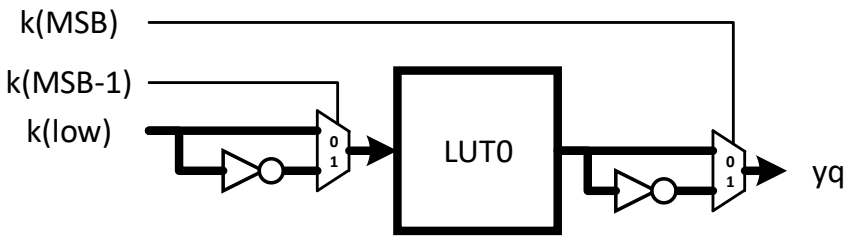
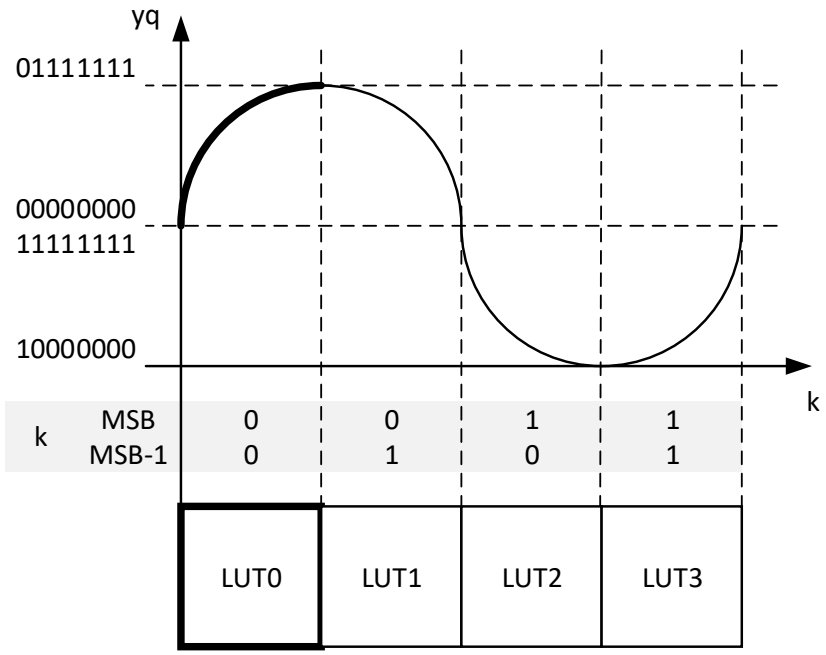
LUT Optimization

Sine wave has quadrangular-symmetrical profile.
We can use just the first quarter, LUT0, adjusting

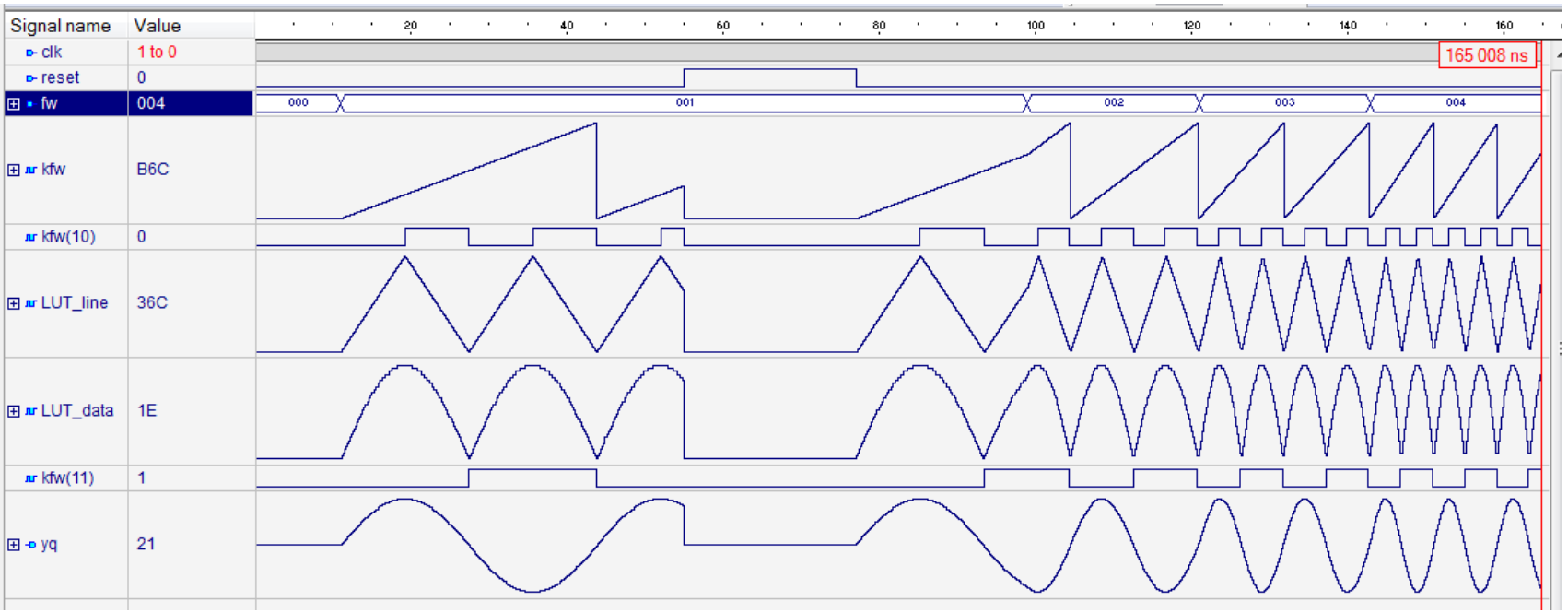
- access modality: normal or reverse (complement).
- amplitude polarity: plain or complemented.





This will save a lot of area (% utilization) for the implementation.

LUT Optimization



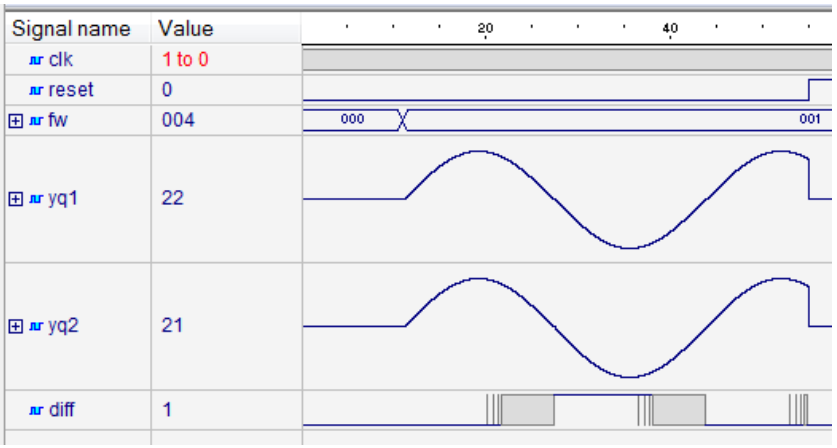
Exercise

To check if the DDFS and DDFS_QLUT are equal, we can write a comparison Test Bench.

```
i_dut1 : DDFS
  port map (
    clk          => clk,
    reset        => reset,
    fw           => fw,
    yq           => yq1
  );

i_dut2 : DDFS_QLUT
  port map (
    clk          => clk,
    reset        => reset,
    fw           => fw,
    yq           => yq2
  );

diff  <= '1' when yq1/=yq2 else '0';
```



Different!!??

Exercise

The DDFS_QLUT is different!!! But the differences are maximum of 1 LSB (one index position of C1 negation).

We can analyze the spectrum of one sin period in both cases:

THD here is evaluated with 3^{rd} 5^{th} 7^{th} 9^{th} 11^{th} harmonics.

Usually even less harmonics are used.

DDFS_QLUT is worst but both THDs are still acceptable

.

$$THD = \frac{\sqrt{V_2^2 + V_3^2 + V_4^2 + \cdots}}{V_1}$$