



Doc.No.: SPEC-FF035T006TP-01

REV : A0

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EFFECTIVE DATE : 2012-02-14

# SPECIFICATION OF LCD MODULE

## MODULE NO.: FF035T006TP-01

Customer Approval:

Accept

Reject

FUTURE FOCUS	SIGNATURE	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		



Doc.No.: SPEC-FF035T006TP-01

REV : A0

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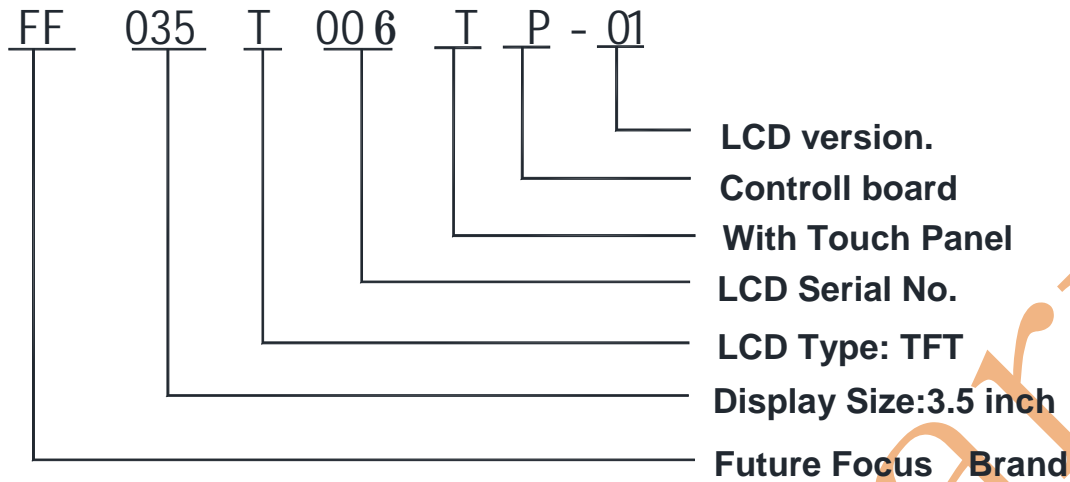
EFFECTIVE DATE : 2012-02-14

### DOCUMENT REVISION HISTORY

Sample Version	Doc. Version	DATE	DESCRIPTION	CHECKED BY
0001	A0	2012-02-14	First Release.	

Preliminary

## 1. GENERAL DESCRIPTION:

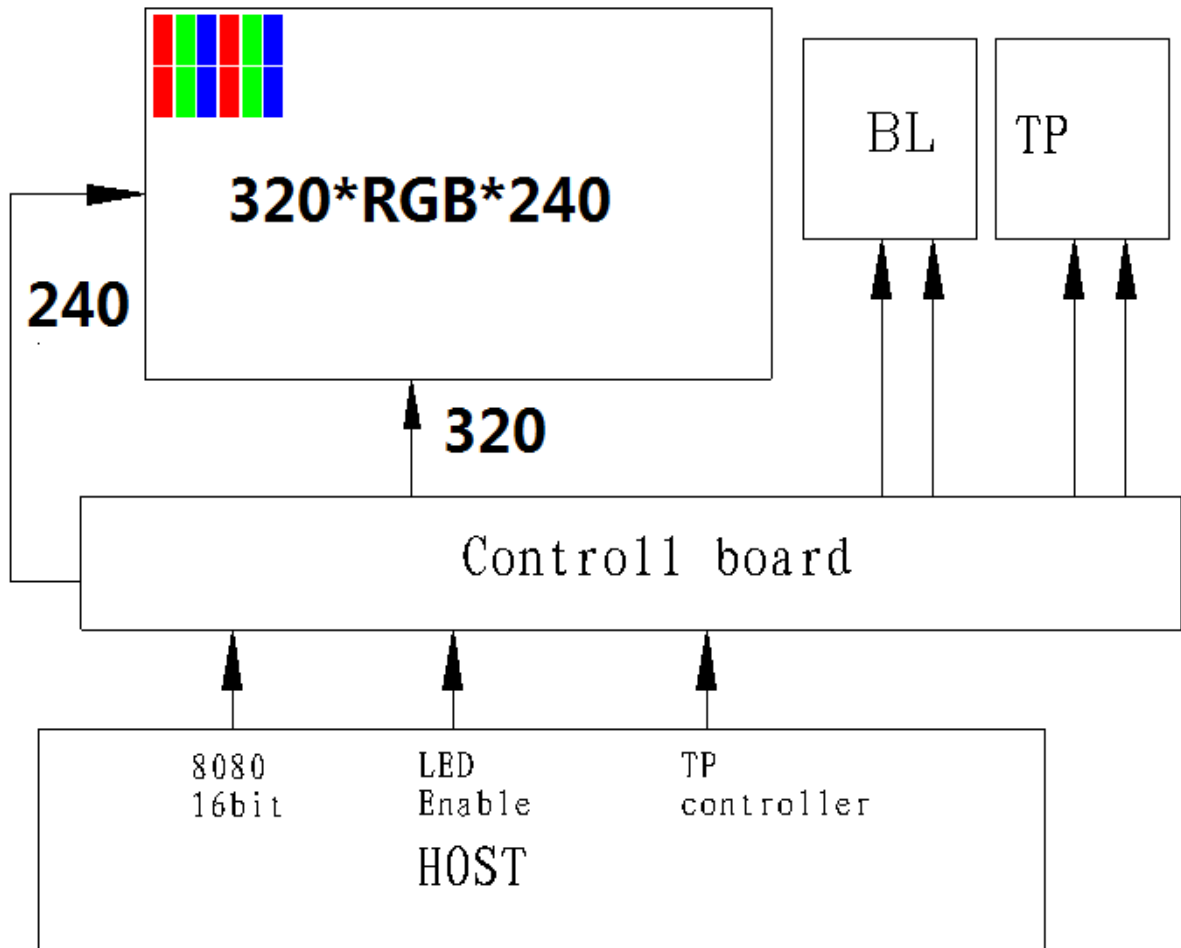


## MECHANICAL SPECIFICATIONS:

ITEM	SPECIFICATION	UNIT
OUTLINE DIMENSIONS	92.4 (W) X63.9(H) X8.0(D)	mm
DISPLAY SIZE	3.5	inch
DOT PITCH	0.073mmX0.219mm	mm
NUMBER OF DOTS	320* (RGB) *240	-
DRIVER IC	/	-
LCD TYPE	TFT(262K) TRANSMISSIVE	-
BACKLIGHT TYPE	LED White	-
VIEWING DIRECTION	6 O'clock	-
INTERFACE	8080 8/16bit	

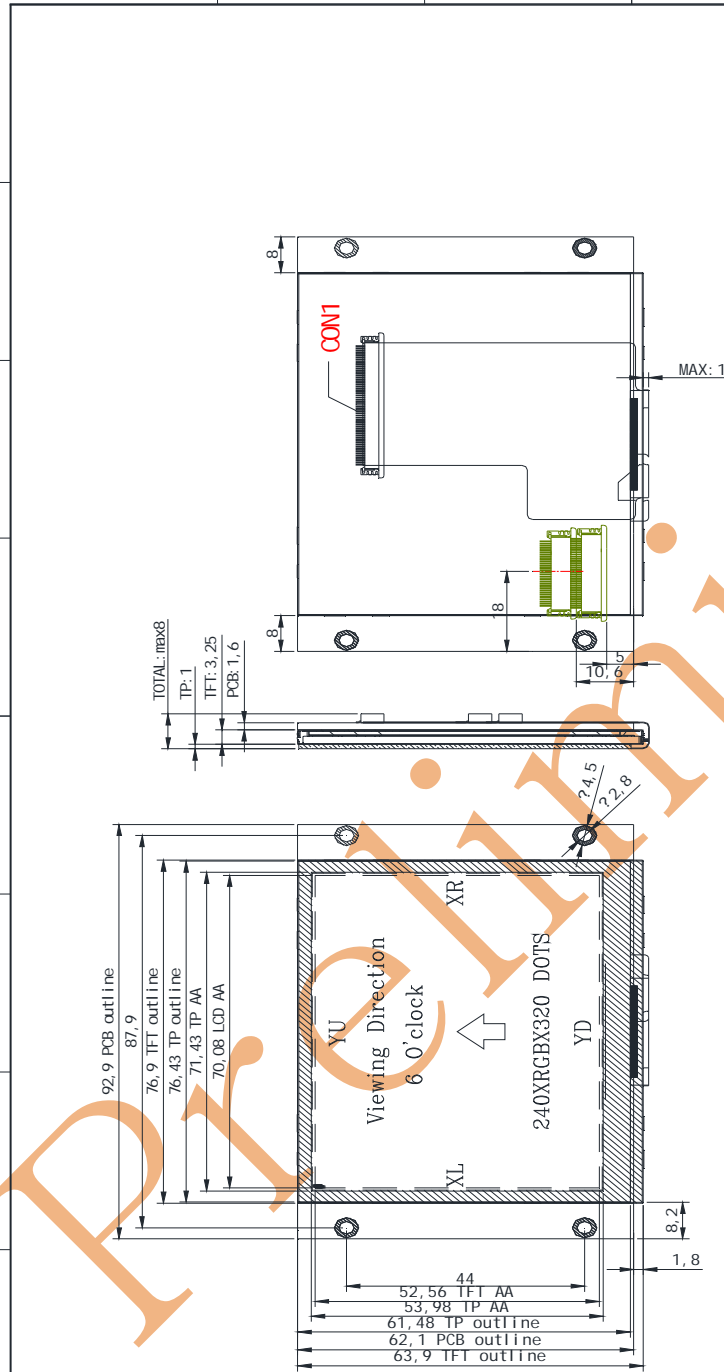
\*See attached drawing for details.

**2.BLOCK DIAGRAM:**



PRELIMINARY

### 3.DIMENSIONAL



NO.	SYMBOL	NO.	SYMBOL	NO.	SYMBOL	NO.	SYMBOL	NO.	SYMBOL	NO.	SYMBOL	NO.	SYMBOL
1	LED-K1	11	G1	31	R3	41	VDD	51	NC				
2	LED-R2	12	B0(LSB)	32	R4	42	VDD	52	ENABLE				
3	LED-A2	13	B1	33	R5	43	YU	53	GND				
4	LED-A1	14	B2	34	R6	44	XL	54	GND				
5	NC	15	B3	35	R7(MSB)	45	YD						
6	NC	16	B4	36	C6	46	HSYNC						
7	NC	17	B5	37	G7(MSB)	47	VSYNC						
8	/RESPT	18	B6	38	R0(LSB)	48	DOTCLK						
9	CS	19	B7(MSB)	39	R1	49	NC						
10	SCL	20	C0(LSB)	40	R2	50	NC						

- NOTES:
1. DISPLAY TYPE: 262K COLOR TFT
  2. POLARIZER: NEGATIVE, TRANSMISSIVE
  3. VIEWING ANGLE: 6:00
  4. DRIVING IC: NT39016D
  5. OPERATING TEMPERATURE: -20° TO 70°C
  6. STORAGE TEMPERATURE: -30° TO 80°C
  7. BACK LIGHT: LED (WHITE)

Future Focus Technology (Shenzhen) Co., Ltd.

TITLE: LCM DIMENSION

DRAWING No.: FF035T006TP-01-OUTLINE

DESIGN: Eric Luo 110707

CHECKED: 110712

APPROVED: DATE

REV: 1.0

PROTECTION:

△	1.0
MARK	REV.

#### **4. PIN DESCRIPTION:**

Con1 pin

NO.	PIN NAME	I/O	Description
1	5.0V/3.3V	P	Power supply
2	NC	-	
3	GND	P	Power Ground
4	RESET	I	System reset 0 – system reset 1 – normal work
5	CS	I	Chip selection
6	RS	I	command/data select
7	RD	I	Read signal
8	WR	I	Write signal
9	TE	O	Tearing effect
10	PWM	O	PWM output
11	D0	IO	Data bus
12	D1	IO	
13	D2	IO	
14	D3	IO	
15	D4	IO	
16	D5	IO	
17	D6	IO	
18	D7	IO	
19	D8	IO	
20	D9	IO	
21	D10	IO	
22	D11	IO	
23	D12	IO	
24	D13	IO	
25	D14	IO	
26	D15	IO	
27	LEDEN	I	Backlight enable. 1 - backlight on 0 - backlight off
28	TPINT	I	touch panel controller interrupt (NC)
29	TPDOUT	O	touch panel controller data output (NC)
30	TPDIN	I	touch panel controller data input (NC)
31	TPCS	I	touch panel controller chip select (NC)
32	TPCLK	I	touch panel controller data colock (NC)

Con2 pin

NO.	PIN NAME	I/O	Description
1	GND	P	Power Ground
2	5.0V/3.3V	P	Power supply
3	RD	I	Read signal
4	WR	I	Write signal
5	CS	I	Chip selection
6	RS	I	command/data select
7	RESET	I	System reset 0 – system reset 1 – normal work
8	D0	IO	data bus
9	D1	IO	
10	D2	IO	
11	D3	IO	
12	D4	IO	
13	D5	IO	
14	D6	IO	
15	D7	IO	
16	D8	IO	
17	D9	IO	
18	D10	IO	
19	D11	IO	
20	D12	IO	
21	D13	IO	
22	D14	IO	
23	D15	IO	
24	LEDEN	I	Backlight enable. 1 - backlight on 0 - backlight off
25	TPINT	O	touch panel controller interrupt (NC)
26	TPDOUT	O	touch panel controller data output (NC)
27	TPDIN	I	touch panel controller data input (NC)
28	TPCS	I	touch panel controller chip select (NC)
29	TPCLK	O	touch panel controller data colock (NC)
30	GND	P	Power ground

## 5. MAXIMUM ABSOLUTE LIMIT:

Item	Symbol	Value	Unit
Power supply voltage for logic	$V_{DD}$	-0.3~5.5	V
Input voltage	$V_{in}$	$V_{DD}+0.3$	V
Operating temperature	$T_{opr}$	-20 to 70	°C
Storage temperature	$T_{stg}$	-30 to 80	°C

**Note:** Note1: Absolute maximum rating is the limit value beyond which the IC maybe broken.

They do not assure operations.

Note2: Background color changes slightly depending on ambient temperature. This Phenomenon is reversible.

$T_a \leq 70^\circ\text{C}$ : 75%RH max

$T_a > 70^\circ\text{C}$ : absolute humidity must be lower than the humidity of 75%RH at  $70^\circ\text{C}$

Note3:  $T_a$  at  $-30^\circ\text{C}$  will be <48hrs, at  $80^\circ\text{C}$  will be <120hrs

## 6.ELECTRICAL CHARACTERISTICS

### 6.1 DC Characteristics ( $V_{DD}=5.0\text{V}, T_a=25^\circ\text{C}$ )

Item	Symbol	Min	Type	Max	Unit	Test condition
Operating voltage	$V_{DD}$	4.7	5.0	5.3	V	-
Supply current	$I_{DD}$	-	250	-	mA	$V_{DD}=5.0\text{V}, T_a=25^\circ\text{C}$
Input voltage	$V_{IH}$	0.7VDD	-	VDD	V	-
	$V_{IL}$	0	-	0.3VDD	V	
Input leakage current	$I_{IL}$	-1.0	-	1.0	$\mu\text{A}$	$V_{IN}=V_{DD}$ or $V_{SS}$

Note: Voltage greater than above may damage the module.

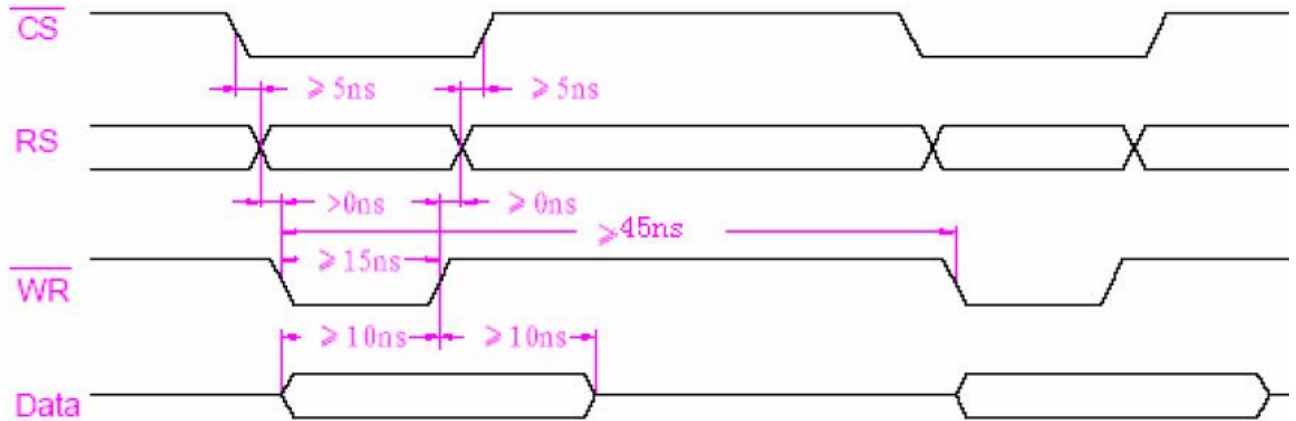
All voltages are specified relative to  $V_{SS}=0\text{V}$ .



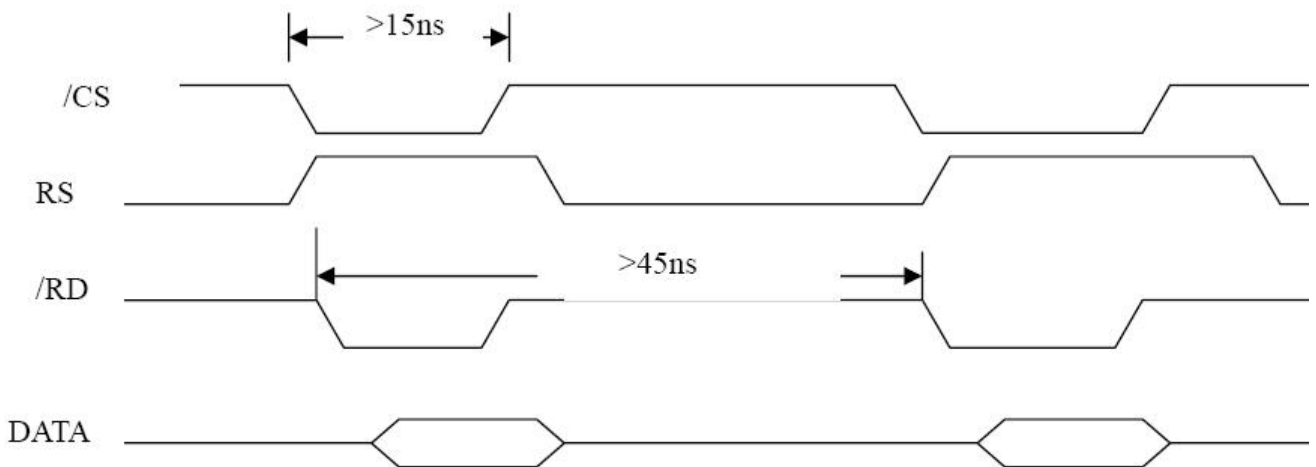
## 6.2 AC TIMING

### 6.2.1 AC input timing

#### Write



#### Read

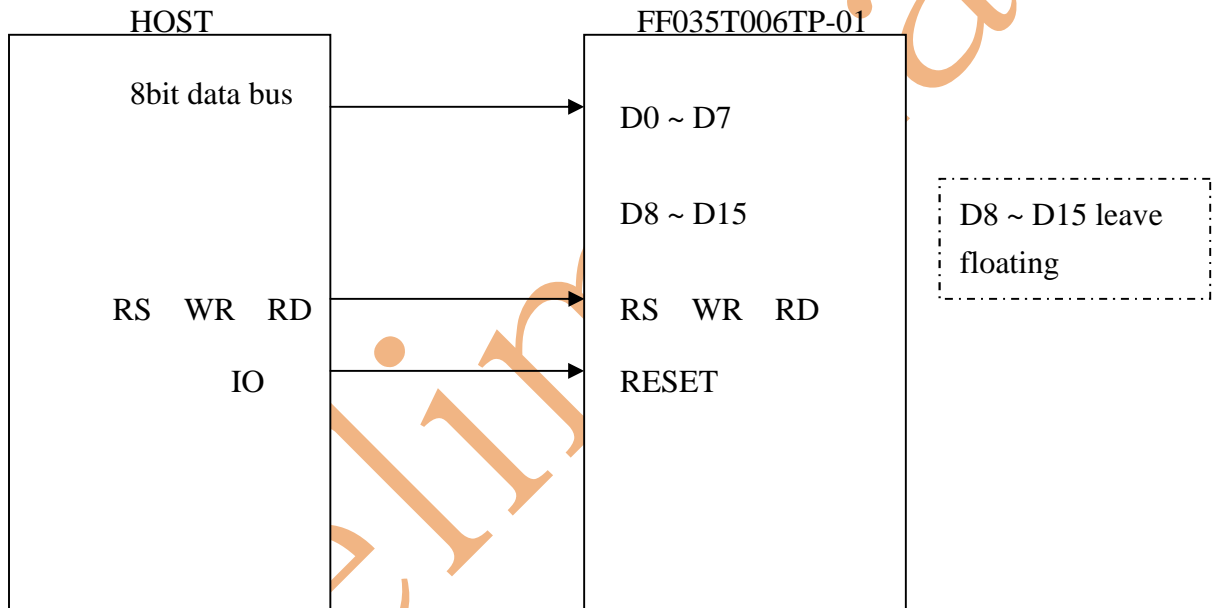


PRC

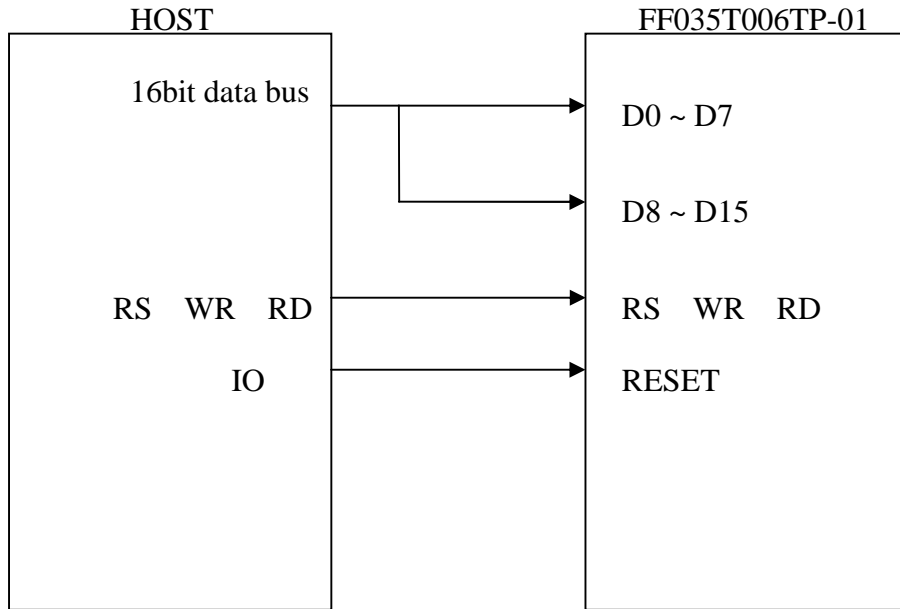
## 7.HARDWARE CONNECT

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]
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>									R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0
	2 <sup>nd</sup>									B7	B6	B5	B4	B3	B2	B1	B0	R7	R6	R5	R4	R3	R2	R1	R0
	3 <sup>rd</sup>									G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
12 bits	1 <sup>st</sup>													R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4
	2 <sup>nd</sup>													G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
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>																	R7	R6	R5	R4	R3	R2	R1	R0
	2 <sup>nd</sup>																	G7	G6	G5	G4	G3	G2	G1	G0
	3 <sup>rd</sup>																	B7	B6	B5	B4	B3	B2	B1	B0

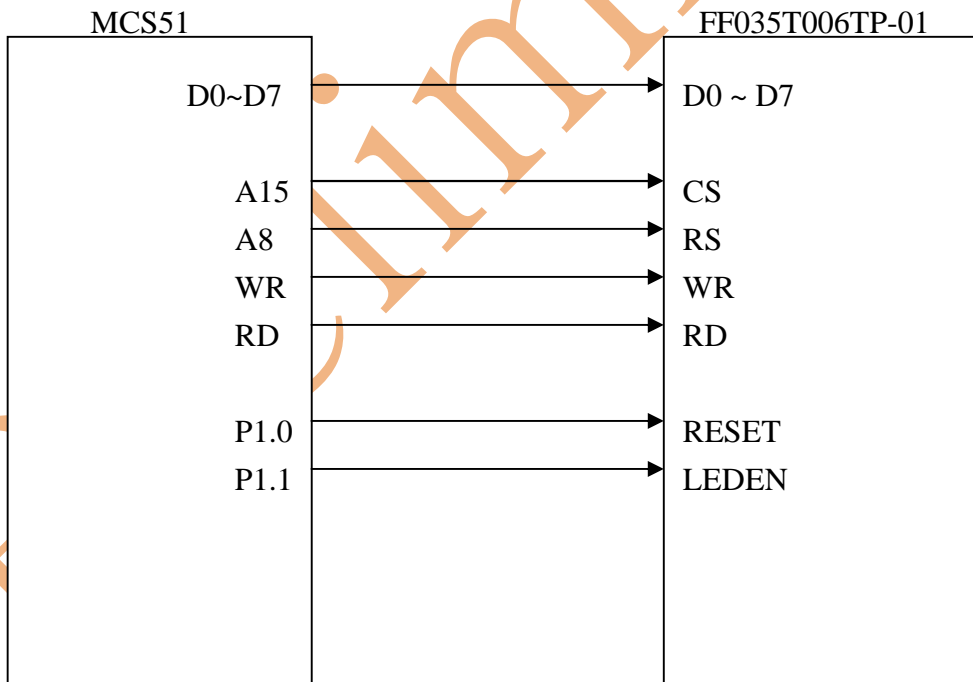
For 8bit connection:



For 16bit connection:

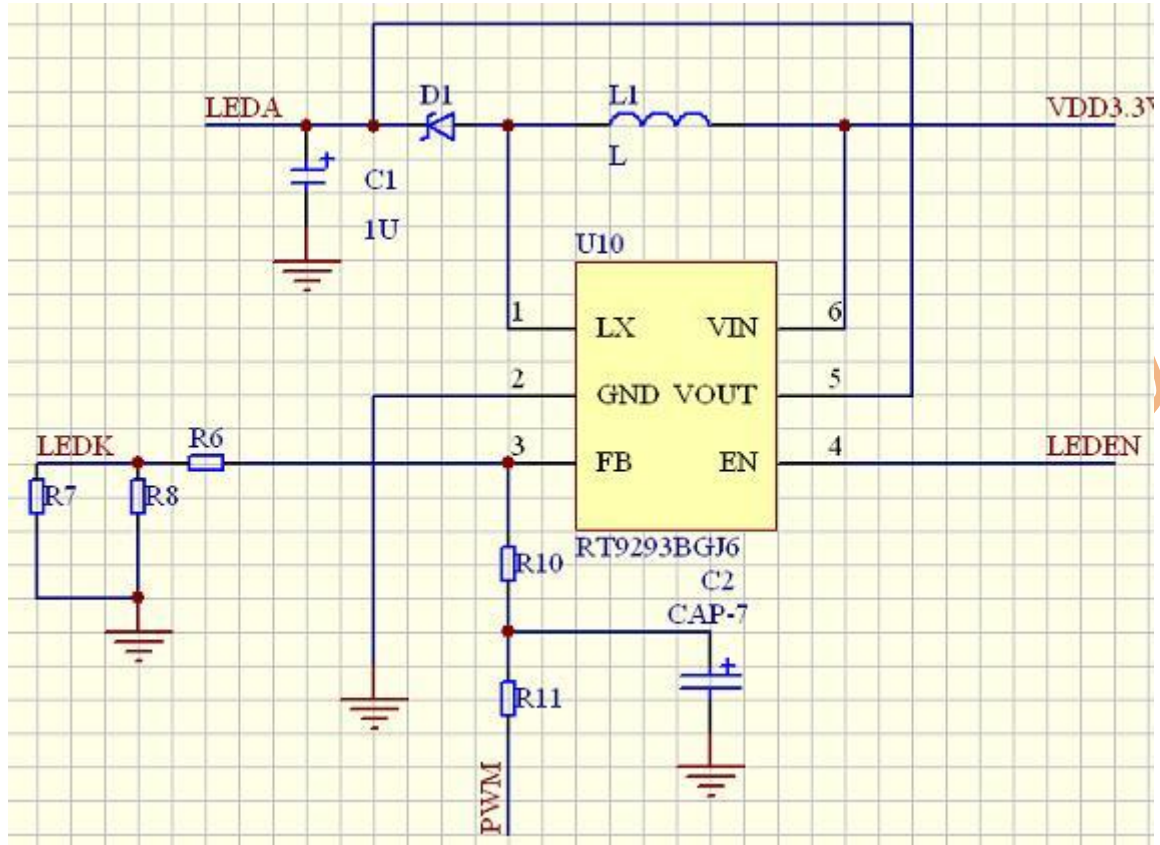


For example :

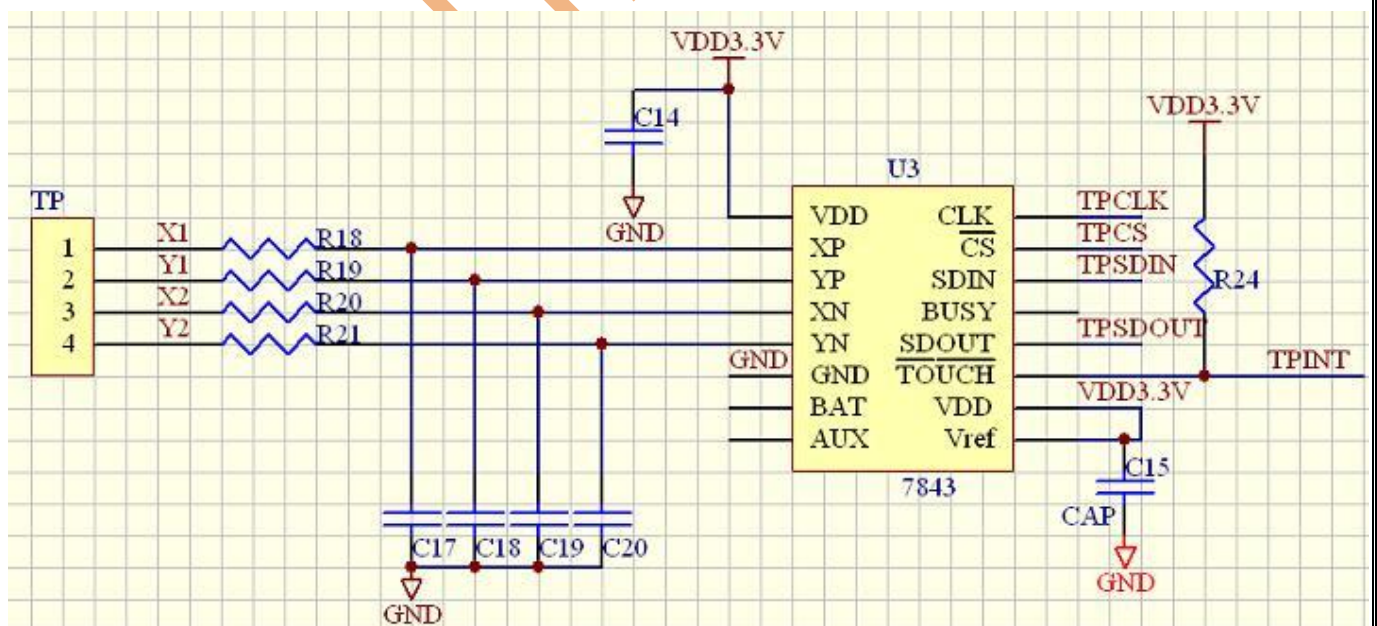


## 8.HARDWARE DRIVER

### 8.1 Backlight control



### 8.2 Touch panel control



## 9.COMMAND

### 9.1 Command list

Hex	Code	Command Description
0x00	nop	No operation
0x01	soft_reset	Software Reset
0x0A	get_power_mode	Get the current power mode
0x0B	get_address_mode	Get the frame buffer to the display panel read order
0x0C	Reserved	Reserved
0x0D	get_display_mode	The SSD1963 returns the Display Image Mode.
0x0E	get_tear_effect_status	Get the Tear Effect status
0x0F	Reserved	Reserved
0x10	enter_sleep_mode	Turn off the panel. This command will pull low the GPIO0. If GPIO0 is configured as normal GPIO or LCD miscellaneous signal with command set_gpio_conf, this command will be ignored.
0x11	exit_sleep_mode	Turn on the panel. This command will pull high the GPIO0. If GPIO0 is configured as normal GPIO or LCD miscellaneous signal with command set_gpio_conf, this command will be ignored.
0x12	enter_partial_mode	Part of the display area is used for image display.
0x13	enter_normal_mode	The whole display area is used for image display.
0x20	exit_invert_mode	Displayed image colors are not inverted.
0x21	enter_invert_mode	Displayed image colors are inverted.
0x26	set_gamma_curve	Selects the gamma curve used by the display panel.
0x28	set_display_off	Blanks the display panel
0x29	set_display_on	Show the image on the display panel
0x2A	set_column_address	Set the column address
0x2B	set_page_address	Set the page address
0x2C	write_memory_start	Transfer image information from the host processor interface to the SSD1963 starting at the location provided by set_column_address and set_page_address
0x2E	read_memory_start	Transfer image data from the SSD1963 to the host processor interface starting at the location provided by set_column_address and set_page_address
0x30	set_partial_area	Defines the partial display area on the display panel

0x33	set_scroll_area	Defines the vertical scrolling and fixed area on display area
0x34	set_tear_off	Synchronization information is not sent from the SSD1963 to the host processor
0x35	set_tear_on	Synchronization information is sent from the SSD1963 to the host processor at the start of VFP
0x36	set_address_mode	Set the read order from frame buffer to the display panel
0x37	set_scroll_start	Defines the vertical scrolling starting point
0x38	exit_idle_mode	Full color depth is used for the display panel
0x39	enter_idle_mode	Reduce color depth is used on the display panel.
0x3A	Reserved	Reserved
0x3C	write_memory_continue	Transfer image information from the host processor interface to the SSD1963 from the last written location
0x3E	read_memory_continue	Read image data from the SSD1963 continuing after the last read_memory_continue or read_memory_start
0x44	set_tear_scanline	Synchronization information is sent from the SSD1963 to the host processor when the display panel refresh reaches the provided scanline
0x45	get_scanline	Get the current scanline
0xA1	read_ddb	Read the DDB from the provided location
0xA8	Reserved	Reserved
0xB0	set_lcd_mode	Set the LCD panel mode and resolution
0xB1	get_lcd_mode	Get the current LCD panel mode, pad strength and resolution
0xB4	set_hori_period	Set front porch
0xB5	get_hori_period	Get current front porch settings
0xB6	set_vert_period	Set the vertical blanking interval between last scanline and next LFRAME pulse
0xB7	get_vert_period	Set the vertical blanking interval between last scanline and next LFRAME pulse
0xB8	set_gpio_conf	Set the GPIO configuration. If the GPIO is not used for LCD, set the direction. Otherwise, they are toggled with LCD

		signals.
0xB9	get_gpio_conf	Get the current GPIO configuration
0xBA	set_gpio_value	Set GPIO value for GPIO configured as output
0xBB	get_gpio_status	Read current GPIO status. If the individual GPIO was configured as input, the value is the status of the corresponding pin. Otherwise, it is the programmed value.
0xBC	set_post_proc	Set the image post processor
0xBD	get_post_proc	Set the image post processor
0xBE	set_pwm_conf	Set the image post processor
0xBF	get_pwm_conf	Set the image post processor
0xC0	set_lcd_gen0	Set the rise, fall, period and toggling properties of LCD signal generator 0
0xC1	get_lcd_gen0	Get the current settings of LCD signal generator 0
0xC2	set_lcd_gen1	Set the rise, fall, period and toggling properties of LCD signal generator 1
0xC3	get_lcd_gen1	Get the current settings of LCD signal generator 1
0xC4	set_lcd_gen2	Set the rise, fall, period and toggling properties of LCD signal generator 2
0xC5	get_lcd_gen2	Get the current settings of LCD signal generator 2
0xC6	set_lcd_gen3	Set the rise, fall, period and toggling properties of LCD signal generator 3
0xC7	get_lcd_gen3	Get the current settings of LCD signal generator 3
0xC8	set_gpio0_rop	Set the GPIO0 with respect to the LCD signal generators using ROP operation. No effect if the GPIO0 is configured as general GPIO.
0xC9	get_gpio0_rop	Get the GPIO0 properties with respect to the LCD signal generators.
0xCA	set_gpio1_rop	Set the GPIO1 with respect to the LCD signal generators using ROP operation. No effect if the GPIO1 is configured as general GPIO.
0xCB	get_gpio1_rop	Get the GPIO1 properties with respect to the LCD signal generators.
0xCC	set_gpio2_rop	Set the GPIO2 with respect to the LCD signal generators using ROP operation. No effect if the GPIO2 is configured as general GPIO.
0xCD	get_gpio2_rop	Get the GPIO2 properties with respect to the LCD signal generators.

0xCE	set_gpi_o3_rop	Set the GPIO3 with respect to the LCD signal generators using ROP operation. No effect if the GPIO3 is configured as general GPIO.
0xCF	get_gpi_o3_rop	Get the GPIO3 properties with respect to the LCD signal generators.
0xD0	set_dbc_conf	Set the dynamic back light configuration
0xD1	get_dbc_conf	Get the current dynamic back light configuration
0xD4	set_dbc_th	Set the threshold for each level of power saving
0xD5	get_dbc_th	Get the threshold for each level of power saving
0xE0	set_pll	Start the PLL. Before the start, the system was operated with the crystal oscillator or clock input
0xE2	set_pll_mn	Set the PLL
0xE3	get_pll_mn	Get the PLL settings
0xE4	get_pll_status	Get the current PLL status
0xE5	set_deep_sleep	Set deep sleep mode
0xE6	set_lshift_freq	Set the LSHIFT (pixel clock) frequency
0xE7	get_lshift_freq	Get current LSHIFT (pixel clock) frequency setting
0xE8	Reserved	Reserved
0xE9	Reserved	Reserved
0xF0	set_pixel_data_interface	Set the pixel data format of the parallel host processor interface
0xF1	get_pixel_data_interface	Get the current pixel data format settings
0xFF	Reserved	Reserved

### 9.1 initialization Code

```

#define HDP 319
#define HT 409
#define HPS 71
#define LPS 1
#define HPW 8

#define VDP 239
#define VT 269
#define VPS 14
#define FPS 1

```



```
#define VPW 15
```

```
_RESET_set1();
```

```
Delay(100);
```

```
_RESET_set0();
```

```
Delay(200);
```

```
_RESET_set1();
```

```
Delay(200);
```

```
LCD_WR_REG(0x00E2); //PLL multiplier, set PLL clock to 120M
```

```
LCD_WR_Data(0x0023); //N=0x36 for 6.5M, 0x23 for 10M crystal
```

```
LCD_WR_Data(0x0002);
```

```
LCD_WR_Data(0x0004);
```

```
LCD_WR_REG(0x00E0); // PLL enable
```

```
LCD_WR_Data(0x0003);
```

```
delay_time(10);
```

```
LCD_WR_REG(0x00E0);
```

```
LCD_WR_Data(0x0003);
```

```
delay_time(10);
```

```
LCD_WR_REG(0x0001); // software reset
```

```
delay_time(10);
```

```
LCD_WR_REG(0x00E6); //PLL setting for PCLK, depends on resolution
```

```
LCD_WR_Data(0x01);
```

```
LCD_WR_Data(0xda);
```

```
LCD_WR_Data(0x73);
```

```
LCD_WR_REG(0x00B0); //LCD SPECIFICATION
```

```
LCD_WR_Data(0x0020);
```

```
LCD_WR_Data(0x0000);
```

```
LCD_WR_Data((HDP>>8)&0X00FF); //Set HDP
```

```
LCD_WR_Data(HDP&0X00FF);
```

```
LCD_WR_Data((VDP>>8)&0X00FF); //Set VDP
```

```
LCD_WR_Data(VDP&0X00FF);
```

```
LCD_WR_Data(0x0000);
```

```
LCD_WR_REG(0x00B4); //HSYNC
LCD_WR_Data((HT>>8)&0X00FF); //Set HT
LCD_WR_Data(HT&0X00FF);
LCD_WR_Data((HPS>>8)&0X00FF); //Set HPS
LCD_WR_Data(HPS&0X00FF);
LCD_WR_Data(HPW); //Set HPW
LCD_WR_Data((LPS>>8)&0X00FF); //Set LPS
LCD_WR_Data(LPS&0X00FF);
LCD_WR_Data(0x0000);
```

```
LCD_WR_REG(0x00B6); //VSYNC
LCD_WR_Data((VT>>8)&0X00FF); //Set VT
LCD_WR_Data(VT&0X00FF);
LCD_WR_Data((VPS>>8)&0X00FF); //Set VPS
LCD_WR_Data(VPS&0X00FF);
LCD_WR_Data(VPW); //Set VPW
LCD_WR_Data((FPS>>8)&0X00FF); //Set FPS
LCD_WR_Data(FPS&0X00FF);
```

```
LCD_WR_REG(0x0036); //rotation
LCD_WR_Data(0x0080);
```

```
LCD_WR_REG(0x00F0); //pixel data interface
LCD_WR_Data(0x0003);
```

```
LCD_WR_REG(0x00B8);
LCD_WR_Data(0x0007);
LCD_WR_Data(0x0000); //GPIO0 normal
```

```
LCD_WR_REG(0x00BE); //set PWM if use PWM control backlight
LCD_WR_Data(0x0003);
LCD_WR_Data(0x00F0);
LCD_WR_Data(0x0001);
LCD_WR_Data(0x00f0);
LCD_WR_Data(0x0000);
```

```
LCD_WR_Data(0x0000);
```

```
LCD_WR_REG(0x00d0); // pwm setting
```

```
LCD_WR_Data(0x000d);
```

```
LCD_WR_REG(0x00ba);
```

```
LCD_WR_Data(0x0000);
```

```
LCD_WR_REG(0x00BA);
```

```
LCD_WR_Data(0x000a); //GPIO[3:0] out 1
```

```
delay_time(50);
```

```
LCD_WR_REG(0x0029); //display on
```

## 9.2Function Code

```
void TFT_CLEAR(unsigned int color)
```

```
{
```

```
    unsigned int l=TFT_WIDTH,w;
```

```
    LCD_WR_REG(0x002A);
```

```
    LCD_WR_Data(0);
```

```
    LCD_WR_Data(0);
```

```
    LCD_WR_Data(HDP>>8);
```

```
    LCD_WR_Data(HDP&0x00ff);
```

```
    LCD_WR_REG(0x002b);
```

```
    LCD_WR_Data(0);
```

```
    LCD_WR_Data(0);
```

```
    LCD_WR_Data(VDP>>8);
```

```
    LCD_WR_Data(VDP&0x00ff);
```

```
    LCD_WR_REG(0x002c);
```

```
    while(l--)
```

```
    {
```

```
        for(w=0;w<TFT_HEIGHT;w++)
```

```
        {
```

```
        LCD_WR_Data(color);
    }
}
}
```

```
void TFT_DrawPoint(unsigned int x,unsigned int y,unsigned int fontcolor)
```

```
{
    LCD_WR_REG(0x002A);
    LCD_WR_Data(x>>8);
    LCD_WR_Data(x&0x00ff);
    LCD_WR_Data(HDP>>8);
    LCD_WR_Data(HDP&0x00ff);
    LCD_WR_REG(0x002b);
    LCD_WR_Data(y>>8);
    LCD_WR_Data(y&0x00ff);
    LCD_WR_Data(VDP>>8);
    LCD_WR_Data(VDP&0x00ff);
    LCD_WR_REG(0x002c);

    LCD_WR_Data(fontcolor);
}
```

### 9.3 Reference For Touch Screen Control (Based on C8051 MCU)

```
void TP_Write(unsigned char cmd)
{
    unsigned char xdata i;
    TP_CS=0;
    TP_DCLK=0;
    for(i=0;i<8;i++)
    {
        if((cmd&0x80)==0)
            TP_DIN=0;
        else
            TP_DIN=1;
    }
}
```

```
    TP_DCLK=1;
    cmd=cmd<<1;
    TP_DCLK=0;//be low ,before read
}
}

unsigned int TP_Read(void)
{
    unsigned char xdata i;
    long int xdata val=0;

    TP_CS=0;
    TP_DOUT = 1;

    for(i=0;i<12;i++)
    {
        TP_DCLK=0;
        if(TP_DOUT)
        {
            val=val|(1<<((11-i)));
        }
        TP_DCLK=1;
    }

    TP_CS=1;
    return val;
}

unsigned int TP_GetPosition(unsigned char cmd)
{
    unsigned int xdata temp;
    unsigned char xdata i=0,j=0,k=0;
    unsigned int xdata TP[10];

    TP_PEN = 1;

    while((i<11)&&(!TP_PEN))
```

```
{
    TP_CS=0;
    TP_Write(cmd+1);
    TP[i]=TP_Read();
    i++;
    TP_CS=1;
}
if(i!=0)
{
    for(j=0;j<i;j++)
        for(k=0;k<i-j;k++)
            if (*(TP+k)>*(TP+k+1))
                {
                    temp=*(TP+k);
                    *(TP+k)=*(TP+k+1);
                    *(TP+k+1)=temp;
                }
    return (TP[i/2]);
}
else
    return 0;
}

void TP_DrawLine(void)
{
    unsigned long int  xdata gx=0,gy=0;           //coordinate on glass
    unsigned long int  xdata tx=0,ty=0;           //coordinate value read from TP
    unsigned long int  xdata gxtemp=0,gytemp=0;   //coordinate on glass

    DispColor(WHITE);//Background color

    TP_PEN = 1;
    while (TP_PEN)
    while(1)
    {
        while(KEY_STEP)
        {
```

```
Delay(50);//!  
while(!TP_PEN)  
{  
    tx=TP_GetPosition(0xd0);//x-position measure  
    gx=(tx-X_min)*(unsigned long int)(COL)/((X_max-X_min));  
  
    ty=TP_GetPosition(0x90);//y-position measure  
    gy=(ty-Y_min)*(unsigned long int)(ROW)/((Y_max-Y_min));  
    //Delay(15);//!  
    //touch panel must be interrupted  
    if((!TP_PENIRQ)&&(gx>=0&&gx<COL)&&(gy>=0&&gy<ROW))  
    {  
        PutPixel(gx,gy,RED);  
    }  
    Delay(50);  
}  
  
DispColor(BLACK);//Background Color  
  
}  
  
}  
  
#ifdef TP_TEST  
    TP_DrawLine();  
#endif
```

## 10. OPTICAL CHARACTERISTICS:

Driving the backlight

No.	ITEM		Symbol	Conditions	Specification			Unit	Note
					Min	Typ	Max		
1	Response Time		Tr+Tf	25°C	-	35		Ms	(1)(2)
2	Contrast Rate		Cr	$\theta=0$ , Normal viewing angle	300	-	-	-	(1)(3)
3	Viewing Angle	Hor.	$\theta L$	CR>10	60	70	-	Deg	-
			$\theta R$		60	70	-		
		Ver.	$\theta+$		60	70	-		
			$\theta-$		40	50	-		
4	Chromaticiry	White	x	Brightness is ON	0.278	0.298	0.318		
			y		0.311	0.331	0.51		
		Red	x		0.587	0.607	0.627		
			y		0.310	0.330	0.350		
		Green	x		0.258	0.278	0.298		
			y		0.526	0.546	0.566		
		Blue	x		0.121	0.141	0.161		
			y		0.138	0.158	0.178		
5	NTSC		S			50	%		
6	luminance		L		550	650		cd/m2	
7	Uniformity		U		75	80		%	

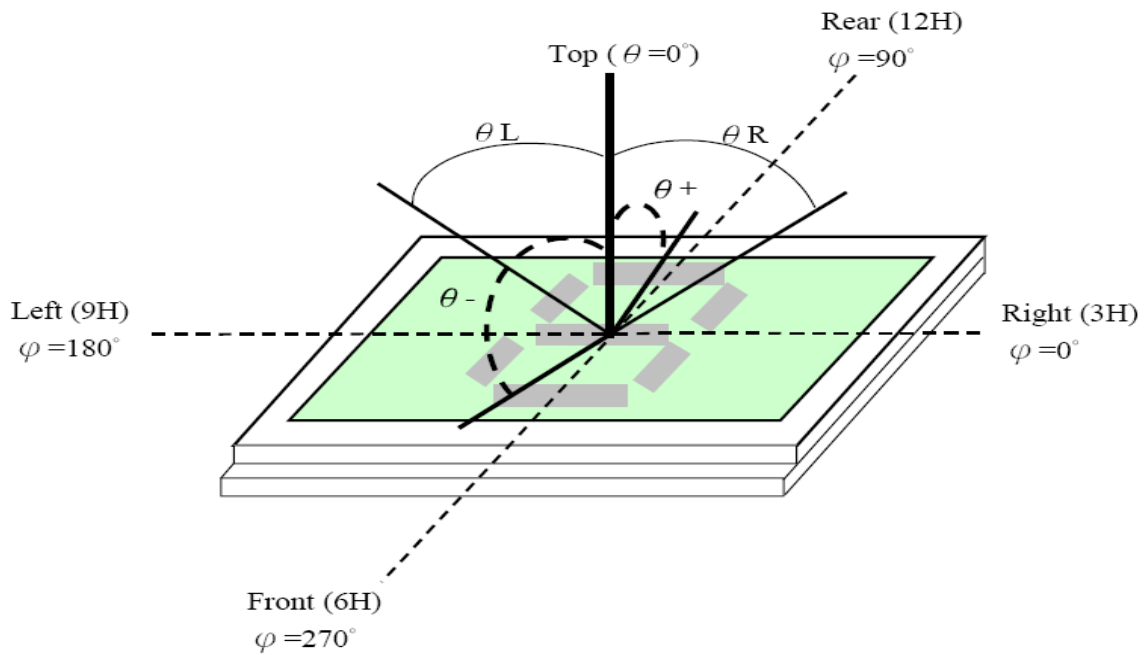
Measure Conditions:

1. Measure surrounding : dark room;
2. Ambient temperature: 25±2°C;
3. 30min.warm-up time.

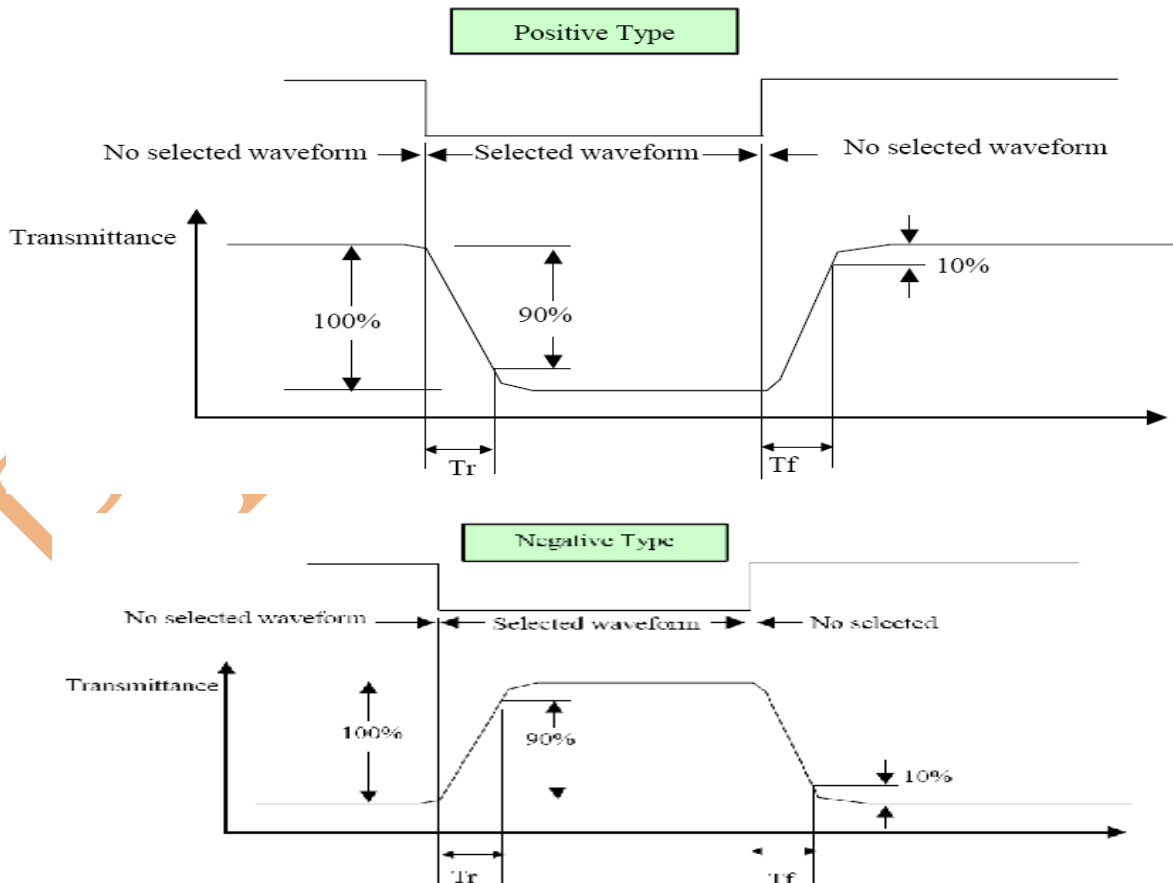
### Note Definition:

Note(1)Viewing angle range:

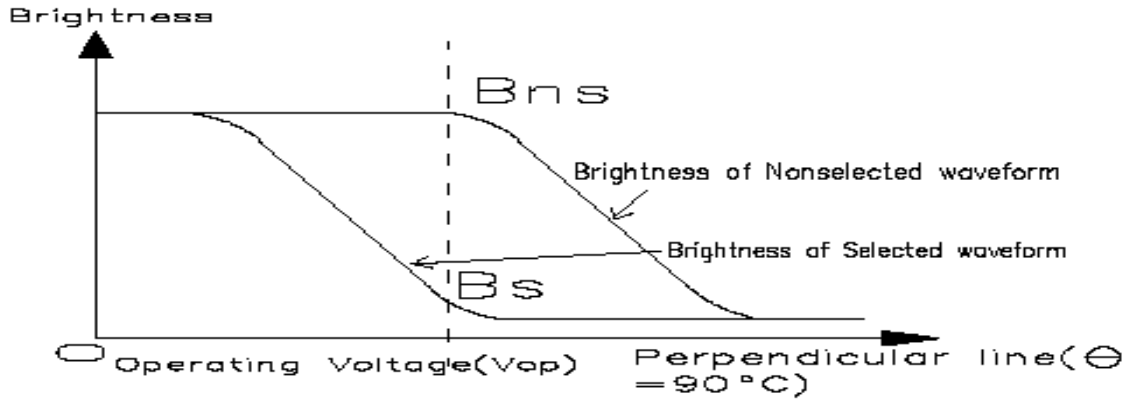




Note(2) Response Time:



**Note(3) Contrast Ratio Definition:**



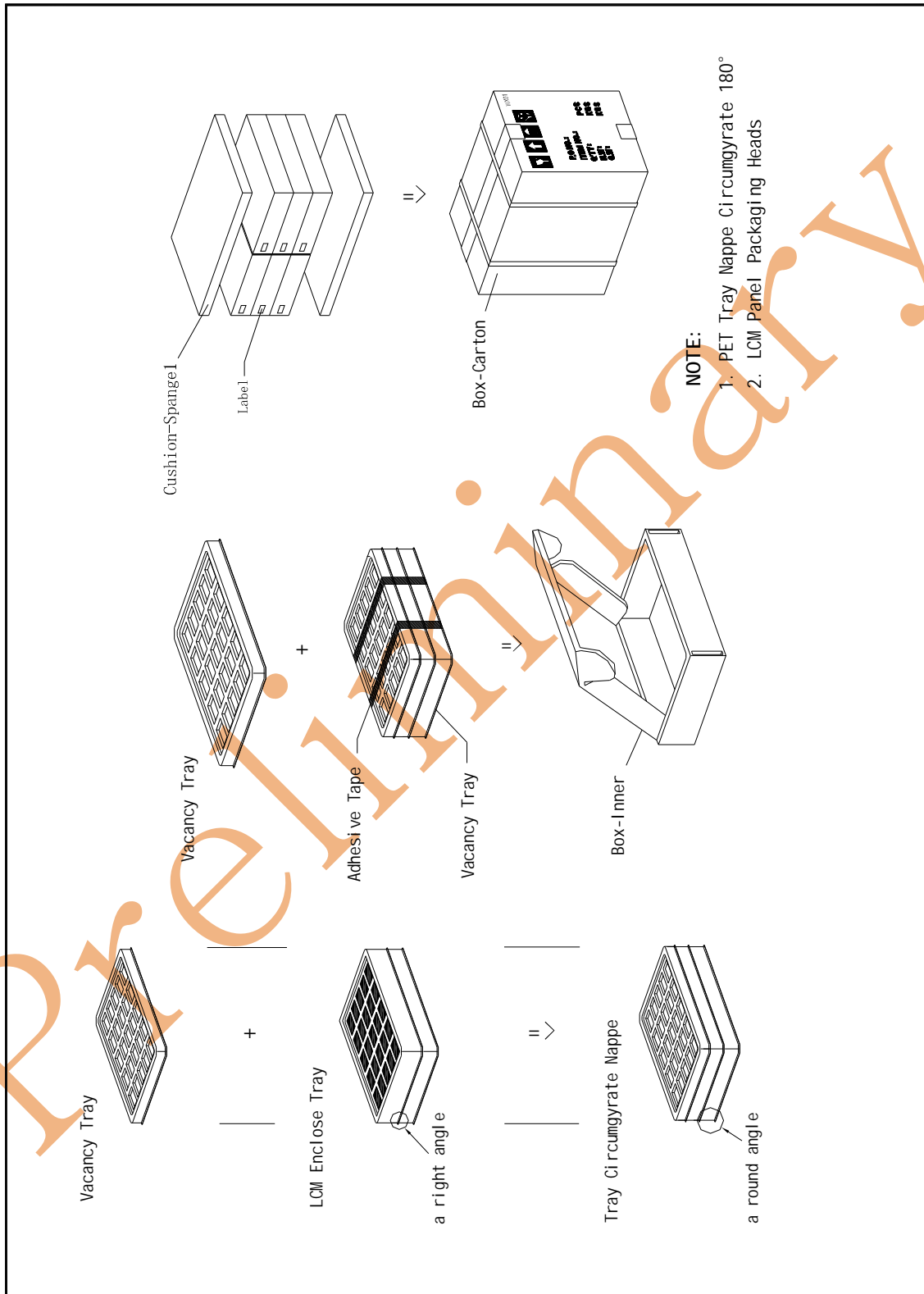
Luminance with all pixel white

Contrast Ratio (Cr) =  $\frac{\text{Luminance with all pixel white}}{\text{Luminance with all pixel black}}$

Luminance with all pixel black

Preliminary

### 11.PACKAGE.



NOTE:

1. PET Tray Nappe Circumgrate 180°
2. LCM Panel Packaging Heads

## **12. STANDARD SPECIFICATION FOR RELIABILITY:**

Item	Condition	Time (hrs)	Assessment
High temp. Storage	70°C	120	No abnormalities in functions and appearance
High temp. Operating	60°C	120	
Low temp. Storage	-20°C	120	
Low temp. Operating	-10°C	120	
Humidity	40°C/ 90%RH	120	
Thermal Shock Temp. Cycle	-30°C ← →70°C (0.5hour ← → 0.5 hour)	10cycles	
ESD Testing	HBM:	±8KV	330Ω/150PF
	MM:	±200V	200PF/0Ω

Functions, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (25±10°C), normal humidity (45±20% RH), and in area not exposed to direct sun light. (Life time of backlight, please refer to Data about backlight.)

### **Testing Conditions and Inspection Criteria:**

For the final test the testing sample must be stored at room temperature for 24 hours, after the tests listed in up Table, Standard specifications for Reliability have been executed in order to ensure stability.

Item	Test Model	In section Criteria
Current Consumption	Refer To Specification	The current consumption should conform to the product specification.
Contrast	Refer To Specification	After the tests have been executed, the contrast must be larger than half of its initial value prior to the tests.
Appearance	Visual inspection	Defect free.

## **13.SPECIFICATION OF QUALITY ASSURANCE:**

### **13.1 Purpose**

This standard for Quality Assurance should affirm the quality of LCD Module products to supply to purchaser by Future Focus.

### **13.2 Standard for Quality Test**

#### a. Inspection:

Before delivering, the supplier should take the following tests, and affirm the quality of product.

#### b. Electro-Optical Characteristics:

According to the individual specification to test the product.

#### c. Test of Appearance Characteristics:

According to the individual specification to test the product.

#### d. Test of Reliability Characteristics:

According to the definition of reliability on the specification for testing products.

#### e. Delivery Test:

Before delivering, the supplier should take the delivery test.

(i) Test method: According to MIL-STD105E.General Inspection Level II take a single time.

(ii) The defects classify of AQL as following:

Major defect: AQL = 0.65

Minor defect: AQL = 2.5

Total defects: AQL = 2.5

### **13.3. Nonconforming Analysis & Deal With Manners**

#### a. Nonconforming Analysis:

(i) Purchaser should supply the detail data of non- conforming sample and the non- conforming.

(ii) After accepting the detail data from purchaser, the analysis of nonconforming should be finished in two weeks.

(iii) If supplier can not finish analysis on time, must announce purchaser before two weeks.

#### b. Disposition of nonconforming:

(i) If find any product defect of supplier during assembly time, supplier must change the good product for every defect after recognition.

(ii) Both supplier and customer should analyze the reason and discuss the disposition of nonconforming when the reason of nonconforming is not sure.

### **13.4. Agreement items**

Both sides should discuss together when the following problems happen.

a. There is any problem of standard of quality assurance, and both sides think that it must be modified.

b. There is any argument item which does not record in the standard of quality assurance.

c. Any other special problem.

### 13.5 Standard of The Product Appearance Test

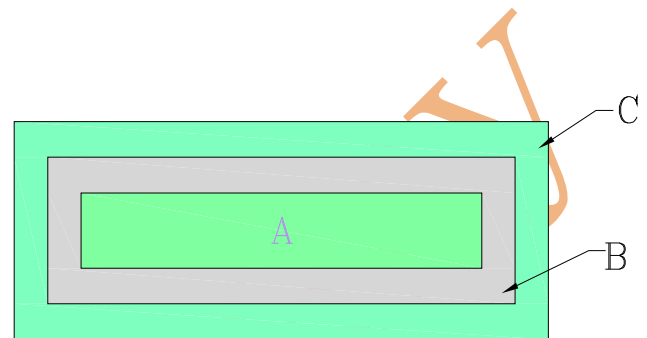
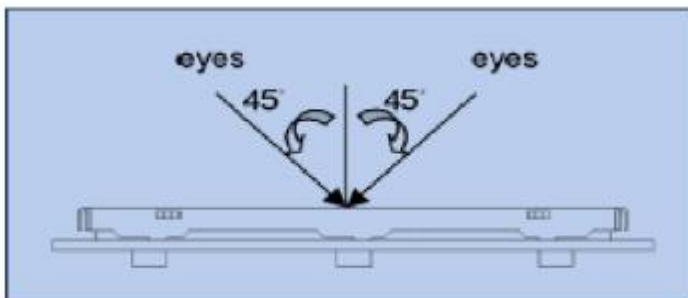
a. Manner of appearance test: This specification should be applied for both light on and off situation.

(i) The test must be under 20W × 2 or 40W fluorescent light, and the distance of view must be at 30±5cm.

(ii) When test the model of transmissive product must add the reflective plate.

(iii)The test direction is base on about around 10° of vertical line (Left graph)

(iiii)Temperature: 25±5℃ Humidity: 65±10%RH



(iv) Definition of area (Right graph)

A. Area: Viewing area.      B. Area: Out of viewing area.(Outside viewing area)

b. Basic principle:

(i) It will accord to the AQL when the standard can not be described.

(ii) The sample of the lowest acceptable quality level must be discussed by both supplier and customer when any dispute happened.

(iii) Must add new item on time when it is necessary.

c. Standard of inspection: (Unit: mm)

Allowable limits defined in follow Dot defect Table should be met for each white, black , R, G, B raster. The limits apply to the entire area. Missing white in 60% or more of typical (one color, R or G or B) pixel aperture is defined as a bright defect, less than 60% is acceptable .Black spot in 60% or more of typical pixel aperture is defined as a dark defect, less than 60% is acceptable.

Dot defect table:

Item	White dot defect	Black dot defect	Total
1	Defect counts	3	3
2	Combined defect Counts	No combined dot defect allowed. Two Single dot defect that within 5mm during each dot defect should becouted as combined dot defect.	

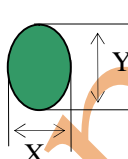
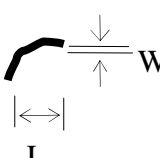
### 131.6 Inspection specification

AQL inspection standard

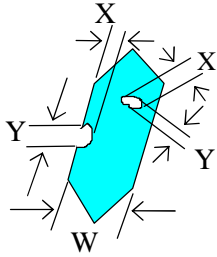
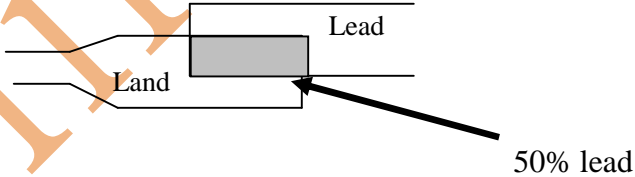
Sampling method: MIL-STD-105E, Level II, single sampling

Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		Contrast defect (dim, ghost)		
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction	2	
	Wrong Back-light	7		
	Non-display	Flat cable or pin reverse	9	
Wrong or missing component		10		
Minor	Display state	Background color deviation	2	2.5
		Black spot and dust	3	
		Line defect	4	
		Scratch		
		Rainbow	5	
	Pin hole	6		
	Polarizer	Bubble and foreign material	3	
		Scratch	4	
	PCB,FPC	Scratch	4	
	Soldering	Poor connection	8	
	Wire	Poor connection	9	
LCD	CHIP OUT	11		

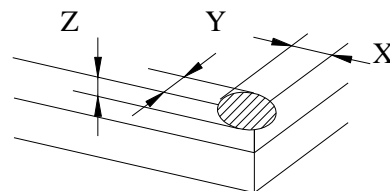
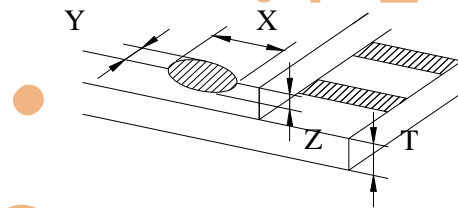
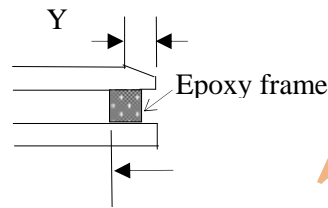
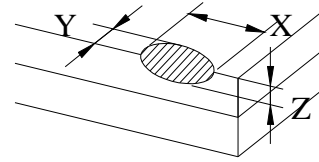
**Note on defect classification:**

No.	Item	Criterion																	
1	Short or open circuit	Not allow																	
	LC leakage																		
	Flickering																		
	No display																		
	Wrong viewing direction																		
	Wrong Back-light																		
2	Contrast defect	Refer to approval sample																	
	Background color deviation																		
3	<p>Point defect, Black spot, dust (incl. Polarizer) ex.: dirt under polarizer, Pinhole of reflector ,glass scratch, dirt under glass,scratch on polarizer</p> <p><math>f = (X+Y)/2</math></p>	 <table border="1"> <thead> <tr> <th>Point Size</th> <th>Acceptable Qty.</th> </tr> </thead> <tbody> <tr> <td><math>\phi \leq 0.20</math></td> <td>Disregard</td> </tr> <tr> <td><math>0.20 &lt; \phi \leq 0.25</math></td> <td>3</td> </tr> <tr> <td><math>0.25 &lt; \phi \leq 0.30</math></td> <td>2</td> </tr> <tr> <td><math>\phi &gt; 0.30</math></td> <td>0</td> </tr> </tbody> </table> <p>Unit: mm</p>	Point Size	Acceptable Qty.	$\phi \leq 0.20$	Disregard	$0.20 < \phi \leq 0.25$	3	$0.25 < \phi \leq 0.30$	2	$\phi > 0.30$	0							
Point Size	Acceptable Qty.																		
$\phi \leq 0.20$	Disregard																		
$0.20 < \phi \leq 0.25$	3																		
$0.25 < \phi \leq 0.30$	2																		
$\phi > 0.30$	0																		
4	<p>Line defect</p>	 <table border="1"> <thead> <tr> <th>L</th> <th>Line W</th> <th>Acceptable Qty.</th> </tr> </thead> <tbody> <tr> <td>---</td> <td><math>0.015 \geq W</math></td> <td>Disregard</td> </tr> <tr> <td><math>3.0 \geq L</math></td> <td><math>0.03 \geq W</math></td> <td rowspan="2">2</td> </tr> <tr> <td><math>2.0 \geq L</math></td> <td><math>0.05 \geq W</math></td> </tr> <tr> <td><math>1.0 \geq L</math></td> <td><math>0.1 &gt; W</math></td> <td>1</td> </tr> <tr> <td>---</td> <td><math>0.05 &lt; W</math></td> <td>Applied as point defect</td> </tr> </tbody> </table> <p>Unit: mm</p>	L	Line W	Acceptable Qty.	---	$0.015 \geq W$	Disregard	$3.0 \geq L$	$0.03 \geq W$	2	$2.0 \geq L$	$0.05 \geq W$	$1.0 \geq L$	$0.1 > W$	1	---	$0.05 < W$	Applied as point defect
L	Line W	Acceptable Qty.																	
---	$0.015 \geq W$	Disregard																	
$3.0 \geq L$	$0.03 \geq W$	2																	
$2.0 \geq L$	$0.05 \geq W$																		
$1.0 \geq L$	$0.1 > W$	1																	
---	$0.05 < W$	Applied as point defect																	
5	Rainbow	Not more than two color changes across the viewing area																	



No.	Item	Criterion								
6	<p><b>Segment pattern</b>  <math>W = \text{Segment width}</math>  <math>f = (X+Y)/2</math></p>	<p>(1) <b>Pin hole</b>  <math>\phi &lt; 0.10\text{mm}</math> is acceptable.</p>  <table border="1" data-bbox="970 734 1430 922"> <thead> <tr> <th>Point Size</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td><math>\phi \leq 1/4W</math></td> <td>Disregard</td> </tr> <tr> <td><math>1/4W &lt; \phi \leq 1/2W</math></td> <td>1</td> </tr> <tr> <td><math>\phi &gt; 1/2W</math></td> <td>0</td> </tr> </tbody> </table> <p>Unit: mm</p>	Point Size	Acceptable Qty	$\phi \leq 1/4W$	Disregard	$1/4W < \phi \leq 1/2W$	1	$\phi > 1/2W$	0
Point Size	Acceptable Qty									
$\phi \leq 1/4W$	Disregard									
$1/4W < \phi \leq 1/2W$	1									
$\phi > 1/2W$	0									
7	<b>Back-light</b>	<p>(1) The color of backlight should correspond its specification.  (2) Not allow flickering</p>								
8	<b>Soldering</b>	<p>(1) Not allow heavy dirty and solder ball on PCB or FPC.  (The size of dirty refer to point and dust defect)  (2) Over 50% of lead should be soldered on Land.</p> 								
9	<b>Wire</b>	<p>(1) Copper wire should not be rusted  (2) Not allow crack on copper wire connection.  (3) Not allow reversing the position of the flat cable.  (4) Not allow exposed copper wire inside the flat cable.</p>								
10	<b>PCB,FPC</b>	<p>(1) Not allow screw rust or damage.  (2) Not allow missing or wrong putting of component.</p>								

2.1.1 chip on the surface



Note: A:LCD Length

X	Y	Z
$>1/8A$	$\leq 0.3\text{mm}$	$\leq 1/2T$
$\leq 1/8A$	Not enter into epoxy frame	$\leq T$
	Not enter into the inner edge of epoxy	$\leq 1/2T$

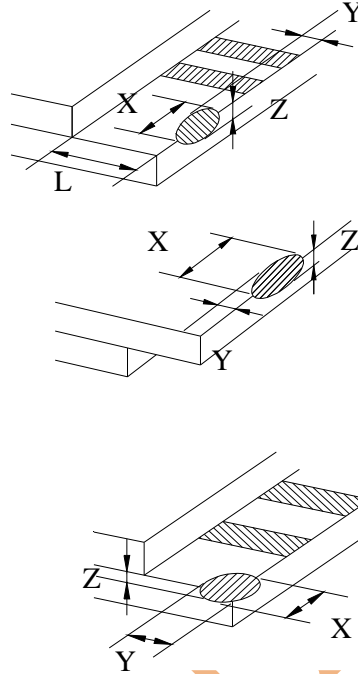
11

LCD

11

LCD

**2.1.2 Chip on the terminal**

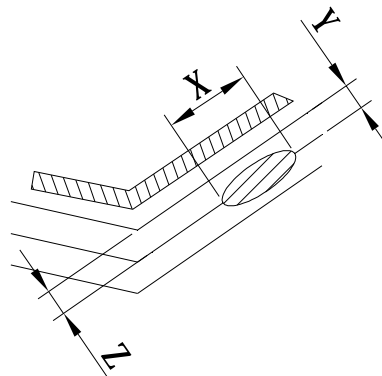


X	Y	Z
$> 1/8A$	$\leq 0.3\text{mm}$	$\leq 1/2T$
$\leq 1/8A$	$\leq 1/2L$	$\leq T$
$\leq 1/8A \& \leq 1\text{mm}$	$\leq L$	$\leq T$
$\leq 1/8A \& \leq 2\text{mm}$	$\leq L$	$\leq 1/2T$

Note: A:LCD Length.

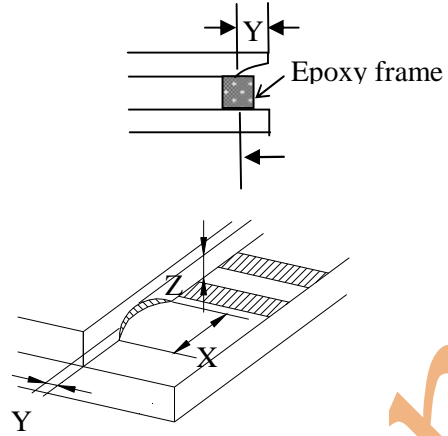
the distance between crack and contact pad must be greater than the width of 1<sup>st</sup> contact pad.

**2.1.3 Chip out on between side**



11

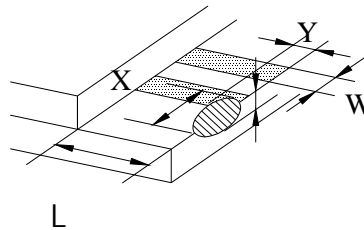
LCD



X	Y	Z
$\leq 1/8A$	Not enter into epoxy frame	$Z \leq 2T$
	Not enter into 1/2 epoxy frame	$Z \leq 1/2T$

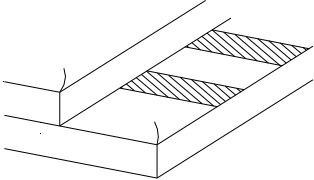
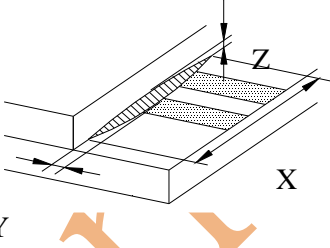
Note: A : LCD Length

**2.1.4 including corner chip and side chip**



Note: A:LCD Length

X	Y	Z
$>1/8A$	$\leq 1/6L$	$\leq 1/2T$
$\leq 1/8A$	$\leq 1/3L$	
$\leq 1/4W$	$\leq 2/3L$	

11	LCD	<p><b>2.2 Chip out</b></p>  <ol style="list-style-type: none"> <li>1) Chip out is that crackles extend to inner edge.</li> <li>2) Crackles round epoxy frame will be rejected.</li> <li>3) Chip out on the terminal will be rejected: <math>Z=T</math> length <math>&gt;1\text{mm}</math> or <math>Z&lt;T</math> length <math>&gt;2\text{mm}</math></li> <li>4) The chip out at ITO will be rejected.</li> </ol> <p><b>2.3 Poor cutting</b></p>  <table border="1" data-bbox="678 1093 1157 1339"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td><math>&gt;1/8</math> A</td> <td><math>\leq 0.3</math></td> <td><math>\leq 1/2T</math></td> </tr> <tr> <td><math>\leq 1/8</math> A</td> <td>According to drawing</td> <td><math>1/2T \leq Z \leq T</math></td> </tr> </tbody> </table> <p style="text-align: right;"><b>Note : A:</b> LCD Length.</p>	X	Y	Z	$>1/8$ A	$\leq 0.3$	$\leq 1/2T$	$\leq 1/8$ A	According to drawing	$1/2T \leq Z \leq T$
X	Y	Z									
$>1/8$ A	$\leq 0.3$	$\leq 1/2T$									
$\leq 1/8$ A	According to drawing	$1/2T \leq Z \leq T$									
12	SMT	<p>According to the &lt;Acceptable of electronic assemblies&gt; IPC-A-610C class 2 stander. Component missing or function defect are Major defect ,the others are Minor defect.</p>									
<p><b>Any one out of the specification will be rejected.</b></p>											

## **14. GENERAL PRECAUTIONS**

### (1) Mounting Method

The panel of the LCD Module consists of two thin glass plates with polarizers which easily get damaged since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD Modules.

### (2) Caution of LCD handling & cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.

- Isopropyl alcohol
- Ethyl alcohol
- Trichlorotrifluoroethane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface. Do not use the following solvent:

- Water
- Ketone
- Aromatics

### (3) Caution against static charge

The LCD Module use C-MOS LSI drivers, so we recommend that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

### (4) Packaging

Modules use LCD elements, and must be treated as such. Avoid intense shock and falls from a height.

- To prevent modules from degradation. Do not operate or store them exposed directly to sunshine or high temperature/humidity.

### (5) Caution for operation

- It is indispensable to drive LCD's within the specified voltage limit since the higher voltage than the limit shorten LCD life. An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of direct current drive.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them.

However those phenomena do not mean malfunction or out of order with LCD's which will come back in the specified operating temperature range.

- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- As light dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

Usage under the relative condition of 40°C, 50%RH or less is required.

#### (6) Storage

In the case of storing for a long period of time (for instance, for years) for the purpose of replacement use, The following ways are recommended.

- Storage in a polyethylene bag with sealed so as not to enter fresh air outside in it, And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is.

Keeping temperature in the specified storage temperature range.

- Storing with no touch on polarizer surface by the anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)

#### (7) Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol which should be burned up later.
- When any liquid crystal leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.

#### **Limited Warranty**

FutureFocus LCD Modules are not consumer products, but may be incorporated by FutureFocus' customers into consumer products or components thereof, FutureFocus does not warrant that its components are fit for any such particular purpose.

1. The liability of FutureFocus is limited to repair or replacement on the terms set forth below. FutureFocus will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between FutureFocus and the customer, FutureFocus will only replace or repair any of its LCM which is found defective electrically or visually when inspected in accordance with FutureFocus.
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCM, they must be properly packaged; there should be detailed description of the failures or defect.

**FutureFocus Limited reserves the right to change this specification.**

**URL: <http://www.future-focus.cn>**

**- END -**