

MAX 10 Multiplier

Last updated 8/10/20

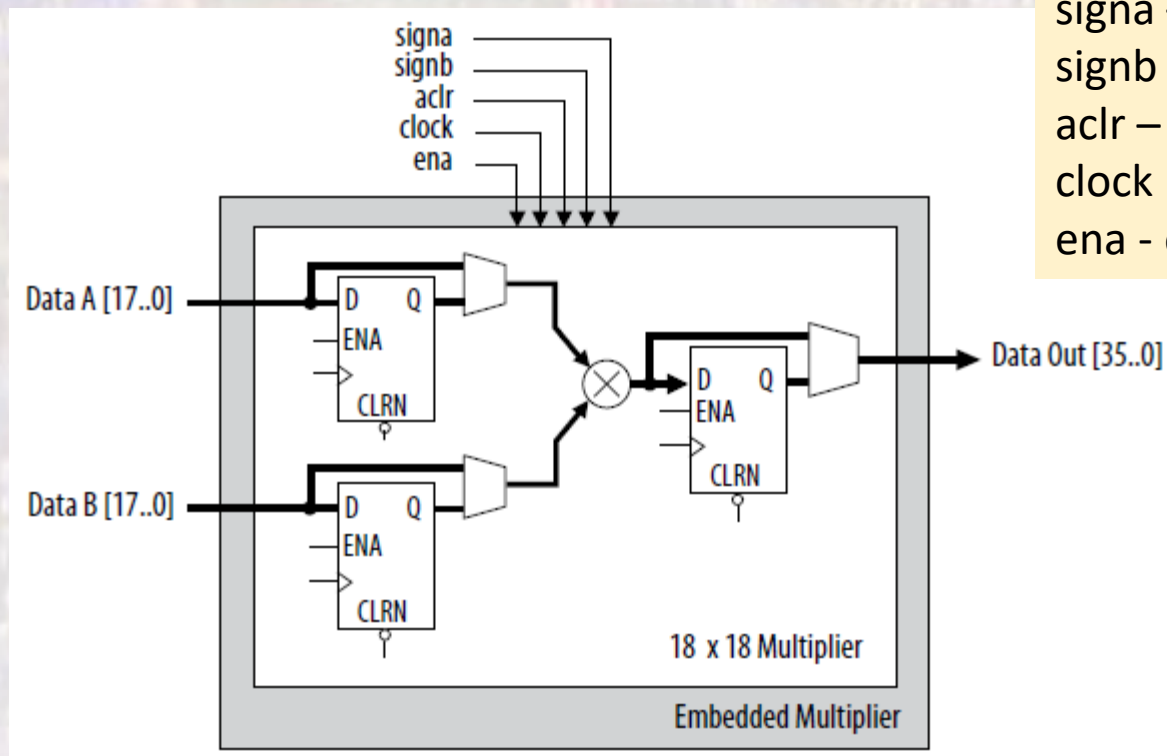
MAX10 Multiplier

These slides describe the operation of the MAX10 Multiplier block

Upon completion: You should be able implement a multiplier on the MAX10 FPGA

MAX10 Multiplier

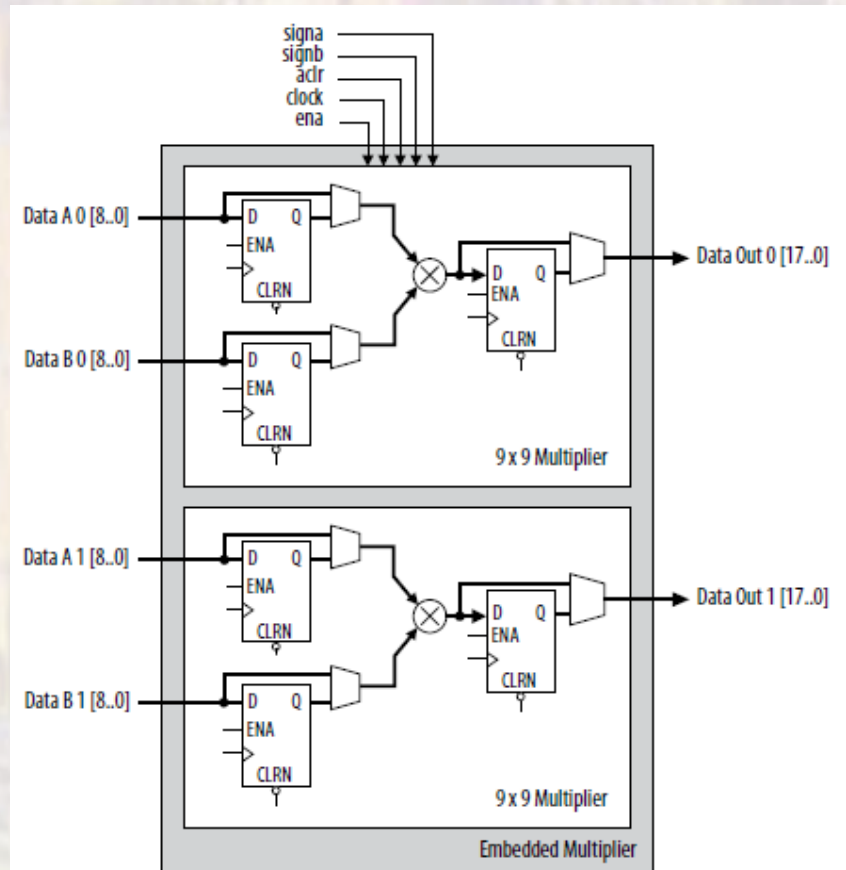
- Multiplier
 - 144 - 18 x 18 multipliers
 - Can be configured as 2 – 9 x 9 multipliers



signa – A is signed
signb – B is signed
aclr – clear registers
clock
ena - enable

MAX10 Multiplier

- Additional Fixed Blocks - Multiplier
 - Configured as 2 – 9 x 9 multipliers



MAX10 Multiplier

- Multipliers
 - Embedded
 - Signals
 - `signa` – A is signed
 - `signb` – B is signed

Data A		Data B		Result
<code>signa</code> Value	Logic Level	<code>signb</code> Value	Logic Level	
Unsigned	Low	Unsigned	Low	Unsigned
Unsigned	Low	Signed	High	Signed
Signed	High	Unsigned	Low	Signed
Signed	High	Signed	High	Signed

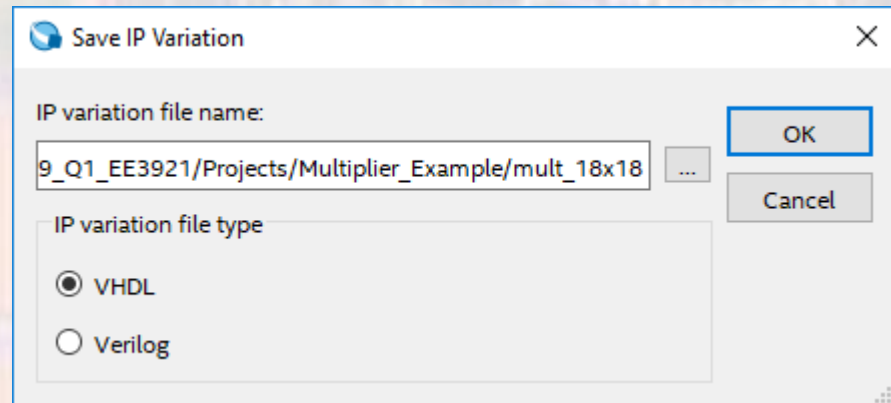
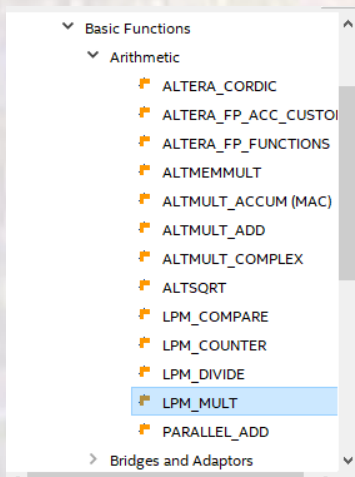
Src: MAX 10 Device Handbook

MAX10 Multiplier

- Multipliers
 - Embedded
 - IP Catalog
 - lpm_mult – standard multiplier
 - altmult_add – uses LEs to implement the adders in multiply/add function
 - altmult_accum –uses LEs to implement the accumulator in a multiply/accumulate function
 - altmult_complex – complex multiplier
 - altmemmult – memory based multiplier

MAX10 Multiplier

- Multipliers – LPM_MULT
 - Note – no signa or signb in this implementation
just an option for signed or unsigned multiplication



MAX10 Multiplier

- Multipliers

MegaWizard Plug-In Manager [page 1 of 5]

LPM_MULT [About] [Documentation]

1 Parameter Settings | 2 EDA | 3 Summary

General > General2 > Pipelining

Currently selected device family: MAX 10
 Match project/default

Multiplier configuration

Multiply 'dataa' input by 'datab' input
 Multiply 'dataa' input by itself (squaring operation)

How wide should the 'dataa' input be? 18 bits
How wide should the 'datab' input be? 18 bits

How should the width of the 'result' output be determined?

Automatically calculate the width
 Restrict the width to 36 bits

Resource Usage
2 dsp_9bit

[Cancel] [< Back] [Next >] [Finish]

MAX10 Multiplier

- Multipliers

MegaWizard Plug-In Manager [page 2 of 5]

LPM_MULT [About] [Documentation]

1 Parameter Settings | 2 EDA | 3 Summary

General > General2 > Pipelining

mult_18x18

dataa[17..0] × datab[17..0] = result[35..0] (Unsigned multiplication)

Resource Usage: 2 dsp_9bit

Datab Input
Does the 'datab' input bus have a constant value?
 No
 Yes, the value is []

Multiplication Type
Which type of multiplication do you want?
 Unsigned
 Signed

Implementation
Which multiplier implementation should be used?
 Use the default implementation
 Use the dedicated multiplier circuitry (Not available for all families)
 Use logic elements

[Cancel] [**< Back**] [**Next >**] [Finish]

MAX10 Multiplier

- Multipliers

MegaWizard Plug-In Manager [page 3 of 5]

LPM_MULT About Documentation

1 Parameter Settings 2 EDA 3 Summary

General > General2 > Pipelining >

mult_18x18

dataa[17..0] datab[17..0] result[35..0]

Unsigned multiplication

Resource Usage

2 dsp_9bit

Pipelining

Do you want to pipeline the function?

No

Yes, I want output latency of 0 dock cycles

Create an 'aclr' asynchronous clear port

Create a 'clken' dock enable dock

Optimization

What type of optimization do you want?

Default

Speed

Area

Cancel < Back Next > Finish

MAX10 Multiplier

- Multipliers

MegaWizard Plug-In Manager [page 5 of 5]

LPM_MULT About Documentation

1 Parameter Settings 2 EDA 3 Summary

mult_18x18

dataa[17..0] datab[17..0] result[35..0] Unsigned multiplication

Resource Usage
2 dsp_9bit

Turn on the files you wish to generate. A gray checkmark indicates a file that is automatically generated, and a green checkmark indicates an optional file. Click Finish to generate the selected files. The state of each checkbox is maintained in subsequent MegaWizard Plug-In Manager sessions.

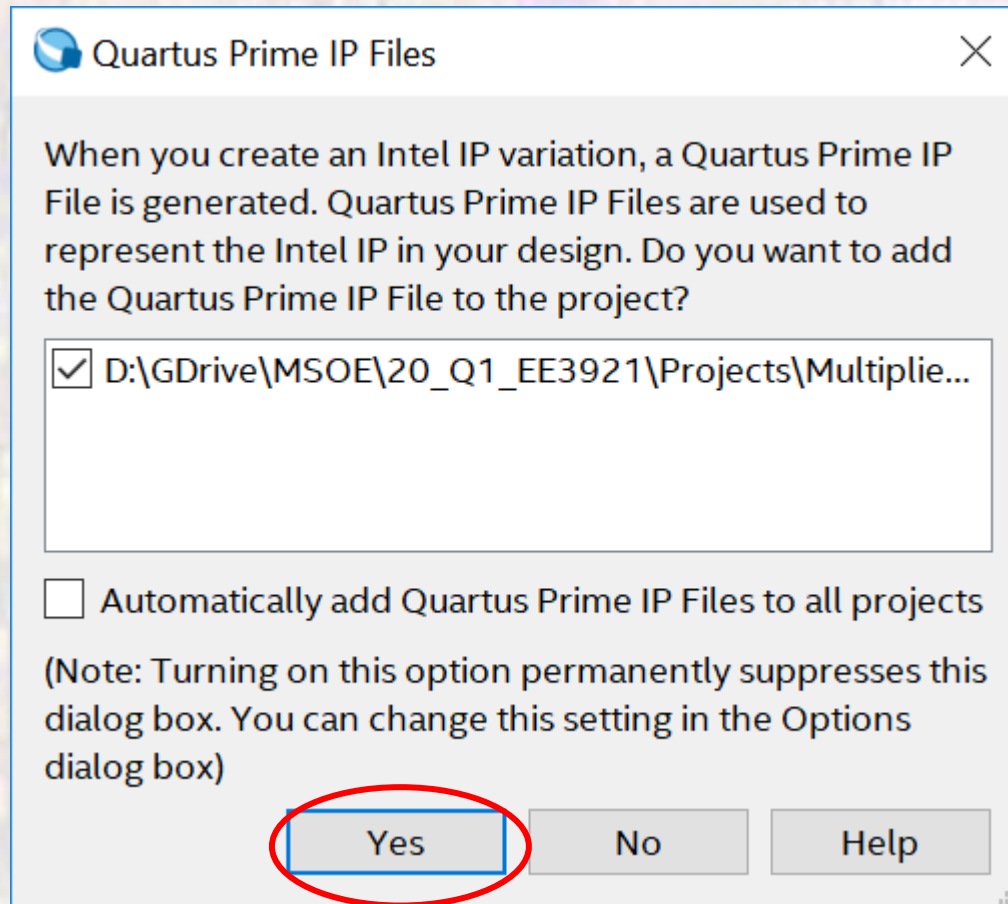
The MegaWizard Plug-In Manager creates the selected files in the following directory:
D:\GDrive\MSOE\19_Q1_EE3921\Projects\Multiplier_Example\

File	Description
<input checked="" type="checkbox"/> mult_18x18.vhd	Variation file
<input type="checkbox"/> mult_18x18.inc	AHDL Include file
<input checked="" type="checkbox"/> mult_18x18.cmp	VHDL component declaration file
<input type="checkbox"/> mult_18x18.bsf	Quartus Prime symbol file
<input checked="" type="checkbox"/> mult_18x18_inst.vhd	Instantiation template file

Cancel < Back Next > Finish

MAX10 Multiplier

- Multipliers



MAX10 Multiplier

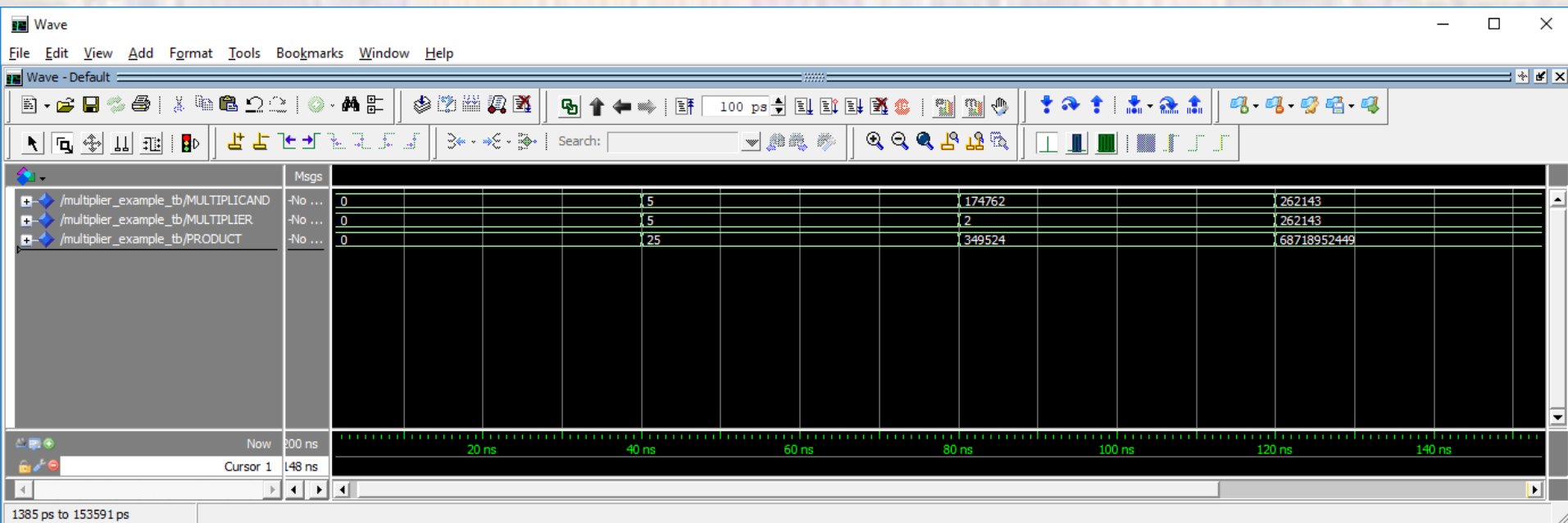
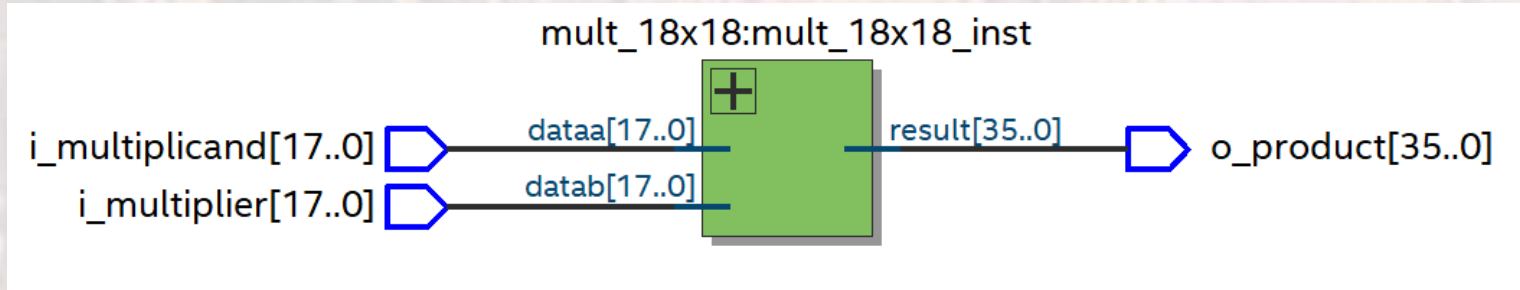
- Multipliers

```
-----  
-- multiplier_example.vhdl  
-- by: johnsontimoj  
-- created: 8/17/2018  
-- version: 0.0  
-----  
-- Multiplier example  
-- inputs: multiplier, multiplicand  
-- outputs: product  
-----  
library ieee;  
use ieee.std_logic_1164.all;  
use ieee.numeric_std.all;  
entity multiplier_example is  
    port ( i_multiplicand: in std_logic_vector(17 downto 0);  
          i_multiplier:   in std_logic_vector(17 downto 0);  
          o_product:      out std_logic_vector(35 downto 0)  
        );  
end entity;
```

```
architecture behavioral of multiplier_example is  
    component mult_18x18  
        PORT  
        ( dataa      : IN STD_LOGIC_VECTOR (17 DOWNT0 0);  
          datab     : IN STD_LOGIC_VECTOR (17 DOWNT0 0);  
          result    : OUT STD_LOGIC_VECTOR (35 DOWNT0 0)  
        );  
    end component;  
begin  
    mult_18x18_inst : mult_18x18 PORT MAP (  
        dataa      => i_multiplicand,  
        datab     => i_multiplier,  
        result    => o_product  
    );  
end architecture;
```

MAX10 Multiplier

- Multipliers



MAX10 Multiplier

- Multipliers
 - Soft Multipliers
 - RAM based Look Up Table
 - All possible solutions stored
 - Used for constant coefficient multiplication
 - ALTMEMMULT
 - Logic based