

# **WINSTAR\_TFT Application Note**

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## **a-Si TFT for SSD1963 Controller**

**320xRGBx240 for 3.5"QVGA**

**480xRGBx272 for 4.3"WQVGA**

**320xRGBx240 for 5.7"QVGA**

**640xRGBx480 for 5.7"VGA**

**800xRGBx480 for 7.0"WVGA**

**262K color**

Vresion 3.0  
Date:2010/07/05

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## 1 RECORD OF REVISION

Revision Date	Page	Contents	Editor
2009/5/5	-	New Release	
2009/11/30	-	Add 7.0" WVGA	
2010/07/05	-	Modify command 0x80	

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## 2 Features

SSD1963 is a display controller of 1215K byte frame buffer to support up to 864 x 480 x 24bit graphics content. It also equips parallel MCU interfaces in different bus width to receive graphics data and command from MCU. Its display interface supports common RAM-less LCD driver of color depth up to 24 bit-per- pixel.

User can send a full screen picture by controlling the MPU with popular microprocessor interface :

16 bit 8080-Series MPU

8 bit 8080-Series MPU

16 bit 6800-Series MPU

8 bit 6800-Series MPU

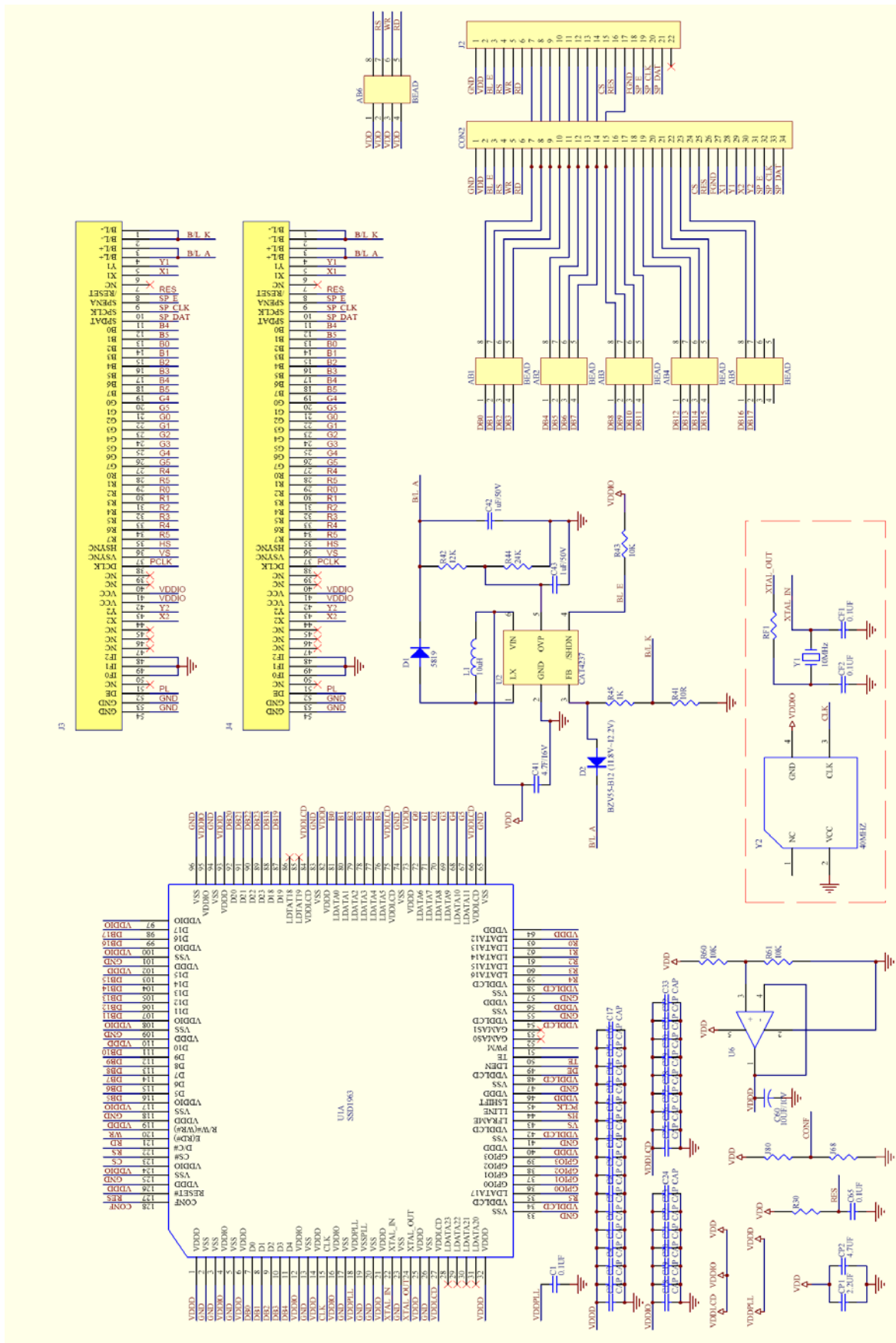
There are five kinds of control board include:

- ⌘ 3.5 inch QVGA built-in LED driver
- ⌘ 4.3 inch WQVGA built-in LED driver
- ⌘ 5.7 inch QVGA built-in VCOM amplifier to adjust contrast and flicker by VR50/VR51.
- ⌘ 5.7 inch VGA built-in VCOM amplifier to adjust flicker by VR31.
- ⌘ 7.0 inch WVGA .

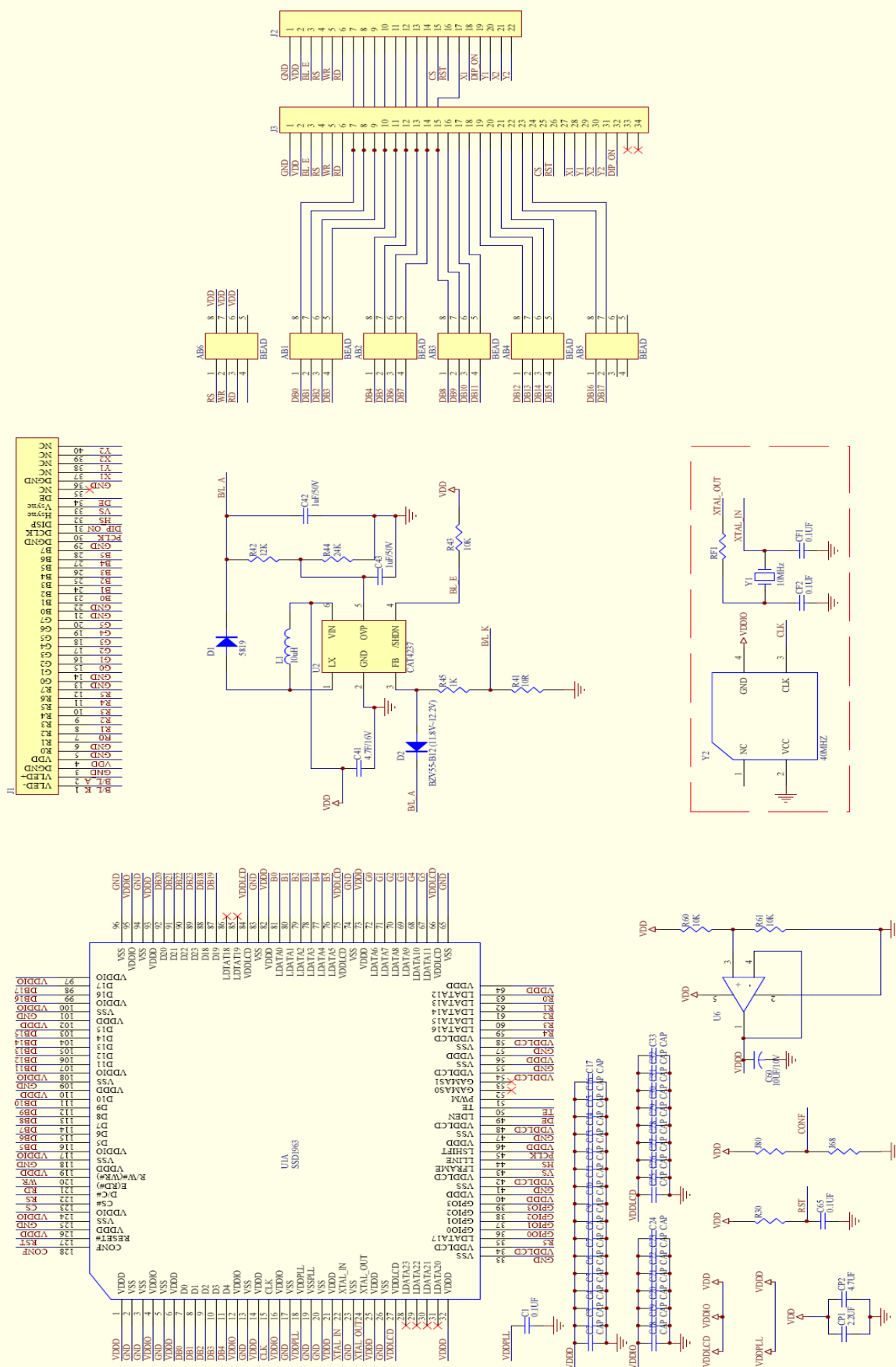
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## 3 Application Circuit

### 3.1 3.5 inch QVGA



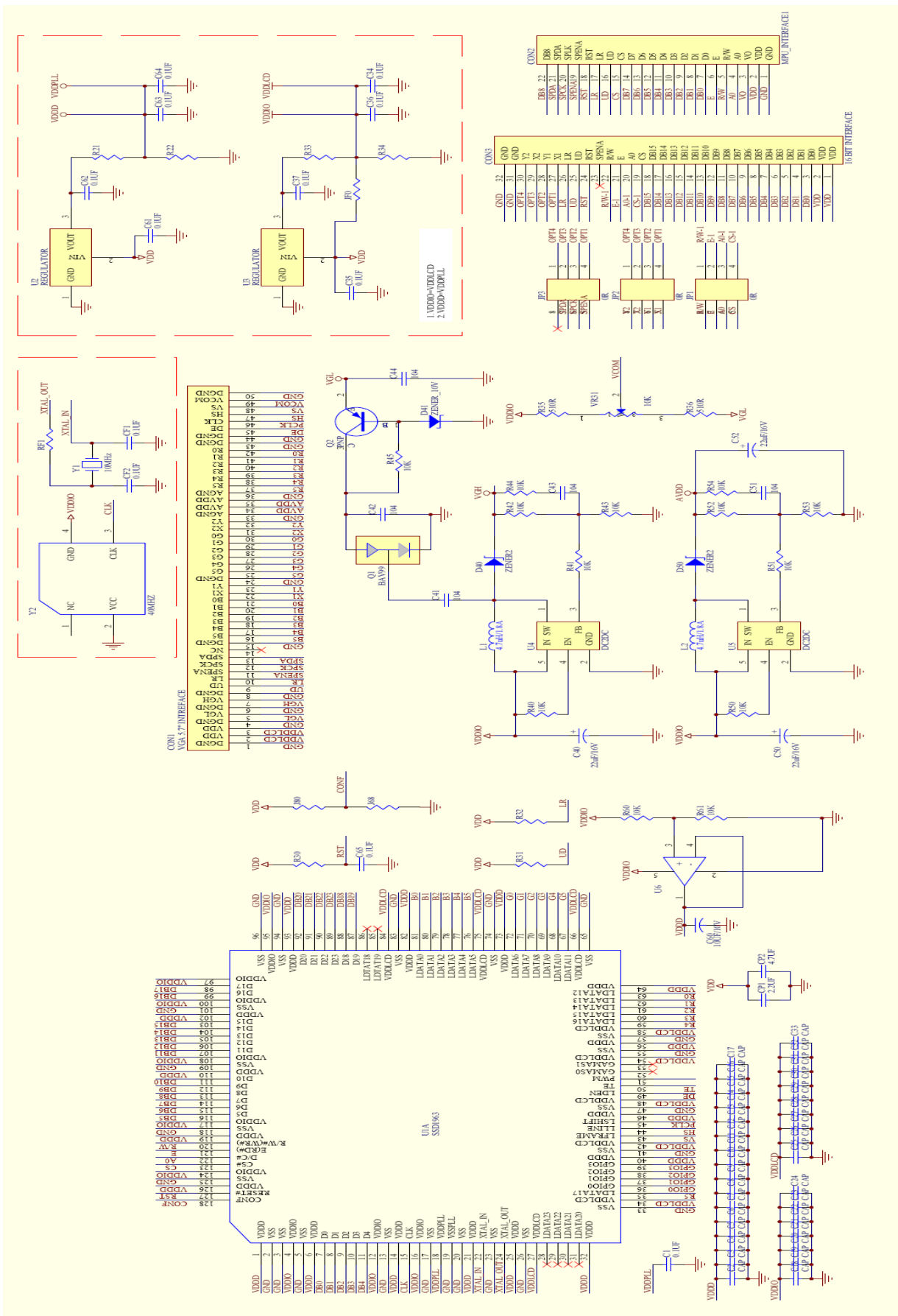
### 3.2 4.3 inch WQVGA





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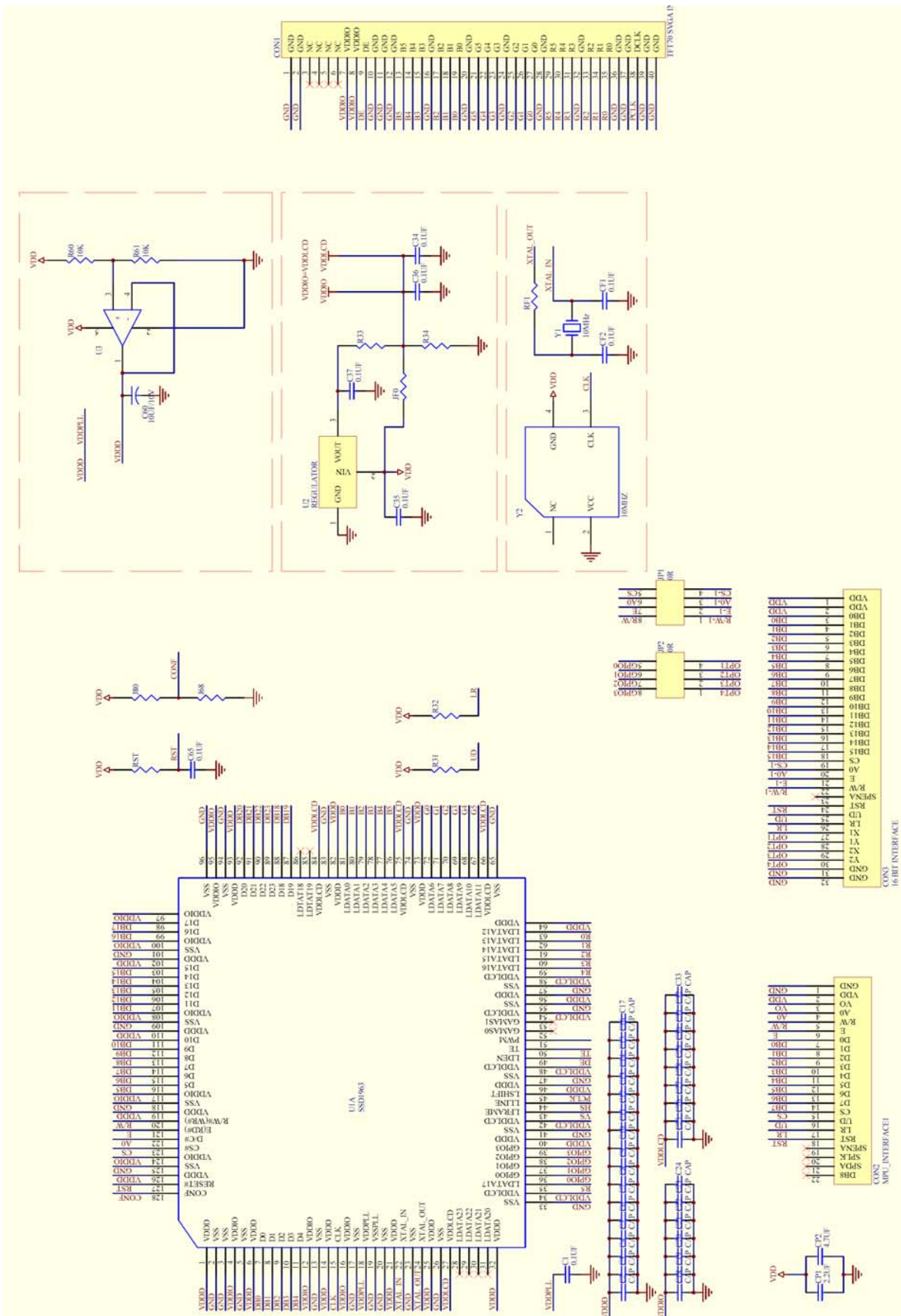
## 3.4 5.7 inch VGA





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## 3.5 7.0 inch WVGA



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## 4 MCU Interface Timing

### 4.1 6800 Mode

Table 13-4: 6800 Mode Timing

Symbol	Parameter	Min	Typ	Max	Unit
$t_{cyc}$	Reference Clock Cycle Time	9	-	-	ns
$t_{PWCSL}$	Pulse width CS# or E low	1	-	-	$t_{cyc}$
$t_{PWCSH}$	Pulse width CS# or E high	1	-	-	$t_{cyc}$
$t_{FDRD}$	First Data Read Delay	5	-	-	$t_{cyc}$
$t_{AS}$	Address Setup Time	1	-	-	ns
$t_{AH}$	Address Hold Time	1	-	-	ns
$t_{DSW}$	Data Setup Time	4	-	-	ns
$t_{DHW}$	Data Hold Time	1	-	-	ns
$t_{DSR}$	Data Access Time	-	-	5	ns
$t_{DHR}$	Output Hold time	1	-	-	ns

Figure 13-1: 6800 Mode Timing Diagram (Use CS# as Clock)

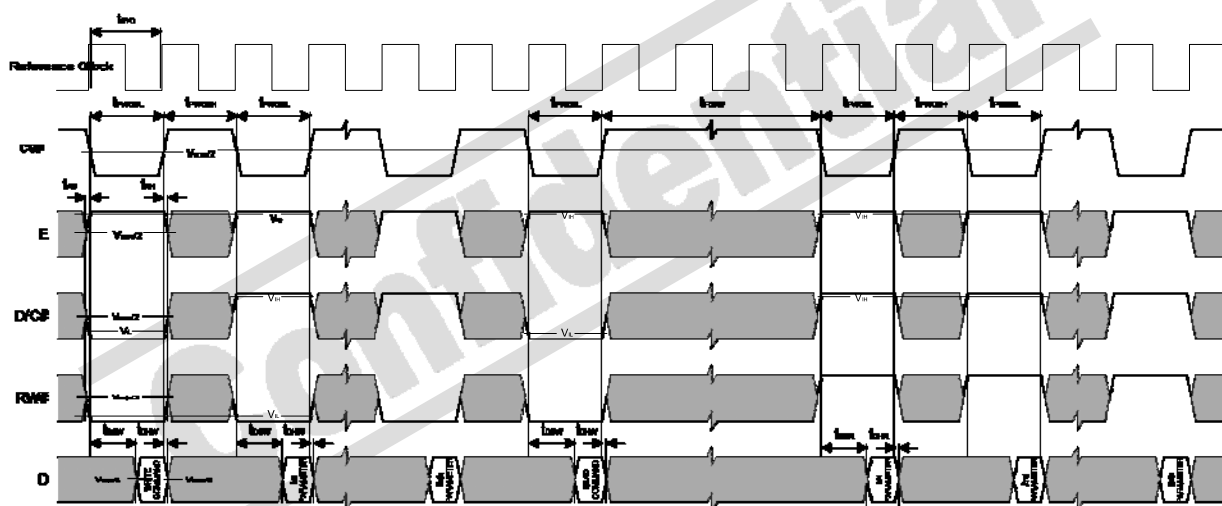
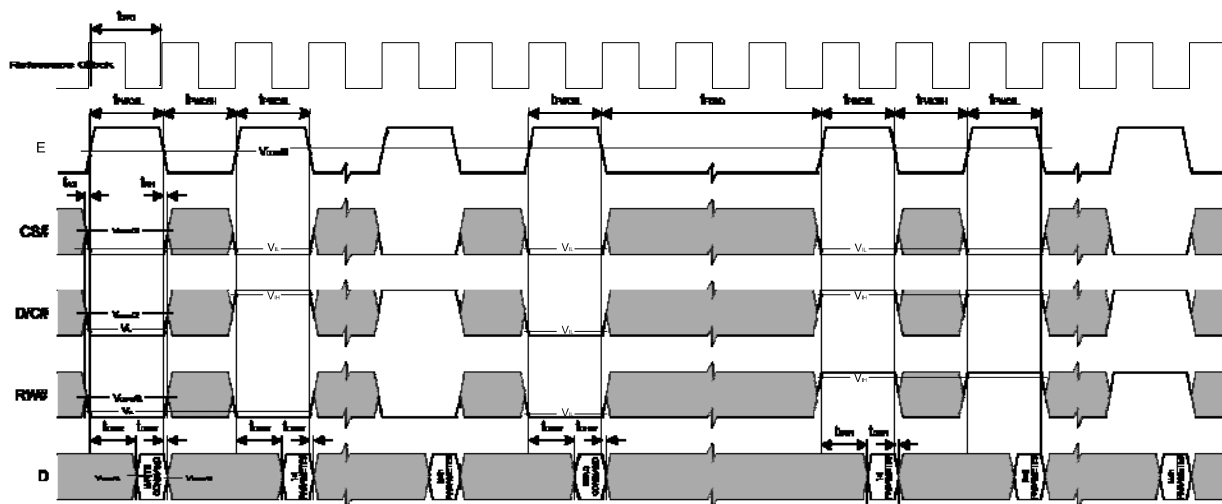


Figure 13-2: 6800 Mode Timing Diagram (Use E as Clock)



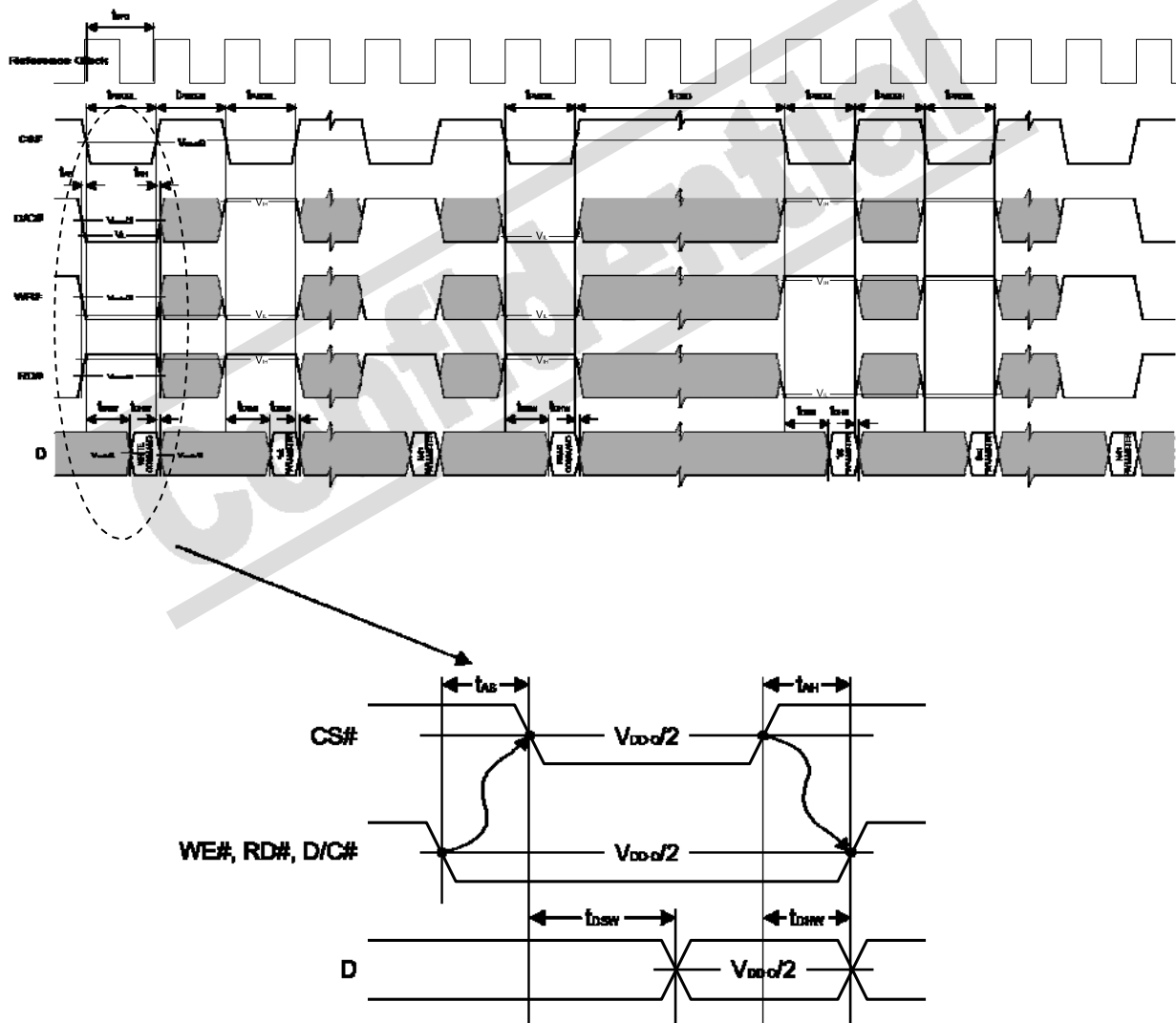
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## 4.2 8080 Mode Write Cycle

Table 13-5: 8080 Mode Timing

Symbol	Parameter	Min	Typ	Max	Unit
$t_{cyc}$	Reference Clock Cycle Time	9	-	-	ns
$t_{PWCSL}$	Pulse width CS# low	1	-	-	$t_{cyc}$
$t_{PWCSH}$	Pulse width CS# high	1	-	-	$t_{cyc}$
$t_{FDRD}$	First Read Data Delay	5	-	-	$t_{cyc}$
$t_{AS}$	Address Setup Time	1	-	-	ns
$t_{AH}$	Address Hold Time	1	-	-	ns
$t_{DSW}$	Data Setup Time	4	-	-	ns
$t_{DHW}$	Data Hold Time	1	-	-	ns
$t_{DSR}$	Data Access Time	-	-	5	ns
$t_{DHR}$	Output Hold time	1	-	-	ns

Figure 13-3: 8080 Mode Timing Diagram



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## 4.3 Pixel Data Format

Both 6800 and 8080 support 8-bit, 9-bit, 16-bit, 18-bit and 24-bit data bus of SSD1963, **but only designed 8-bit and 16-bit data bus for all kinds of control board.**

Depending on the width of the data bus, the display data are packed into the data bus in different ways.

Table 7-1: Pixel Data Format

Interface	Cycle	D[23]	D[22]	D[21]	D[20]	D[19]	D[18]	D[17]	D[16]	D[15]	D[14]	D[13]	D[12]	D[11]	D[10]	D[9]	D[8]	D[7]	D[6]	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]
24 bits	1 <sup>st</sup>	R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
18 bits	1 <sup>st</sup>							R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
16 bits (565 format)	1 <sup>st</sup>									R5	R4	R3	R2	R1	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1
16 bits	1 <sup>st</sup>									R5	R4	R3	R2	R1	R0	X	X	G5	G4	G3	G2	G1	G0	X	X
	2 <sup>nd</sup>									B5	B4	B3	B2	B1	B0	X	X	R5	R4	R3	R2	R1	R0	X	X
	3 <sup>rd</sup>									G5	G4	G3	G2	G1	G0	X	X	B5	B4	B3	B2	B1	B0	X	X
9 bits	1 <sup>st</sup>																R5	R4	R3	R2	R1	R0	G5	G4	G3
	2 <sup>nd</sup>																G2	G1	G0	B5	B4	B3	B2	B1	B0
8 bits	1 <sup>st</sup>																	R5	R4	R3	R2	R1	R0	X	X
	2 <sup>nd</sup>																	G5	G4	G3	G2	G1	G0	X	X
	3 <sup>rd</sup>																	B5	B4	B3	B2	B1	B0	X	X

X: Don't Care

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## 5 Reference Initial code :

### 5.1 8bit-80 interface mode , 262K color , 3.5\_Panel:320xRGBx240

```
void main(void)
{
    Initial_SSD1963();
    FULL_ON(0xff0000);    // red
    FULL_ON(0x00ff00);    // green
    FULL_ON(0x0000ff);    // blue
}

void Write_Command (unsigned char command)
{
    IC_RD = 1;            // /RD=1
    IC_A0 = 0;            // D/C=0
    IC_WR= 0;            // /WR=0
    IC_CS = 0;            // /CS=0
    Data_BUS = command;   // Data Bus OUT

    IC_CS = 1;            // /CS=1
    IC_WR= 1;            // /WR=1
}

void Write_Data (unsigned char data1)
{
    IC_RD = 1;
    IC_A0 = 1;
    IC_WR = 0;
    IC_CS = 0;
    Data_BUS = data1;
    IC_CS = 1;
    IC_WR= 1;
}

void Command_Write(unsigned char command,unsigned char data1)
{
    Write_Command(command);
    Write_Data(data1);
}

void SendData(unsigned long color)
{
    Write_Data((color)>>16);    // color is red
    Write_Data((color)>>8);     // color is green
    Write_Data(color);         // color is blue
}
```

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```
void Initial_SSD1963 (void)                //for 3.5 QVGA
{
    IC_RST = 0;
    _nop_();
    _nop_();
    _nop_();
    IC_RST = 1;
    _nop_();
    _nop_();
    _nop_();

    Write_Command(0x01);                    //Software Reset
    Write_Command(0x01);
    Write_Command(0x01);
    Command_Write(0xe0,0x01);               // START PLL
    Command_Write(0xe0,0x03);               // LOCK PLL

    Write_Command(0xb0);                    //SET LCD MODE  SET TFT 18Bits MODE
    Write_Data(0x0c);                       //SET TFT MODE & hsync+Vsync+DEN MODE
    Write_Data(0x00);                       //SET TFT MODE & hsync+Vsync+DEN MODE
    Write_Data(0x01);                       //SET horizontal size=320-1 HightByte
    Write_Data(0x3f);                       //SET horizontal size=320-1 LowByte
    Write_Data(0x00);                       //SET vertical size=240-1 HightByte
    Write_Data(0xef);                       //SET vertical size=240-1 LowByte
    Write_Data(0x00);                       //SET even/odd line RGB seq.=RGB

    Command_Write(0xf0,0x00);               //SET pixel data I/F format=8bit
    Command_Write(0x3a,0x60);               // SET R G B format = 6 6 6

    Write_Command(0xe2);                    //SET PLL freq=113.33MHz  ;
    Write_Data(0x22);
    Write_Data(0x03);
    Write_Data(0x04);

    Write_Command(0xe6);                    //SET PCLK freq=6.5MHz/19MHz  ; pixel clock frequency
    Write_Data(0x00);                       //0x02
    Write_Data(0xea);                       //0xb0
    Write_Data(0xec);                       //0xb5

    Write_Command(0xb4);                    //SET HBP
    Write_Data(0x01);                       //SET HSYNC Total = 440
    Write_Data(0xb8);
    Write_Data(0x00);                       //SET HBP = 68
    Write_Data(0x44);
```

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```
Write_Data(0x0f);           //SET VBP 16 = 15 + 1
Write_Data(0x00);           //SET Hsync pulse start position
Write_Data(0x00);
Write_Data(0x00);           //SET Hsync pulse subpixel start position

Write_Command(0xb6);         //SET VBP
Write_Data(0x01);           //SET Vsync total 265 = 264 + 1
Write_Data(0x08);
Write_Data(0x00);           //SET VBP = 18
Write_Data(0x12);
Write_Data(0x07);           //SET Vsync pulse 8 = 7 + 1
Write_Data(0x00);           //SET Vsync pulse start position
Write_Data(0x00);

Write_Command(0x2a);         //SET column address
Write_Data(0x00);           //SET start column address=0
Write_Data(0x00);
Write_Data(0x01);           //SET end column address=320
Write_Data(0x3f);

Write_Command(0x2b);         //SET page address
Write_Data(0x00);           //SET start page address=0
Write_Data(0x00);
Write_Data(0x00);           //SET end page address=240
Write_Data(0xef);

Write_Command(0x29);         //SET display on
Write_Command(0x2c);

}
```

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```
WindowSet(unsigned int s_x,unsigned int e_x,unsigned int s_y,unsigned int e_y)
```

```
{
    Write_Command(0x2a);           //SET page address
    Write_Data((s_x)>>8);           //SET start page address=0
    Write_Data(s_x);
    Write_Data((e_x)>>8);           //SET end page address=320
    Write_Data(e_x);

    Write_Command(0x2b);           //SET column address
    Write_Data((s_y)>>8);           //SET start column address=0
    Write_Data(s_y);
    Write_Data((e_y)>>8);           //SET end column address=240
    Write_Data(e_y);
}
```

```
void FULL_ON(unsigned long dat)
```

```
{
    unsigned int x,y;
    WindowSet(0x0000,0x013f,0x0000,0x00ef);
    Write_Command(0x2c);_
    for (x=0;x<240;x++)
    {
        for (y= 0;y<320;y++)
        {
            SendData(dat);
        }
    }
}
```



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```
5.2 8bit-80 interface mode , 262K color , 4.3_Panel:480xRGBx272
void Initial_SSD1963 (void)                                //for 4.3 WQVGA
{
    IC_RST = 0;
    _nop_();
    _nop_();
    _nop_();
    IC_RST = 1;
    _nop_();
    _nop_();
    _nop_();

    Write_Command(0x01);                                    //Software Reset
    Write_Command(0x01);
    Write_Command(0x01);
    Command_Write(0xe0,0x01);                               // START PLL
    Command_Write(0xe0,0x03);                               // LOCK PLL

    Write_Command(0xb0);                                     //SET LCD MODE  SET TFT 18Bits MODE
    Write_Data(0x08);                                       //SET TFT MODE & hsync+Vsync+DEN MODE
    Write_Data(0x00);                                       //SET TFT MODE & hsync+Vsync+DEN MODE
    Write_Data(0x01);                                       //SET horizontal size=480-1 HightByte
    Write_Data(0xdf);                                       //SET horizontal size=480-1 LowByte
    Write_Data(0x01);                                       //SET vertical size=272-1 HightByte
    Write_Data(0x0f);                                       //SET vertical size=272-1 LowByte
    Write_Data(0x00);                                       //SET even/odd line RGB seq.=RGB

    Command_Write(0xf0,0x00);                               //SET pixel data I/F format=8bit
    Command_Write(0x3a,0x60);                               // SET R G B format = 6 6 6

    Write_Command(0xe2);                                    //SET PLL freq=113.33MHz  ;
    Write_Data(0x22);
    Write_Data(0x03);
    Write_Data(0x04);

    Write_Command(0xe6);                                    //SET PCLK freq=9MHz  ; pixel clock frequency
    Write_Data(0x01);
    Write_Data(0x45);
    Write_Data(0x47);

    Write_Command(0xb4);                                    //SET HBP
    Write_Data(0x02);                                       //SET HSYNC Total = 525
    Write_Data(0x0d);
    Write_Data(0x00);                                       //SET HBP = 43
    Write_Data(0x2b);
```

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```
Write_Data(0x28);           //SET VBP 41 = 40 + 1
Write_Data(0x00);           //SET Hsync pulse start position
Write_Data(0x00);
Write_Data(0x00);           //SET Hsync pulse subpixel start position

Write_Command(0xb6);        //SET VBP
Write_Data(0x01);           //SET Vsync total 286 = 285 + 1
Write_Data(0x1d);
Write_Data(0x00);           //SET VBP = 12
Write_Data(0x0c);
Write_Data(0x09);           //SET Vsync pulse 10 = 9 + 1
Write_Data(0x00);           //SET Vsync pulse start position
Write_Data(0x00);

Write_Command(0x2a);        //SET column address
Write_Data(0x00);           //SET start column address=0
Write_Data(0x00);
Write_Data(0x01);           //SET end column address=480
Write_Data(0xdf);

Write_Command(0x2b);        //SET page address
Write_Data(0x00);           //SET start page address=0
Write_Data(0x00);
Write_Data(0x01);           //SET end page address=272
Write_Data(0x0f);

Write_Command(0x29);        //SET display on
Write_Command(0x2c);

}
```

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```
5.3 8bit-80 interface mode , 262K color , 5.7_Panel:320xRGBx240
void Initial_SSD1963 (void)                                //for 5.7 QVGA
{
    IC_RST = 0;
    _nop_();
    _nop_();
    _nop_();
    IC_RST = 1;
    _nop_();
    _nop_();
    _nop_();

    Write_Command(0x01);                                    //Software Reset
    Write_Command(0x01);
    Write_Command(0x01);
    Command_Write(0xe0,0x01);                                // START PLL
    Command_Write(0xe0,0x03);                                // LOCK PLL

    Write_Command(0xb0);                                     //SET LCD MODE  SET TFT 18Bits MODE
    Write_Data(0x0c);                                       //SET TFT MODE & hsync+Vsync+DEN MODE
    Write_Data(0x00);                                       //SET TFT MODE & hsync+Vsync+DEN MODE
    Write_Data(0x01);                                       //SET horizontal size=320-1 HightByte
    Write_Data(0x3f);                                       //SET horizontal size=320-1 LowByte
    Write_Data(0x00);                                       //SET vertical size=240-1 HightByte
    Write_Data(0xef);                                       //SET vertical size=240-1 LowByte
    Write_Data(0x00);                                       //SET even/odd line RGB seq.=RGB

    Command_Write(0xf0,0x00);                                //SET pixel data I/F format=8bit
    Command_Write(0x3a,0x60);                                // SET R G B format = 6 6 6

    Write_Command(0xe2);                                     //SET PLL freq=113.33MHz ;
    Write_Data(0x22);
    Write_Data(0x03);
    Write_Data(0x04);

    Write_Command(0xe6);                                     //SET PCLK freq=6.4MHz ; pixel clock frequency
    Write_Data(0x00);
    Write_Data(0xe7);
    Write_Data(0x4f);

    Write_Command(0xb4);                                     //SET HBP
    Write_Data(0x01);                                       //SET HSYNC Total = 440
    Write_Data(0xb8);
    Write_Data(0x00);                                       //SET HBP = 68
    Write_Data(0x44);
```

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```
Write_Data(0x0f);           //SET VBP 16 = 15 + 1
Write_Data(0x00);           //SET Hsync pulse start position
Write_Data(0x00);
Write_Data(0x00);           //SET Hsync pulse subpixel start position

Write_Command(0xb6);        //SET VBP
Write_Data(0x01);           //SET Vsync total 265 = 264 + 1
Write_Data(0x08);
Write_Data(0x00);           //SET VBP = 19
Write_Data(0x13);
Write_Data(0x07);           //SET Vsync pulse 8 = 7 + 1
Write_Data(0x00);           //SET Vsync pulse start position
Write_Data(0x00);

Write_Command(0x2a);        //SET column address
Write_Data(0x00);           //SET start column address=0
Write_Data(0x00);
Write_Data(0x01);           //SET end column address=320
Write_Data(0x3f);

Write_Command(0x2b);        //SET page address
Write_Data(0x00);           //SET start page address=0
Write_Data(0x00);
Write_Data(0x00);           //SET end page address=240
Write_Data(0xef);

Write_Command(0x29);        //SET display on
Write_Command(0x2c);

}
```

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5.4 8bit-80 interface mode , 262K color , 5.7\_Panel:640xRGBx480  
void Initial\_SSD1963 (void) //for 5.7 VGA

```
{
    IC_RST = 0;
    _nop_();
    _nop_();
    _nop_();
    IC_RST = 1;
    _nop_();
    _nop_();
    _nop_();

    Write_Command(0x01);           //Software Reset
    Write_Command(0x01);
    Write_Command(0x01);
    Command_Write(0xe0,0x01);      // START PLL
    Command_Write(0xe0,0x03);      // LOCK PLL

    Write_Command(0xb0);           //SET LCD MODE  SET TFT 18Bits MODE
    Write_Data(0x0c);              //SET TFT MODE & hsync+Vsync+DEN MODE
    Write_Data(0x00);              //SET TFT MODE & hsync+Vsync+DEN MODE
    Write_Data(0x02);              //SET horizontal size=640-1 HightByte
    Write_Data(0x7f);              //SET horizontal size=640-1 LowByte
    Write_Data(0x01);              //SET vertical size=480-1 HightByte
    Write_Data(0xdf);              //SET vertical size=480-1 LowByte
    Write_Data(0x00);              //SET even/odd line RGB seq.=RGB

    Command_Write(0xf0,0x00);      //SET pixel data I/F format=8bit
    Command_Write(0x3a,0x60);      // SET R G B format = 6 6 6

    Write_Command(0xe2);          //SET PLL freq=113.33MHz  ;
    Write_Data(0x22);
    Write_Data(0x03);
    Write_Data(0x04);

    Write_Command(0xe6);          //SET PCLK freq=6.43MHz  ; pixel clock frequency
    Write_Data(0x00);
    Write_Data(0xe7);
    Write_Data(0x4f);

    Write_Command(0xb4);          //SET HBP,
    Write_Data(0x20);              //SET HSYNC Total = 8367
    Write_Data(0xaf);
    Write_Data(0x00);              //SET HBP = 163
    Write_Data(0xa3);
```

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```
Write_Data(0x07);           //SET VBP 8 = 7 + 1
Write_Data(0x00);           //SET Hsync pulse start position
Write_Data(0x00);
Write_Data(0x00);           //SET Hsync pulse subpixel start position

Write_Command(0xb6);        //SET VBP,
Write_Data(0x01);           //SET Vsync total 496 = 495 + 1
Write_Data(0xef);
Write_Data(0x00);           //SET VBP = 4
Write_Data(0x04);
Write_Data(0x01);           //SET Vsync pulse 2 = 1 + 1
Write_Data(0x00);           //SET Vsync pulse start position
Write_Data(0x00);

Write_Command(0x2a);        //SET column address
Write_Data(0x00);           //SET start column address=0
Write_Data(0x00);
Write_Data(0x02);           //SET end column address=640
Write_Data(0x7f);

Write_Command(0x2b);        //SET page address
Write_Data(0x00);           //SET start page address=0
Write_Data(0x00);
Write_Data(0x01);           //SET end page address=480
Write_Data(0xdf);

Write_Command(0x29);        //SET display on
Write_Command(0x2c);

}
```

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5.5 8bit-80 interface mode , 262K color , 7.0\_Panel:800xRGBx480  
void Initial\_SSD1963 (void) //for 7.0 VGA

```
{
    IC_RST = 0;
    _nop_();
    _nop_();
    _nop_();
    IC_RST = 1;
    _nop_();
    _nop_();
    _nop_();

    Write_Command(0x01);           //Software Reset
    Write_Command(0x01);
    Write_Command(0x01);
    Command_Write(0xe0,0x01);      // START PLL
    Command_Write(0xe0,0x03);      // LOCK PLL

    Write_Command(0xb0);           //SET LCD MODE  SET TFT 18Bits MODE
    Write_Data(0x08);              //SET TFT MODE & hsync+Vsync+DEN MODE
    Write_Data(0x00);              //SET TFT MODE & hsync+Vsync+DEN MODE
    Write_Data(0x03);              //SET horizontal size=800-1 HightByte
    Write_Data(0x1f);              //SET horizontal size=800-1 LowByte
    Write_Data(0x01);              //SET vertical size=480-1 HightByte
    Write_Data(0xdf);              //SET vertical size=480-1 LowByte
    Write_Data(0x00);              //SET even/odd line RGB seq.=RGB

    Command_Write(0xf0,0x00);      //SET pixel data I/F format=8bit
    Command_Write(0x3a,0x60);      // SET R G B format = 6 6 6

    Write_Command(0xe2);          //SET PLL freq=113.33MHz  ;
    Write_Data(0x22);
    Write_Data(0x03);
    Write_Data(0x04);

    Write_Command(0xe6);          //SET PCLK freq=33.26MHz  ; pixel clock frequency
    Write_Data(0x00);
    Write_Data(0xe7);
    Write_Data(0x4f);

    Write_Command(0xb4);          //SET HBP,
    Write_Data(0x20);              //SET HSYNC Total = 8367
    Write_Data(0xaf);
    Write_Data(0x00);              //SET HBP = 163
    Write_Data(0xa3);
}
```

# WINSTAR\_TFT Application Note

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```
Write_Data(0x07);           //SET VBP 8 = 7 + 1
Write_Data(0x00);           //SET Hsync pulse start position
Write_Data(0x00);
Write_Data(0x00);           //SET Hsync pulse subpixel start position

Write_Command(0xb6);        //SET VBP,
Write_Data(0x01);           //SET Vsync total 496 = 495 + 1
Write_Data(0xef);
Write_Data(0x00);           //SET VBP = 4
Write_Data(0x04);
Write_Data(0x01);           //SET Vsync pulse 2 = 1 + 1
Write_Data(0x00);           //SET Vsync pulse start position
Write_Data(0x00);

Write_Command(0x2a);        //SET column address
Write_Data(0x00);           //SET start column address=0
Write_Data(0x00);
Write_Data(0x03);           //SET end column address=800
Write_Data(0x1f);

Write_Command(0x2b);        //SET page address
Write_Data(0x00);           //SET start page address=0
Write_Data(0x00);
Write_Data(0x01);           //SET end page address=480
Write_Data(0xdf);

Write_Command(0x29);        //SET display on
Write_Command(0x2c);

}
```