**module** BoothMul(clk,rst,start,**X**,**Y**,valid,**Z**);

**input** clk;

**input** rst;

**input** start;

**input** **signed** [**3**:**0**]**X**,**Y**;

**output** **signed** [**7**:**0**]**Z**;

**output** valid;

**reg** **signed** [**7**:**0**] **Z**,next\_Z,Z\_temp;

**reg** next\_state, pres\_state;

**reg** [**1**:**0**] temp,next\_temp;

**reg** [**1**:**0**] count,next\_count;

**reg** valid, next\_valid;

**parameter** **IDLE** = **1'b0**;

**parameter** **START** = **1'b1**;

**always** @ (**posedge** clk **or** **negedge** rst)

**begin**

**if**(!rst)

**begin**

**Z**          <= **8'd0**;

valid      <= **1'b0**;

pres\_state <= **1'b0**;

temp       <= **2'd0**;

count      <= **2'd0**;

**end**

**else**

**begin**

**Z**          <= next\_Z;

valid      <= next\_valid;

pres\_state <= next\_state;

temp      <= next\_temp;

count      <= next\_count;

**end**

**end**

**always** @ (\*)

**begin**

**case**(pres\_state)

**IDLE:**

**begin**

next\_count = **2'b0**;

next\_valid = **1'b0**;

**if**(start)

**begin**

    next\_state = **START**;

    next\_temp = {**X**[**0**],**1'b0**};

    next\_Z = {**4'd0**,**X**};

**end**

**else**

**begin**

    next\_state = pres\_state;

    next\_temp = **2'd0**;

    next\_Z = **8'd0**;

**end**

**end**

**START:**

**begin**

**case**(temp)

**2'b10**: Z\_temp = {**Z**[**7**:**4**]-**Y**,**Z**[**3**:**0**]};

**2'b01**: Z\_temp = {**Z**[**7**:**4**]+**Y**,**Z**[**3**:**0**]};

**default**: Z\_temp = {**Z**[**7**:**4**],**Z**[**3**:**0**]};

**endcase**

next\_temp = {**X**[count+**1**],**X**[count]};

next\_count = count + **1'b1**;

next\_Z = Z\_temp >>> **1**;

next\_valid = (&count) ? **1'b1** : **1'b0**;

next\_state = (&count) ? **IDLE** : pres\_state;

**end**

**endcase**

**end**

**endmodule**