CFFT A new radix 4 complex fft processor

1. Description

CFFT is a radix-4 fast Fourier transform (FFT) core with configurable data width and
a configurable number of sample points in the FFT.

Twiddle factors are implemented using the CORDIC algorithm, causing the gain of the
CFFT core to be different from the standard FFT algorithm. This variation in gain
is not important for orthogonal frequency division modulation (OFDM) and demodulation.
The gain can be corrected, to that of a conventional FFT, by applying a constant
multiplying factor.

The input of FFT core is ordered by radix 4 and the output is reverse ordered.
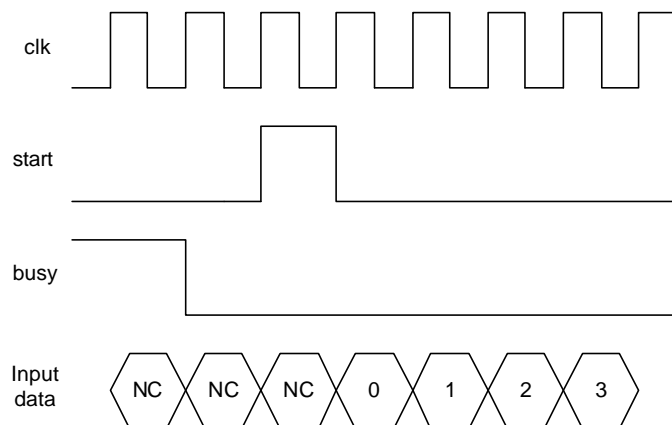
2. Theory of operation

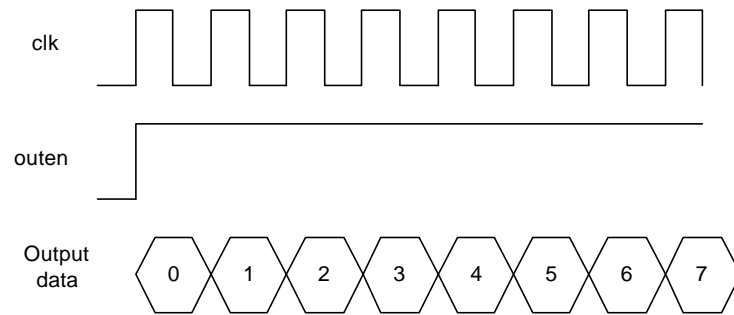FFT algorithm is described in detail in many text books. We'll just skip it here.

3. Block diagram
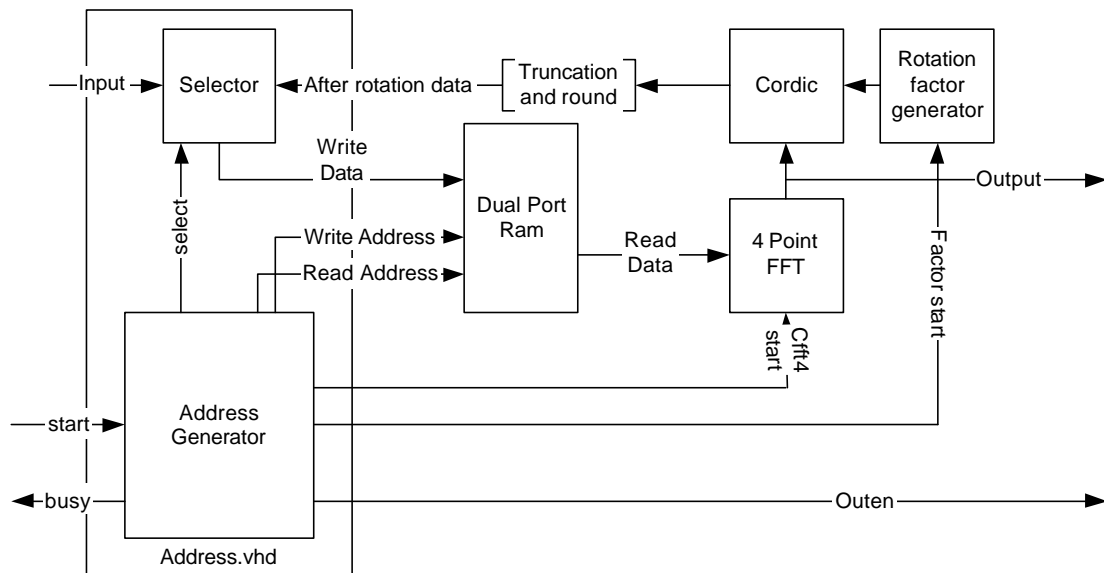
4. Timing

a. input timing

b. output timing

5. Misc

a. Gain

Points	Standard FFT	CFFT	Standard IFFT	CFFT(inverse)
256	1	0.0698	1/256	17.9
1024	1	0.0287	1/1024	29.4
4096	1	0.0118	1/4096	48.2742

The result is obtained by comparison between Matlab simulation and circuit simulation.

b. Output Order

The output sequence is 2bit reverse ordered. For example, the 789th (1100010101) output in an 1024-point FFT is actually at 339 (0101010011).

c. Synthesis

This core can be synthesized using Synplify70. It can be placed and routed using Xilinx ISE4.1. A 1024 point FFT, with a 12 bit I/Q input can be fitted into an XCV50E-6 and runs at a clock speed of 90MHz.