best parameter settings to meet the requirements of specific applications.