系统的 Verilog 设计

```
----------------------------------------时钟代码----------------------------------------
module clock(hour_g,hour_s,minute_g,minute_s,second_g,second_s,clk,clkh_g,
clkm_g,clk_set,clk_alarm,alarm_on,rco_1,rco_2,rco_3,rco_4,rco_5,rco_6);
----------------------------------输出输入接口定义-------------------------------------
output [6:0] hour_g,hour_s,minute_g,minute_s,second_g,second_s;
output rco_1,rco_2,rco_3,rco_4,rco_5,rco_6;
input clk,clkh_g,clkm_g,clk_set;
input clk_alarm,alarm_on;
-------------------------使用的输入输出、参数及接口针脚说明-------------------
//      use hour_1、hour_2 minute_1 minute_2 second_1 second_2 normal
//      use hour_3、hour_4 minute_3 minute_4 set
//      use hour_5、hour_6 minute_5 minute_6 alarm

//      use cnt1    cnt2 part clk

//      use alarm_on    alarm on/off

//      use clk_1hz normal
//      use clk_32hz show rco_1 rco_2 rco_3(integra point and alarm)

//      use set set model
//      use alarm alarm model

//      use hour_on set hour on
//      use minute_on set minute on

//      clk    ==50 MHz
//      use clkh_g clkm_g set clock/alarm clock
         by one touch or set clock by press        //pin       key[3]    key[2]
//use clk_set set model                            //pin       key[1]
//use clk_alarm alarm model                        //pin       key[0]

//use alarm_on set alarm on/off                    //pin       SW[0]

//use rco_1 rco_2 rco_3 integra point    //pin LEDR[17] LEDR[16] LEDR[15]
//use rco_1 rco_3 alarm
//use rco_4 alarm/normal model                     //pin    LEDG[7]
//use rco_5 alarm_on/off                           //pin    LEDG[6]
```

```
//use rco_6 set/normal model                    //pin    LEDG[5]

// use hour_g    our_s minute_g minute_s second_g second_s show clock
--------------------------------使用参数及输出的重定义------------------------------
reg[3:0] hour_1;
reg[3:0] hour_2;
reg[3:0] minute_1;
reg[3:0] minute_2;
reg[3:0] second_1;
reg[3:0] second_2;
reg[6:0] hour_g,hour_s,minute_g,minute_s,second_g,second_s;
reg[31:0] cnt1;
reg[31:0] cnt2;
reg           clk_1hz;
reg           clk_32hz;
reg           rco_1;
reg           rco_2;
reg           rco_3;
reg           rco_4;
reg           rco_5;
reg           rco_6;
reg           alarm;
reg           set;
reg           hour_on;
reg           minute_on;
reg[3:0] hour_3;
reg[3:0] hour_4;
reg[3:0] minute_3;
reg[3:0] minute_4;
reg[3:0] hour_5;
reg[3:0] hour_6;
reg[3:0] minute_5;
reg[3:0] minute_6;
--------------------------------50 MHz 脉冲分频为 1 Hz 时钟--------------------------
parameter div_pata1=24999999;

always@(posedge clk)

begin
   if(cnt1==div_pata1)
```

```
    begin
      cnt1<=0;
      clk_1hz=!clk_1hz;
    end
  else
  cnt1<=cnt1+1;
end
--------------------------------50 MHz 脉冲分频为 32 Hz 时钟-------------------------
parameter div_pata2=781249;

always@(posedge clk)

begin
  if(cnt2==div_pata2)
    begin
      cnt2<=0;
      clk_32hz=!clk_32hz;
    end
  else
  cnt2<=cnt2+1;
end

--------------------------时钟正常计时及按住按键设置时间-------------------------
always@(posedge clk_1hz)

begin
--------------------------时钟正常计时及按住按键设置时间-----------------------
  if(set==0||set==1&&alarm==1)            //normal
    begin
-----------------------------------时钟正常计时时间----------------------------------
    if(clkh_g==1&&clkm_g==1)
      begin                                  ///second start
      if(second_1==9)
        begin
          if(second_2==5)                              //59 second
            begin                                        /// minute start
              if(minute_1==9)
                begin
                  if(minute_2==5) //59 minute
                    begin                                  /// hour    start
```

```
-----------------------------------时钟小时24时制的限制----------------------------
                if(hour_1==3&&hour_2==2)       //23 hour
                  begin
                    second_1<=4'd0000;
                    second_2<=4'd0000;
                    minute_1<=4'd0000;
                    minute_2<=4'd0000;
                    hour_1<=4'd0000;
                    hour_2=4'd0000;
                  end
-----------------------------------时钟小时十位正常计时----------------------------
                else if(hour_1==9)
                  begin
                    second_1<=4'd0000;
                    second_2<=4'd0000;
                    minute_1<=4'd0000;
                    minute_2<=4'd0000;
                    hour_1<=4'd0000;
                    hour_2<=hour_2+1;
                  end
-----------------------------------时钟小时个位正常计时----------------------------
                else
                  begin
                    second_1<=4'd0000;
                    second_2<=4'd0000;
                    minute_1<=4'd0000;
                    minute_2<=4'd0000;
                    hour_1<=hour_1+1;
                  end
              end                                    /// hour end
-----------------------------------时钟分钟十位正常计时----------------------------
            else
              begin
                second_1<=4'd0000;
                second_2<=4'd0000;
                minute_1<=4'd0000;
                minute_2<=minute_2+1;
              end
            end
-----------------------------------时钟分钟个位正常计时----------------------------
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```
            else
              begin
                second_1<=4'd0000;
                second_2<=4'd0000;
                minute_1<=minute_1+1;                  /// minute end
              end
          end
-----------------------------------时钟秒钟十位正常计时----------------------------
         else
          begin
            second_1<=4'd0000;
            second_2<=second_2+1;
          end
       end
-----------------------------------时钟秒钟个位正常计时----------------------------
     else
       second_1<=second_1+1;                          ///second end
   end
 end                                  // normal end
--------------------------调时模式中单按键调整的小时导入时钟-----------------
 else
   begin
     if(hour_on==1)
       begin
         hour_1<=hour_3;
         hour_2<=hour_4;
       end
--------------------------调时模式中单按键调整的分钟导入时钟-----------------
     if(minute_on==1)
       begin
         minute_1<=minute_3;
         minute_2<=minute_4;
       end
--------------------------调时模式中按住按键调整的小时-------------------------
       if(clkh_g==0&&alarm==0)
       begin
         if(hour_1==3&&hour_2==2)
         begin
           hour_1<=4'd0000;
           hour_2<=4'd0000;
```

```
        end
      else if(hour_1==9)
        begin
          hour_1<=0;
          hour_2<=hour_2+1;
        end
      else
          hour_1<=hour_1+1;
    end
----------------------------调时模式中按住按键调整的分钟--------------------------
     if(clkm_g==0&&alarm==0)
    begin
        if(minute_1==9&&minute_2==5)
        begin
          minute_1<=4'd0000;
          minute_2<=4'd0000;
        end
        if(minute_1==9)
        begin
          minute_1<=4'd0000;
          minute_2<=minute_2+1;
        end
      else
          minute_1<=minute_1+1;
    end
  end

end

------------使用32 Hz频率设置整点报时和闹钟的LED灯闪烁及样式----------
always@(posedge clk_32hz)
--------------------------------设置整点报时灯的花型---------------------------------
 begin
  if(second_1==0&&second_2==0&&minute_1==0&&minute_2==0)
     //show integra point
    begin
      if(rco_1==1)
        begin
          rco_2<=1;
          rco_1<=0;
```

```
        end
      else if(rco_2==1)
        begin
          rco_3<=1;
          rco_2<=0;
        end
      else if(rco_3==1)
        begin
          rco_1<=1;
          rco_3<=0;
        end
      else
        rco_1<=1;
    end
  else
    begin
      rco_1<=0;
      rco_2<=0;
      rco_3<=0;
    end                                  //show integra point end
--------------------------------设置闹钟工作灯的花型----------------------------------
    if(alarm_on==1)              // alarm on
      begin
        if(hour_1==hour_5&&hour_2==hour_6&&minute_1==minute_5&&
          minute_2==minute_6&&second_1==4'd0000&&second_2==4'd0000)
          begin
            if(rco_1==1)
              begin
                rco_3<=1;
                rco_1<=0;
              end
            else if(rco_3==1)
              begin
                rco_1<=1;
                rco_3<=0;
              end
            else
              rco_1<=1;
          end
        else
```

```
          begin
            rco_1<=0;
            rco_3<=0;
          end
       end                  // alarm    on end
  end

-----------------------------------单按键调整小时-----------------------------------
always@(posedge clkh_g)
---------------------------单按键调整调时模式的小时-------------------------------
begin
    if(alarm==0&&set==1)                          // set hour
      begin
       hour_on<=1;
       hour_3<=hour_1;
       hour_4<=hour_2;
       if(hour_3==3&&hour_4==2)
         begin
           hour_3<=4'd0000;
           hour_4<=4'd0000;
         end
       else if(hour_3==9)
         begin
           hour_3<=0;
           hour_4<=hour_4+1;
         end
       else
           hour_3<=hour_3+1;
     end                                                 // set hour
--------------------------------调整闹钟模式的小时---------------------------------
     else if(alarm==1)                                    //set alarm hour
       begin
         if(hour_5==3&&hour_6==2)
           begin
             hour_5<=4'd0000;
             hour_6<=4'd0000;
           end
         else if(hour_5==9)
           begin
             hour_5<=0;
```

```
            hour_6<=hour_6+1;
          end
        else
          hour_5<=hour_5+1;
      end                                    // set alarm hour end
end
-----------------------------------单按键调整分钟-------------------------------------
always@(posedge clkm_g)       //set minute
-----------------------------单按键调整调时模式的分钟-----------------------------
begin
    if(alarm==0&&set==1)              // set minute
    begin
        minute_on<=1;
        minute_3<=minute_1;
        minute_4<=minute_2;
      if(minute_3==9&&minute_4==5)
        begin
          minute_3<=4'd0000;
          minute_4<=4'd0000;
        end
      else if(minute_3==9)
        begin
          minute_3<=4'd0000;
          minute_4<=minute_4+1;
        end
      else
          minute_3<=minute_3+1;
    end                                              // set minute end
--------------------------------调整闹钟模式的分钟-----------------------------------
    else if(alarm==1)           // set alarm minute
      begin
        if(minute_5==9&&minute_6==5)
          begin
            minute_5<=4'd0000;
            minute_6<=4'd0000;
          end
        else if(minute_5==9)
          begin
            minute_5<=4'd0000;
            minute_6<=minute_6+1;
```

```
          end
        else
          minute_5<=minute_5+1;
      end                          // set alarm minute end
end

-----------------------------------设置调时模式----------------------------------------
always@(posedge clk_set)         //set set model

begin
 if(set==0)
  begin
   rco_6<=1;
   set<=1;
  end
 else
  begin
   rco_6<=0;
   set<=0;
  end
end

-----------------------------------设置闹钟模式----------------------------------------
always@(posedge clk_alarm)         //set alarm model

 begin
  if(alarm==1)
   begin
    alarm<=0;
    rco_4<=0;
   end
  else
   begin
    alarm<=1;
    rco_4<=1;
   end
 end

-----------------------------------设置闹钟开关----------------------------------------
always@(posedge clk_1hz)       //show alarm_on
```

```
begin
  if(alarm_on==1)
    rco_5<=1;
  else
    rco_5<=0;
end


----------------------------------数码管显示秒钟个位数--------------------------------
always@(posedge clk_1hz)          // show second_g
-------------------------数码管显示闹钟模式中的秒钟十位数-----------------------
begin
  if(alarm==1)                          // alarm model
    begin
      second_g<=7'b1000000;
    end
---------------------数码管显示调时或正常模式中的秒钟个位数-------------------
  else                                  // normal model
    begin
      case(second_1)
        4'b0000:second_g<=7'b1000000;
        4'b0001:second_g<=7'b1111001;
        4'b0010:second_g<=7'b0100100;
        4'b0011:second_g<=7'b0110000;
        4'b0100:second_g<=7'b0011001;
        4'b0101:second_g<=7'b0010010;
        4'b0110:second_g<=7'b0000010;
        4'b0111:second_g<=7'b1111000;
        4'b1000:second_g<=7'b0000000;
        4'b1001:second_g<=7'b0010000;
        default:second_g<=7'b1111111;
      endcase
    end
end
----------------------------------数码管显示秒钟十位数--------------------------------
always@(posedge clk_1hz)              //show second_s
-----------------------数码管显示闹钟模式中的秒钟十位数-------------------------
begin
  if(alarm==1)                           // alarm model
```

```
    begin
      second_s<=7'b1000000;
    end
----------------------数码管显示调时或正常模式中的秒钟十位数-------------------
  else                                  // normal model
      begin
        case(second_2)
          4'b0000:second_s<=7'b1000000;
          4'b0001:second_s<=7'b1111001;
          4'b0010:second_s<=7'b0100100;
          4'b0011:second_s<=7'b0110000;
          4'b0100:second_s<=7'b0011001;
          4'b0101:second_s<=7'b0010010;
          4'b0110:second_s<=7'b0000010;
          4'b0111:second_s<=7'b1111000;
          4'b1000:second_s<=7'b0000000;
          4'b1001:second_s<=7'b0010000;
          default:second_s<=7'b1111111;
        endcase
      end
end
----------------------------------数码管显示分钟个位数-------------------------------
always@(posedge clk_1hz)          //show minute_g
-----------------------数码管显示闹钟模式中的分钟个位数-------------------------
begin
  if(alarm==1&&set==0&&clkm_g==1)
      begin
        case(minute_5)
          4'b0000:minute_g<=7'b1000000;
          4'b0001:minute_g<=7'b1111001;
          4'b0010:minute_g<=7'b0100100;
          4'b0011:minute_g<=7'b0110000;
          4'b0100:minute_g<=7'b0011001;
          4'b0101:minute_g<=7'b0010010;
          4'b0110:minute_g<=7'b0000010;
          4'b0111:minute_g<=7'b1111000;
          4'b1000:minute_g<=7'b0000000;
          4'b1001:minute_g<=7'b0010000;
          default:minute_g<=7'b1111111;
        endcase
```

```
    end
------------------数码管显示调时模式中单按键调整的分钟个位数----------------
else if(alarm==0&&set==1&&clkm_g==1)
    begin
      case(minute_3)
      4'b0000:minute_g<=7'b1000000;
      4'b0001:minute_g<=7'b1111001;
      4'b0010:minute_g<=7'b0100100;
      4'b0011:minute_g<=7'b0110000;
      4'b0100:minute_g<=7'b0011001;
      4'b0101:minute_g<=7'b0010010;
      4'b0110:minute_g<=7'b0000010;
      4'b0111:minute_g<=7'b1111000;
      4'b1000:minute_g<=7'b0000000;
      4'b1001:minute_g<=7'b0010000;
      default:minute_g<=7'b1111111;
     endcase
    end
-------数码管显示正常模式的或调时模式中按住按键调整的分钟个位数------
  else if(alarm==0&&set==0||alarm==1&&clkm_g==0||set==1&&clkm_g==0)
    begin
     case(minute_1)
      4'b0000:minute_g<=7'b1000000;
      4'b0001:minute_g<=7'b1111001;
      4'b0010:minute_g<=7'b0100100;
      4'b0011:minute_g<=7'b0110000;
      4'b0100:minute_g<=7'b0011001;
      4'b0101:minute_g<=7'b0010010;
      4'b0110:minute_g<=7'b0000010;
      4'b0111:minute_g<=7'b1111000;
      4'b1000:minute_g<=7'b0000000;
      4'b1001:minute_g<=7'b0010000;
      default:minute_g<=7'b1111111;
     endcase
    end
end
----------------------------------数码管显示分钟十位数--------------------------------

always@(posedge clk_1hz)          //show minute_s
-----------------------数码管显示闹钟模式中的分钟十位数-----------------------
```

```
begin
  if(alarm==1&&set==0&&clkm_g==1)
        begin
       case(minute_6)
         4'b0000:minute_s<=7'b1000000;
         4'b0001:minute_s<=7'b1111001;
         4'b0010:minute_s<=7'b0100100;
         4'b0011:minute_s<=7'b0110000;
         4'b0100:minute_s<=7'b0011001;
         4'b0101:minute_s<=7'b0010010;
         4'b0110:minute_s<=7'b0000010;
         4'b0111:minute_s<=7'b1111000;
         4'b1000:minute_s<=7'b0000000;
         4'b1001:minute_s<=7'b0010000;
         default:minute_s<=7'b1111111;
       endcase
     end
----------------数码管显示调时模式中单按键调整的分钟十位数------------------
  else if(alarm==0&&set==1&&clkm_g==1)
     begin
        case(minute_4)
         4'b0000:minute_s<=7'b1000000;
         4'b0001:minute_s<=7'b1111001;
         4'b0010:minute_s<=7'b0100100;
         4'b0011:minute_s<=7'b0110000;
         4'b0100:minute_s<=7'b0011001;
         4'b0101:minute_s<=7'b0010010;
         4'b0110:minute_s<=7'b0000010;
         4'b0111:minute_s<=7'b1111000;
         4'b1000:minute_s<=7'b0000000;
         4'b1001:minute_s<=7'b0010000;
         default:minute_s<=7'b1111111;
       endcase
     end
-------数码管显示正常模式的或调时模式中按住按键调整的分钟十位数------
  else if(alarm==0&&set==0||alarm==1&&clkm_g==0||set==1&&clkm_g==0)
     begin
       case(minute_2)
         4'b0000:minute_s<=7'b1000000;
         4'b0001:minute_s<=7'b1111001;
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```
        4'b0010:minute_s<=7'b0100100;
        4'b0011:minute_s<=7'b0110000;
        4'b0100:minute_s<=7'b0011001;
        4'b0101:minute_s<=7'b0010010;
        4'b0110:minute_s<=7'b0000010;
        4'b0111:minute_s<=7'b1111000;
        4'b1000:minute_s<=7'b0000000;
        4'b1001:minute_s<=7'b0010000;
        default:minute_s<=7'b1111111;
      endcase
    end
end
----------------------------------数码管显示小时个位数------------------------------
always@(posedge clk_1hz)          //show hour_g
-----------------------数码管显示闹钟模式中的小时十位数-------------------------
begin
  if(alarm==1&&set==0&&clkh_g==1)
    begin
      case(hour_5)
        4'b0000:hour_g<=7'b1000000;
        4'b0001:hour_g<=7'b1111001;
        4'b0010:hour_g<=7'b0100100;
        4'b0011:hour_g<=7'b0110000;
        4'b0100:hour_g<=7'b0011001;
        4'b0101:hour_g<=7'b0010010;
        4'b0110:hour_g<=7'b0000010;
        4'b0111:hour_g<=7'b1111000;
        4'b1000:hour_g<=7'b0000000;
        4'b1001:hour_g<=7'b0010000;
        default:hour_g<=7'b1111111;
      endcase
    end
----------------数码管显示调时模式中单按键调整的小时个位数-----------------
  else if(alarm==0&&set==1&&clkh_g==1)
    begin
      case(hour_3)
        4'b0000:hour_g<=7'b1000000;
        4'b0001:hour_g<=7'b1111001;
        4'b0010:hour_g<=7'b0100100;
        4'b0011:hour_g<=7'b0110000;
```

```
        4'b0100:hour_g<=7'b0011001;
        4'b0101:hour_g<=7'b0010010;
        4'b0110:hour_g<=7'b0000010;
        4'b0111:hour_g<=7'b1111000;
        4'b1000:hour_g<=7'b0000000;
        4'b1001:hour_g<=7'b0010000;
        default:hour_g<=7'b1111111;
      endcase
    end
-------数码管显示正常模式的或调时模式按住按键调整的小时个位数---------
  else if(alarm==0&&set==0||set==1&&clkh_g==0)
    begin
      case(hour_1)
        4'b0000:hour_g<=7'b1000000;
        4'b0001:hour_g<=7'b1111001;
        4'b0010:hour_g<=7'b0100100;
        4'b0011:hour_g<=7'b0110000;
        4'b0100:hour_g<=7'b0011001;
        4'b0101:hour_g<=7'b0010010;
        4'b0110:hour_g<=7'b0000010;
        4'b0111:hour_g<=7'b1111000;
        4'b1000:hour_g<=7'b0000000;
        4'b1001:hour_g<=7'b0010000;
        default:hour_g<=7'b1111111;
      endcase
    end
end
----------------------------------数码管显示小时十位数-------------------------------
always@(posedge clk_1hz)          //show hour_s

begin
------------------------数码管显示闹钟模式中的小时十位数-----------------------
  if(alarm==1&&set==0&&clkh_g==1)
      begin
      case(hour_6)
        4'b0000:hour_s<=7'b1000000;
        4'b0001:hour_s<=7'b1111001;
        4'b0010:hour_s<=7'b0100100;
        4'b0011:hour_s<=7'b0110000;
        4'b0100:hour_s<=7'b0011001;
```

```
        4'b0101:hour_s<=7'b0010010;
        4'b0110:hour_s<=7'b0000010;
        4'b0111:hour_s<=7'b1111000;
        4'b1000:hour_s<=7'b0000000;
        4'b1001:hour_s<=7'b0010000;
        default:hour_s<=7'b1111111;
      endcase
    end
----------------数码管显示调时模式中单按键调整的小时十位数----------------
  else if(alarm==0&&set==1&&clkh_g==1)
    begin
      case(hour_4)
        4'b0000:hour_s<=7'b1000000;
        4'b0001:hour_s<=7'b1111001;
        4'b0010:hour_s<=7'b0100100;
        4'b0011:hour_s<=7'b0110000;
        4'b0100:hour_s<=7'b0011001;
        4'b0101:hour_s<=7'b0010010;
        4'b0110:hour_s<=7'b0000010;
        4'b0111:hour_s<=7'b1111000;
        4'b1000:hour_s<=7'b0000000;
        4'b1001:hour_s<=7'b0010000;
        default:hour_s<=7'b1111111;
      endcase
    end
------------数码管显示正常模式的或调时模式按住按键的小时十位数----------
  else if(alarm==0&&set==0||set==1&&clkh_g==0)
    begin
      case(hour_2)
        4'b0000:hour_s<=7'b1000000;
        4'b0001:hour_s<=7'b1111001;
        4'b0010:hour_s<=7'b0100100;
        4'b0011:hour_s<=7'b0110000;
        4'b0100:hour_s<=7'b0011001;
        4'b0101:hour_s<=7'b0010010;
        4'b0110:hour_s<=7'b0000010;
        4'b0111:hour_s<=7'b1111000;
        4'b1000:hour_s<=7'b0000000;
        4'b1001:hour_s<=7'b0010000;
        default:hour_s<=7'b1111111;
```

```
        endcase
      end
end


endmodule
```

---

5 结论以及结果说明

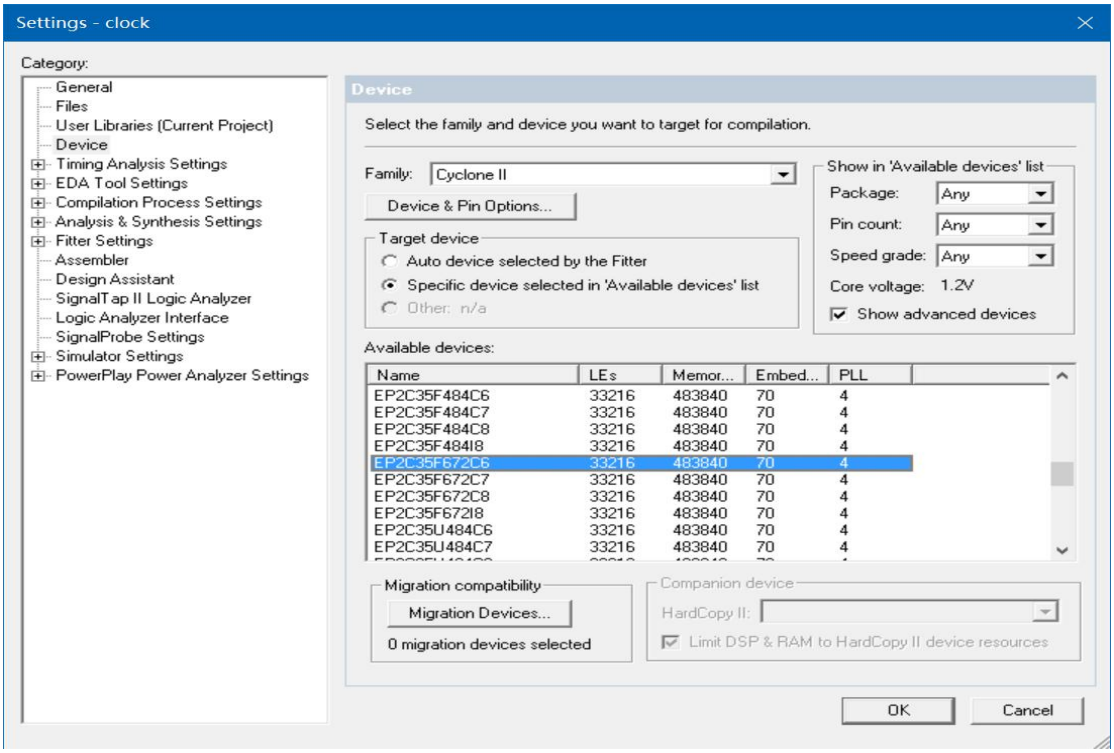

图 5.1　开发板驱动下载图

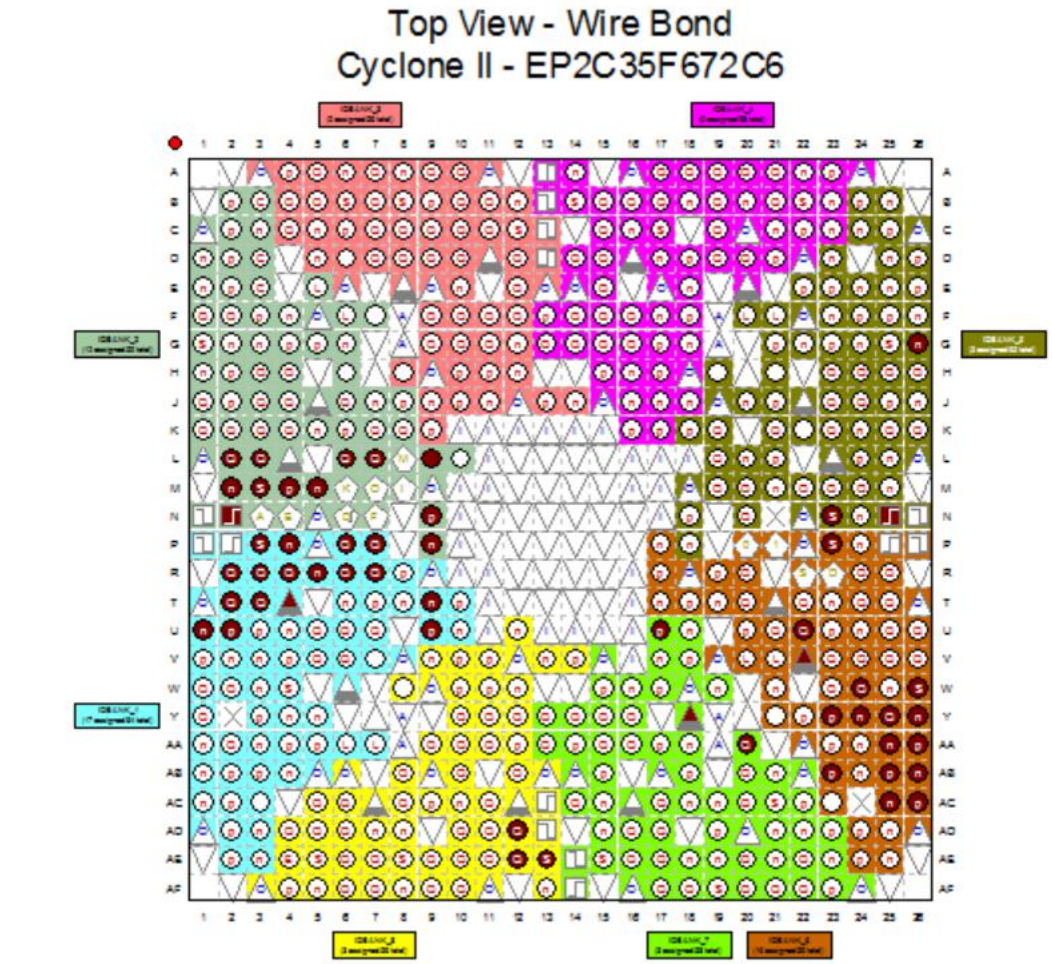

图 5.2　开发板针脚图