DENSITRON DISPLAYS

LIQUID CRYSTAL DISPLAY MODULE

Product Specification

PRODUCT NUMBER	TSR5413

INTERNAL APPROVALS		
Product Manager	Engineering	Document Control

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REVISION RECORD

Rev.	Date	Page	Par.	Comment	ECN no.
A	11/21/08	--	--	New DCA Specification – Combined all TSR5413 versions.	E3927
B	7/14/09	11	--	Added LCD Glass layout	E4142
C	10/23/09	13	--	Added LCD current consumption	E4201
D	8/11/10	14	--	Touch screen spec updated	E4345
E	7/11/13	12,27,28	--	Updated recommended circuit. Added read EEPROM procedure.	E4826
F	11/05/13	12	--	Updated recommended circuit schematics.	E4880
G	04/23/14	6,7,8,15	--	Recommended touch controller updated. Added touch screen drawing.	E4958

1 PRODUCT SPECIFICATION

1.1 MAIN FEATURES

ITEM	CONTENTS	UNIT
Outline Dimension*[1]	85.0 (W) x 55.0 (H) x 8.00 (D)	mm
Active Area	64.78 (W) x 34.54 (H)	mm
Viewing Area	78.60 (W) x 39.60 (H)	mm
Dot Size	0.25 (W) x 0.25 (H)	mm
Display Format	240 x 128	Dots
Viewing Direction	6:00	O'clock
Duty Ratio	1/128	Duty
Bias Drive	1/12	Bias
Module Operating Voltage	3.0	Volts
LCD Operating Voltage	11.6	Volts
IC Controller	ST7529	--
Operating Temperature	-20 ~ 80	°C
Storage Temperature	-30 ~ 80	°C
RoHS Complaint	Yes	-

*Note 1: The outline dimensions for Sunburst Yellow backlight type will be 85.0 (W) x 55.0 (H) x 8.50 Max (D) mm due to the addition of Yellow filter.

1.2 AVAILABLE FLUID AND POLARIZER TYPES

LCD TYPE		STN		FSTN	
		Normal Temp.	Wide Temp.	Normal Temp.	Wide Temp.
Transmissive	Negative	N/A	✓	N/A	✓
Transflective	Positive	N/A	N/A	N/A	✓

1.3 AVAILABLE BACKLIGHT TYPES AND COLORS

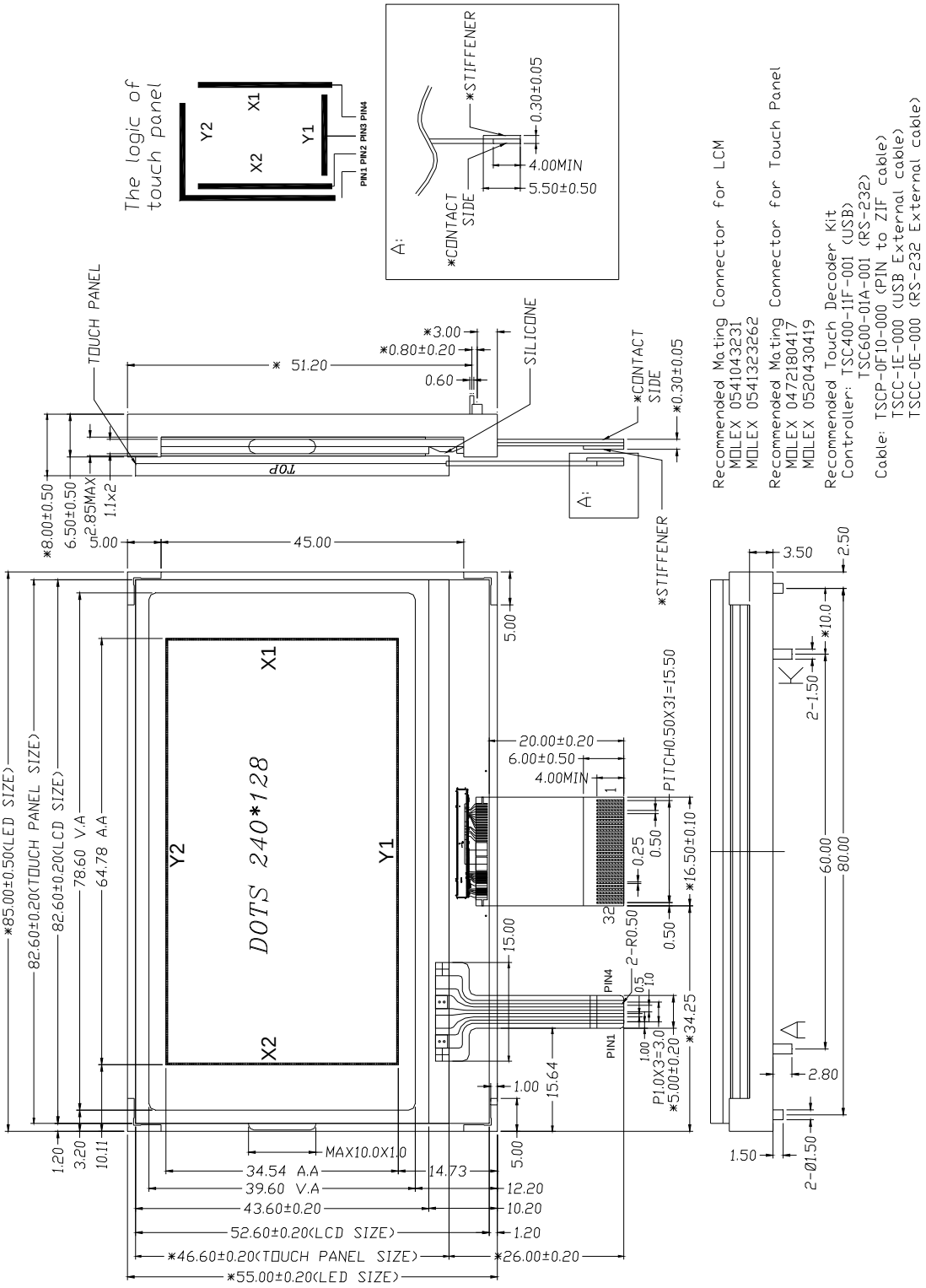
BACKLIGHT COLOR	Jade Green	Arctic White	Warm Amber	Midnight Blue	Tangerine Orange	Sunburst Yellow	RGB Type
Edge LED	✓	✓	N/A	✓	✓	✓	✓

1.4 CHOICE OF BACKLIGHT COLORS AND LCD SURFACE LUMINOSITIES

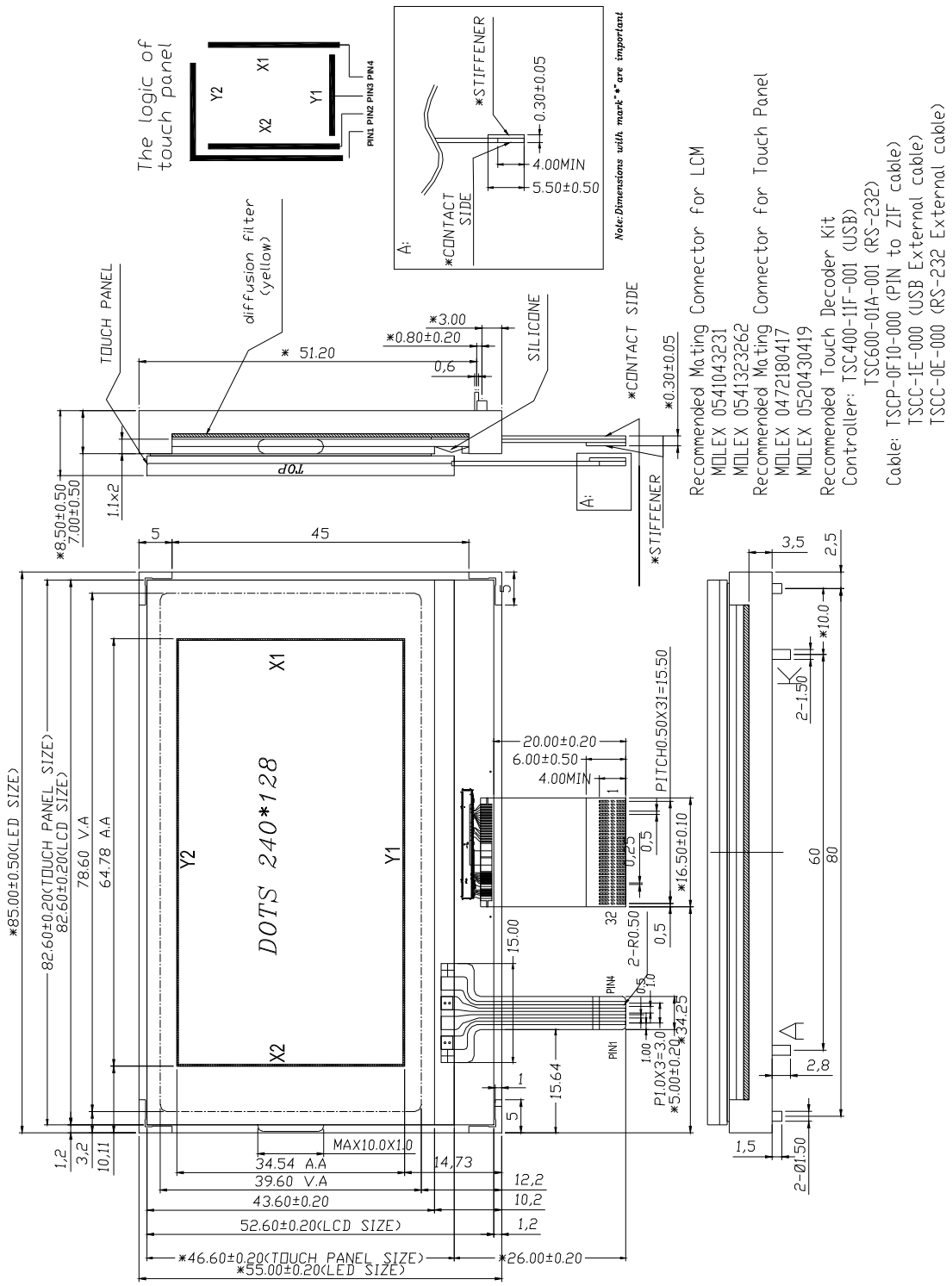
-	MIDNIGHT BLUE	JADE GREEN	TANGERINE ORANGE	SUNBURST YELLOW	RGB TYPE	ARCTIC WHITE	UNIT
FSTN /Transmissive/Negative	3.0	2.8	4.3	31.0	6.0 (R), 10.0 (G) & 4.0 (B)	45.0	Cd/m^2
STN/ Transmissive/Negative	N/A	N/A	N/A	N/A	N/A	41.0	Cd/m^2
FSTN /Transflective/Positive	N/A	N/A	N/A	N/A	5.0 (R), 9.0 (G) & 3.0 (B)	70.0	Cd/m^2

2 MECHANICAL DRAWING

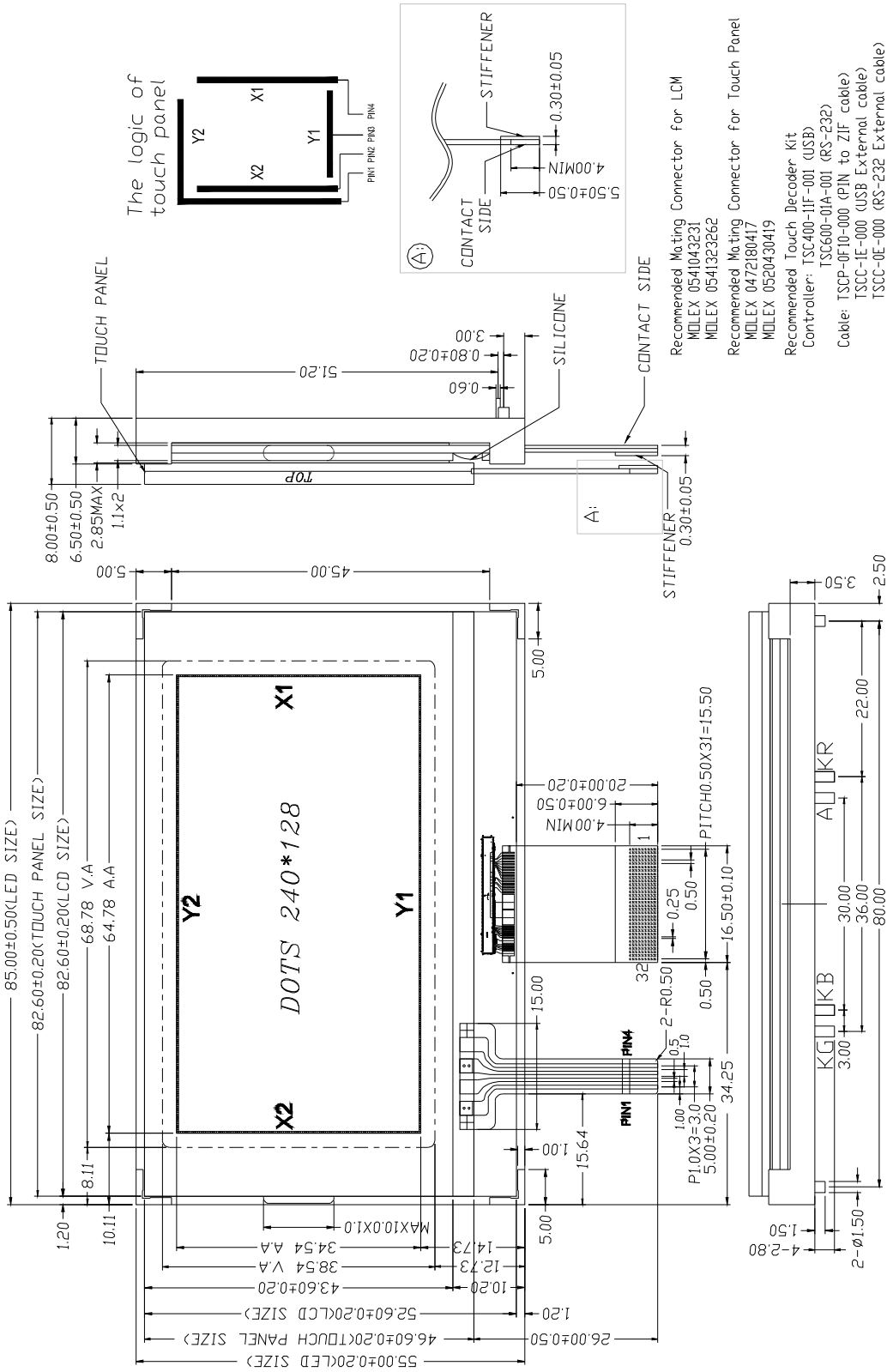
2.1 FOR ALL BACKLIGHT TYPES EXCEPT SUNBURST YELLOW AND RGB



2.2 FOR SUNBURST YELLOW BACKLIGHT TYPE



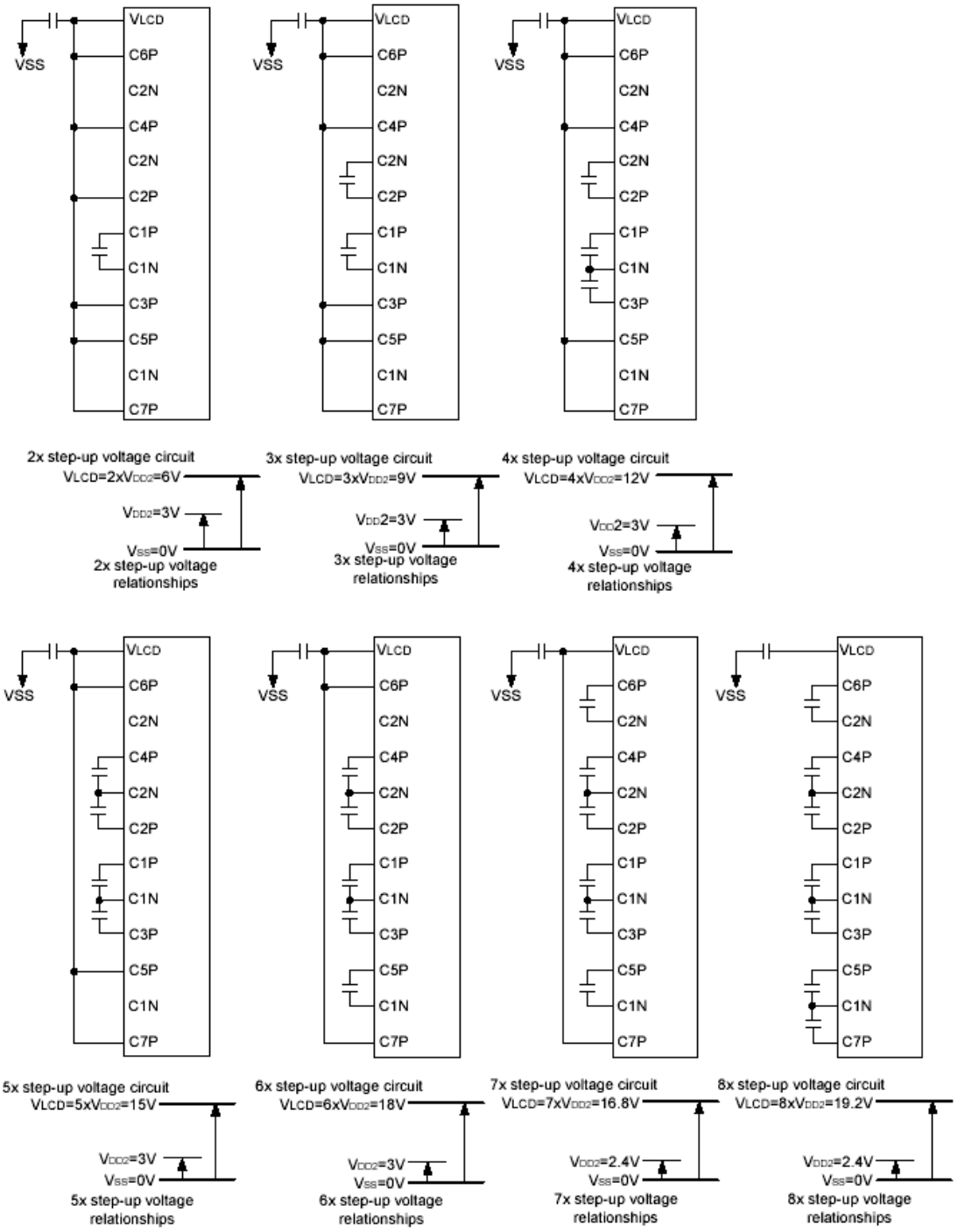
2.3 FOR RGB TYPE BACKLIGHT



3 PIN CONNECTIONS

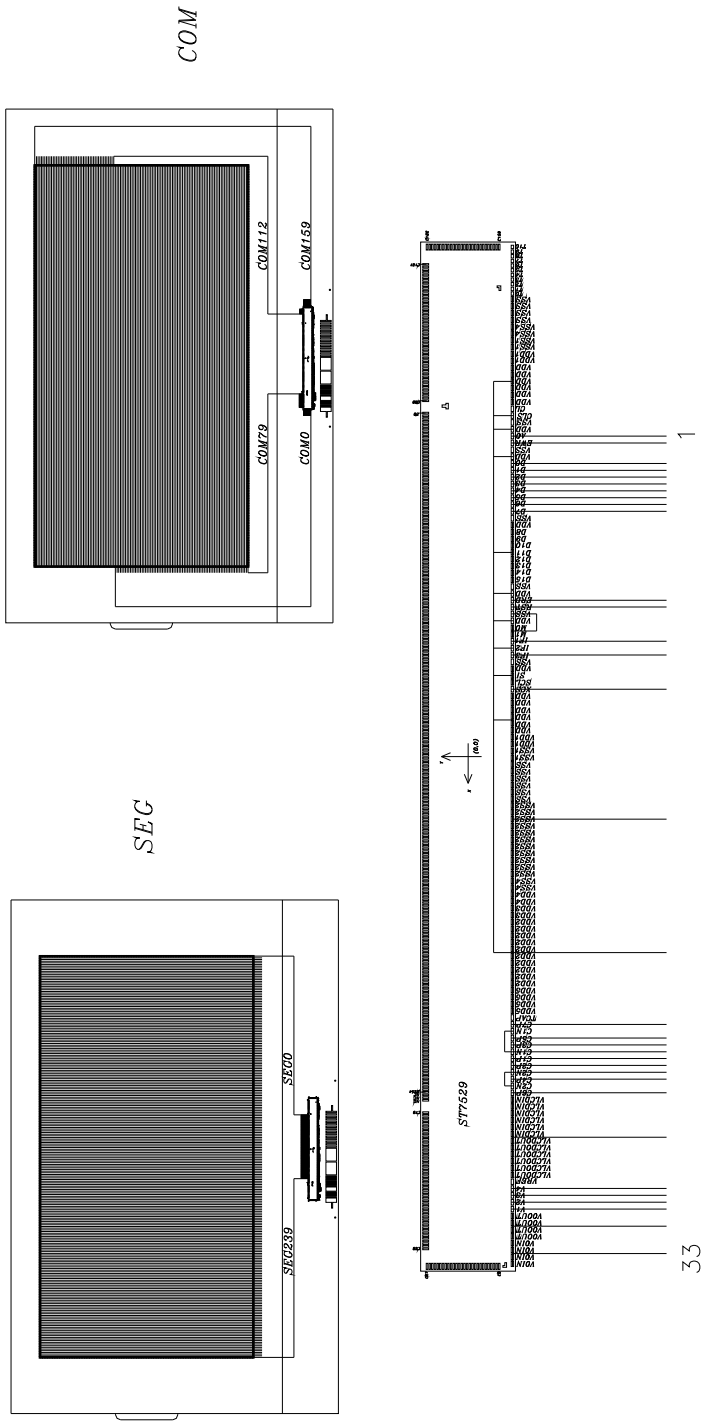
Pin No.	Symbol	Function
1	A0	Identify The Data or a Command.
2	RW-/WR	Read/Write execution control
3~10	D0-D7	The 8-bit bi-directional data bus to be connected to the MCU in parallel interface mode
11	E-/RD	Read/Write execution control
12	RST	Reset input pin
13	IF1	Parallel/Serial data input select input
14	IF3	Parallel/Serial data input select input
15	XCS	Chip select input pin
16	VSS	Ground
17	VDD	Chip's power supply pin
18	C7P	Connection Pin for Voltage Converter
19	C5P	Connection Pin for Voltage Converter
20	C3P	Connection Pin for Voltage Converter
21	C1N	Connection Pin for Voltage Converter
22	C1P	Connection Pin for Voltage Converter
23	C2P	Connection Pin for Voltage Converter
24	C2N	Connection Pin for Voltage Converter
25	C4P	Connection Pin for Voltage Converter
26	C6P	Connection Pin for Voltage Converter
27	VLCD	If the internal voltage generator is used， the V_{LCDIN} & V_{LCDOUT} must be connected together.
28-32	V4, V3, V2, V1, V0	LCD driving supply voltage. Connect to ground when internal power circuit is active, *refer to recommended schematic.

4 THE STEP-UP VOLTAGE CIRCUITS



Note: The regulating capacitance on V0 ~ V4 should be between 1.0 to 2.2 uF.

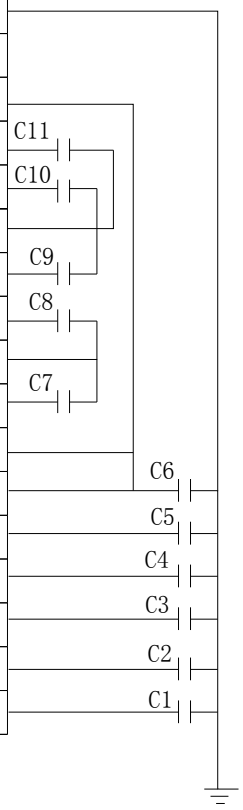
5 LCD GLASS LAYOUT



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16				
A0	EWR	D0	D1	D2	D3	D4	D5	D6	D7	ERD	RST	IF1	IF3	XCS	VSS				
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33			
VDD	C7P	C5P	C3P	C1N	C1P	C2P	C2N	C4P	C6P	VLCD	V4	V3	V2	V1	V0UT	V0IN			

6 RECOMMENDED CIRCUIT SCHEMATIC

1	A0	P3.0
2	RW-/WR	P3.1
3	D0	P1.0
4	D1	P1.1
5	D2	P1.2
6	D3	P1.3
7	D4	P1.4
8	D5	P1.5
9	D6	P1.6
10	D7	P1.7
11	E-/RD	P3.2
12	RST	P3.3
13	IF1	VSS
14	IF3	VDD
15	XCS	P3.4
16	VSS	VSS
17	VDD	VDD
18	C7P	C7P
19	C5P	C5P
20	C3P	C3P
21	C1N	C1N
22	C1P	C1P
23	C2P	C2P
24	C2N	C2N
25	C4P	C4P
26	C6P	C6P
27	VLCD	VLCD
28	V4	V4
29	V3	V3
30	V2	V2
31	V1	V1
32	V0	V0



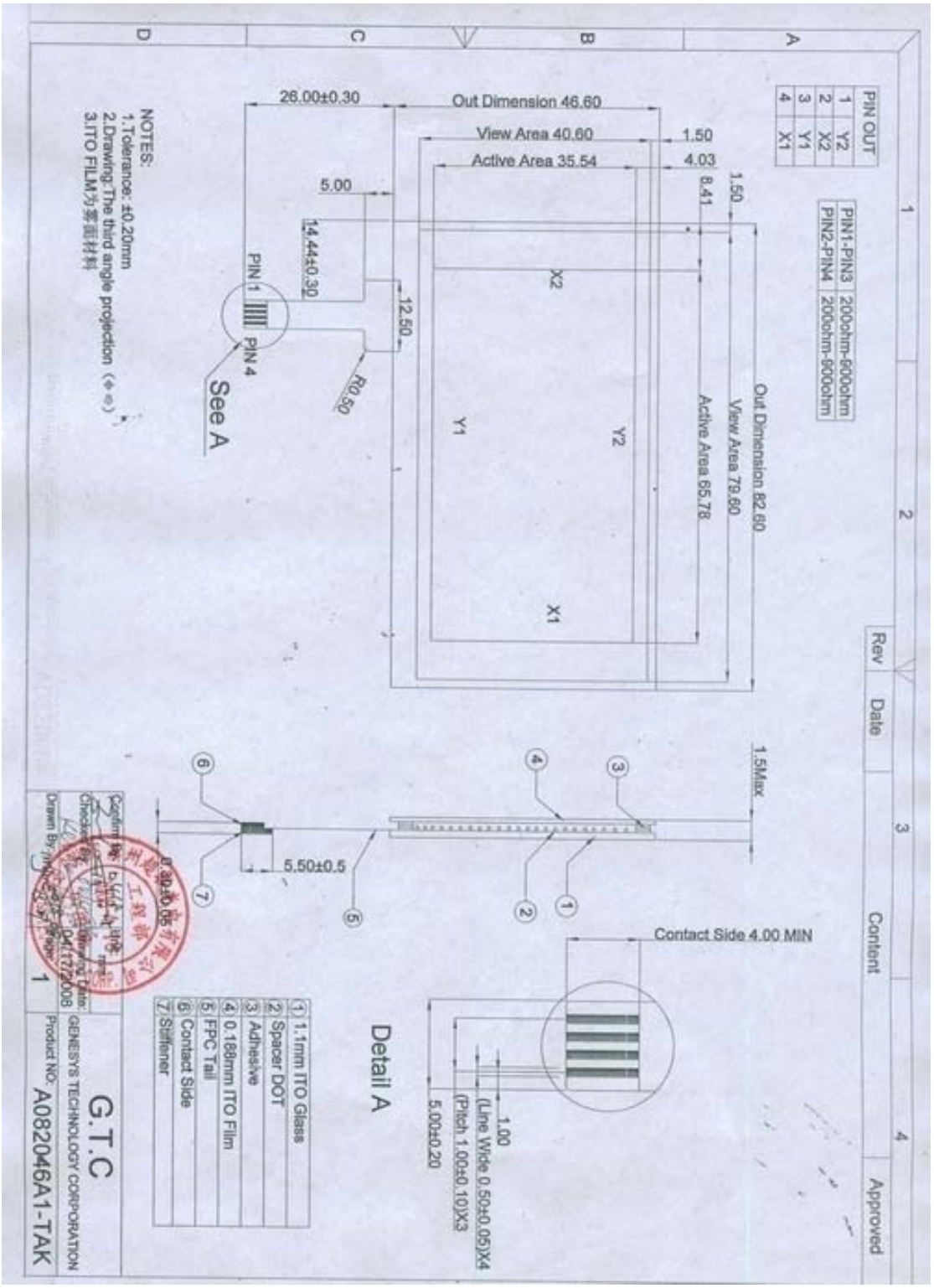
7 ELECTRO-OPTICAL CHARACTERISTICS

Item			Symbol	Min	Typ.	Max	Unit	Condition
Supply Voltage (Logic)			Vdd-Vss	2.7	3.0	3.3	V	-
LCD current consumption			Idd	1.8	-	2.2	mA	
LCD Operating Voltage			$Vdd-V_0$	-	12.0	-	V	-20°C
				11.4	11.6	11.8	V	25°C
				-	11.1	-	V	80°C
Response Time	FSTN Negative Type		Ton	-	92	-	ms	-
			Toff	-	444	-		
	STN Negative Type		Ton	-	116	-		
			Toff	-	344	-		
	FSTN Positive Type		Ton	-	112	-		
			Toff	-	404	-		
Contrast Ratio			CR	2	-	-	-	-
Viewing Angle	FSTN Negative Type	12H	θ1	-	54	-	Deg.	(CR≥2.0)
		6H	θ2	-	67	-		
		3H	θ3	-	50	-		
		9H	θ4	-	50	-		
	STN Negative Type	12H	θ1	-	52	-		
		6H	θ2	-	65	-		
		3H	θ3	-	50	-		
		9H	θ4	-	50	-		
	FSTN Positive Type	12H	θ1	-	55	-		
		6H	θ2	-	68	-		
		3H	θ3	-	50	-		
		9H	θ4	-	50	-		
LCD Threshold Voltage	FSTN Negative Type		Vth	-	10.9	-	V	25°C
	STN Negative Type		Vth	-	11.0	-		
	FSTN Positive Type		Vth	-	10.8	-		

8 4-WIRE RESISTIVE TOUCH SCREEN

ITEM	CONTENTS
ROHS Compliant	Yes
Surface Hardness	3H
Optical Clarity	80%
Operation Temperature	-20°C ~ 70°C (20%~90%RH)
Storage Temperature	-30°C ~ 85°C (20%~90%RH)
Endurance Test Strikes	+ 1 Million
Operating Voltage	3~5VDC, Nominal
Resistance	Pin 1-2: 200Ω-900Ω Pin 3-4: 200Ω-900Ω
Linearity	<1.5%
Insulation Resistance	> 20MΩ (25V DC)
Transmission	> 78%
Faceplate Surface	☐ ITO Film without hard-coating ☐ ITO Film with hard-coating ■ ITO Film with anti-glare ☐ ITO Film with anti-Newton ring ☐ ITO Film with hard-coating and anti-Newton ring ☐ ITO Film with anti-glare and anti-Newton ring
Operating Pressure	60~200g
Type	Film to Glass

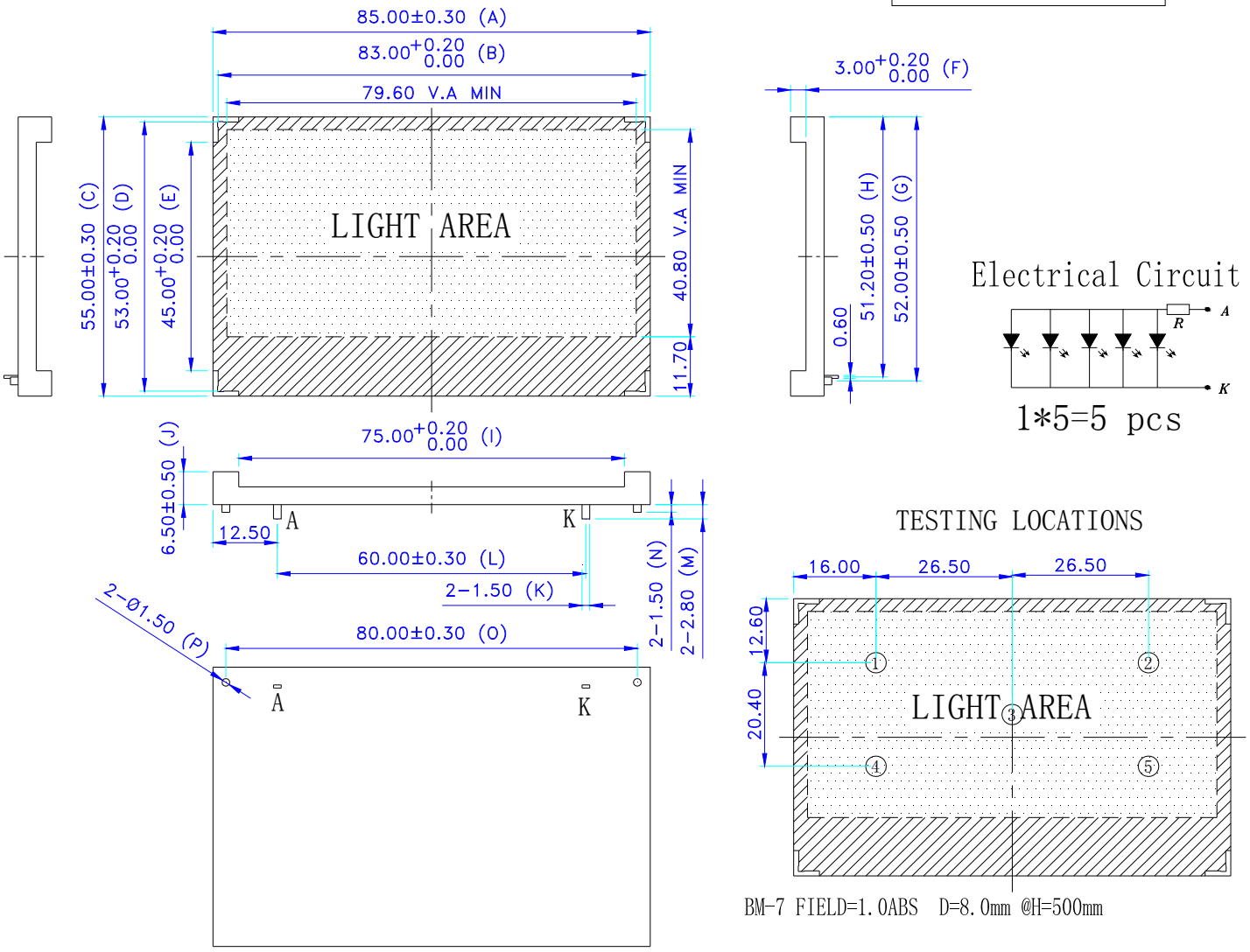
Mechanical Drawing



9 THE LED BACKLIGHT

9.1 MECHANICAL DRAWING FOR ALL BACKLIGHT TYPES EXCEPT RGB

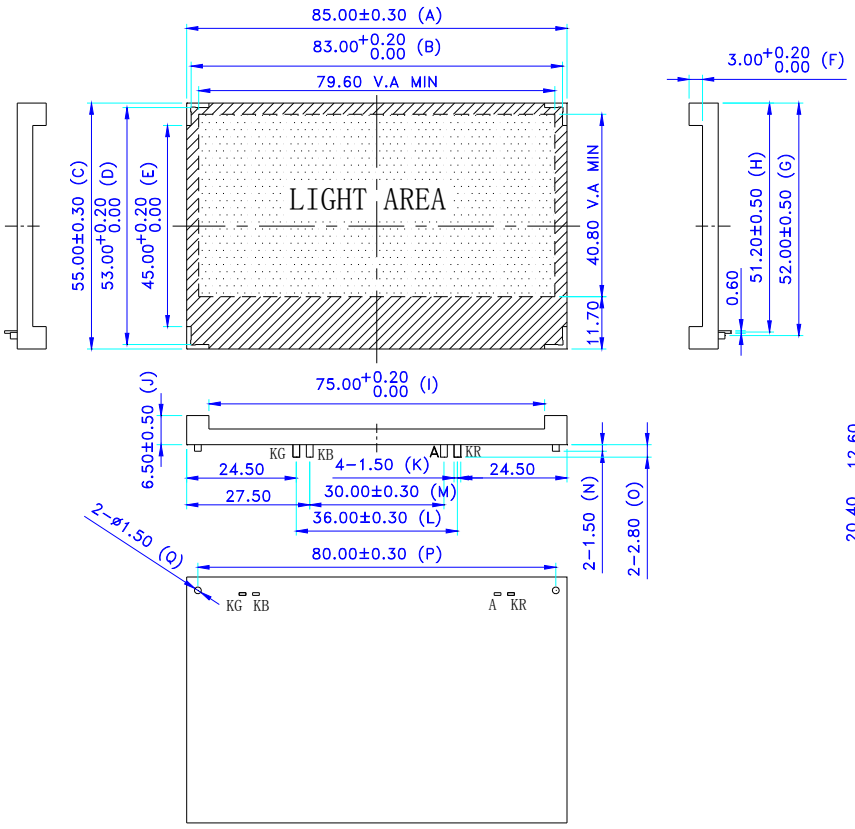
ROHS COMPLIANT



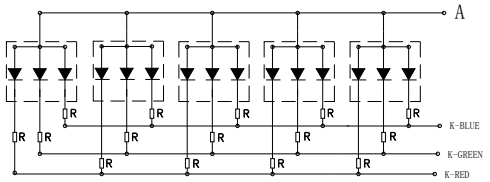
Note 1: LED Lifetime (Half Brightness) is estimated to be 30,000 hrs at 15 mA / LED (25°C).
Note 2: Please refer to the PWM white paper at http://www.densitron.com/displays/lcd_support.aspx for background on extending LED backlight lifetimes.

9.2 MECHANICAL DRAWING FOR RGB BACKLIGHT

ROHS COMPLIANT

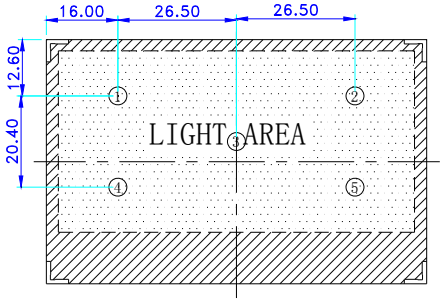


Electrical Circuit



Red: 5*1=5pcs
Green: 5*1=5pcs
Blue: 5*1=5pcs

TESTING LOCATIONS



BM-7 FIELD=1.0ABS D=8.0mm @H=500mm

RED:	BLUE	GREEN
VF: 1.8--2.0V	VF: 2.9--3.2V	VF: 3.1--3.3V
IV: mcd	IV: mcd	IV: mcd
DW: 624--627nm	DW: 525--530nm	DW: 465--475nm

9.3 BACKLIGHT ELECTRO-OPTICAL CHARACTERISTICS

7.3.1 MIDNIGHT BLUE

-	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Input Voltage	V_{IN}	3.0	3.2	3.4	V	If = 75 mA
Forward Current	If	--	75	100	mA	--
Forward Dissipation	Pd	--	--	0.34	W	If = 75 mA
Reverse Voltage	V_R	--	--	5.0	V	--
Reverse Current	I_R	--	--	0.5	mA	V_R = 5.0 V
Luminous Intensity	Iv	20	--	--	Cd/m^2	If = 75 mA
Luminous Uniformity	Δ Iv	70	--	--	%	If = 75 mA
Emission Wavelength	p	465	--	475	--	If = 15 mA, Ta = 25ºC Each chip

7.3.2 JADE GREEN

-	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Input Voltage	V_{IN}	3.0	3.2	3.4	V	If = 50 mA
Forward Current	If	--	50	75	mA	--
Forward Dissipation	Pd	--	--	0.255	W	If = 50 mA
Reverse Voltage	V_R	--	--	5.0	V	--
Reverse Current	I_R	--	--	0.5	mA	V_R = 5.0 V
Luminous Intensity	Iv	15	--	--	Cd/m^2	If = 50 mA
Luminous Uniformity	Δ Iv	70	--	--	%	If = 50 mA
Emission Wavelength	p	569	--	575	--	If = 15 mA, Ta = 25ºC Each chip

7.3.3 TANGERINE ORANGE

-	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Input Voltage	V_{IN}	3.0	3.2	3.4	V	If = 50 mA
Forward Current	If	--	50	75	mA	--
Forward Dissipation	Pd	--	--	0.255	W	If = 50 mA
Reverse Voltage	V_R	--	--	5.0	V	--
Reverse Current	I_R	--	--	0.5	mA	V_R = 5.0 V
Luminous Intensity	Iv	60	--	--	Cd/m^2	If = 50 mA
Luminous Uniformity	Δ Iv	70	--	--	%	If = 50 mA
Emission Wavelength	p	600	--	610	--	If = 15 mA, Ta = 25ºC Each chip

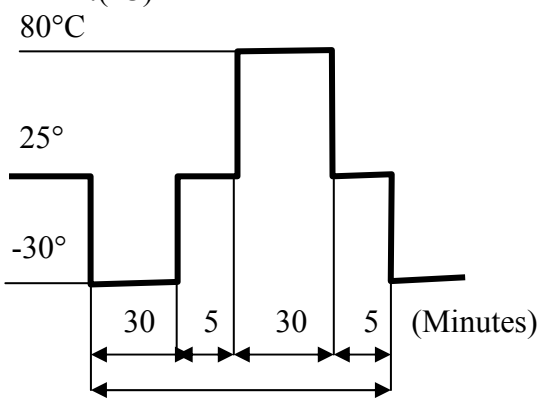
7.3.4 SUNBURST YELLOW AND ARCTIC WHITE

-	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Input Voltage	V_{IN}	3.0	3.2	3.4	V	If = 75 mA
Forward Current	If	--	75	100	mA	--
Forward Dissipation	Pd	--	--	0.34	W	If = 75 mA
Reverse Voltage	V_R	--	--	5.0	V	--
Reverse Current	I_R	--	--	0.5	mA	V_R = 5.0 V
Luminous Intensity	Iv	500	--	--	Cd/m^2	If = 75 mA
Luminous Uniformity	Δ Iv	70	--	--	%	If = 75 mA
Color Chromaticity	X	0.27	--	0.33	--	If = 15 mA, Ta = 25ºC Each chip
	Y	0.27	--	0.33	--	

7.3.5 RGB TYPE

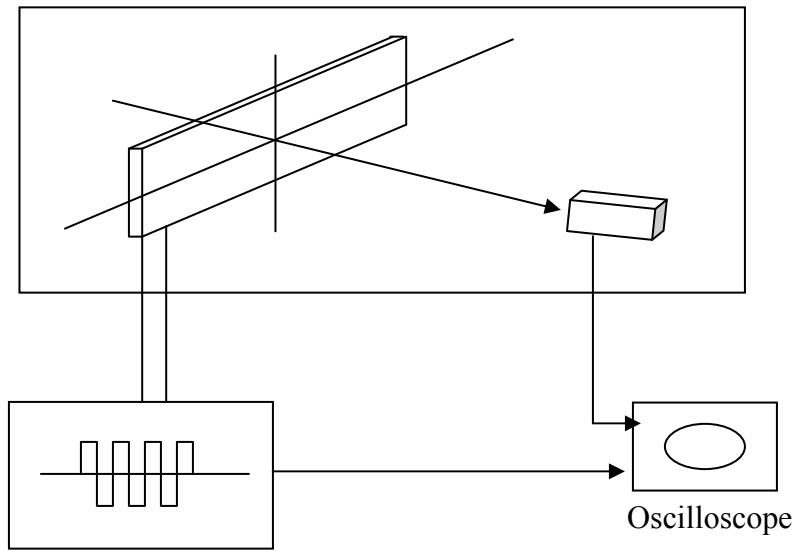
-	SYMBOL	COLORS	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Input Voltage	V_{IN}	RGB	3.0	3.2	3.4	V	If = 50 mA for Red and 75 mA for Blue & Green
Forward Current	If	RED	--	50	75	mA	--
		BLUE	--	75	100	mA	
		GREEN	--	75	100	mA	
Forward Dissipation	Pd	RED	--	--	0.255	W	If = 50 mA
		BLUE	--	--	0.34	W	If = 75 mA
		GREEN	--	--	0.34	W	If = 75 mA
Reverse Voltage	V_R	RGB	--	--	5.0	V	--
Reverse Current	I_R	RGB	--	--	0.5	mA	V_R = 5.0 V
Luminous Intensity	Iv	RED	50	75	100	Cd/m^2	If = 50 mA
		BLUE	80	--	--	Cd/m^2	If = 75 mA
		GREEN	200	--	400	Cd/m^2	If = 75 mA
Luminous Uniformity	Δ Iv	RED	70	--	--	%	If = 50 mA
		BLUE	70	--	--	%	If = 75 mA
		GREEN	70	--	--	%	If = 75 mA
Emission Wavelength	p	RED	620	--	630	--	If = 20 mA, Ta = 25ºC Each chip
		BLUE	465	--	476	--	If = 30 mA, Ta = 25ºC Each chip
		GREEN	520	--	530	--	If = 30 mA, Ta = 25ºC Each chip

10 RELIABILITY TEST

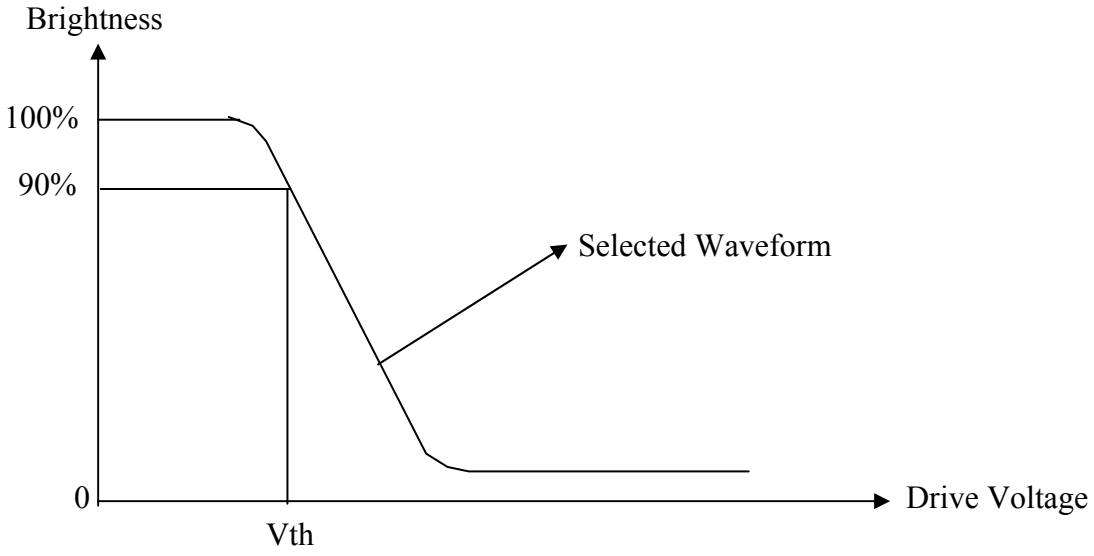
Items	Test Condition	Equipment	Test Result
High TEMP Storage	TEMP:80±2ºC Time: 96h Restore:24h	Tenny	Passed
Low TEMP Storage	TEMP: -30±3 ºC Time: 96h Restore:24h	Tenny	Passed
High TEMP Operating	TEMP: 80±2 ºC Vop: 3.3V Time: 24h Restore:24h	Tenny	Passed
Low TEMP Operating	TEMP: -20±2 ºC Vop: 3.3V Time: 24h Restore:24h	Tenny	Passed
High TEMP High Hum Storage	TEMP:40±2 ºC Hum: 95%Rh Time: 96h Restore:24h	Tenny	Passed
Thermal Shock	TEMP:(°C)  5 Cycles Restore:24h	Tenny	Passed

11 THE LCD MEASURING METHOD AND EQUIPMENT

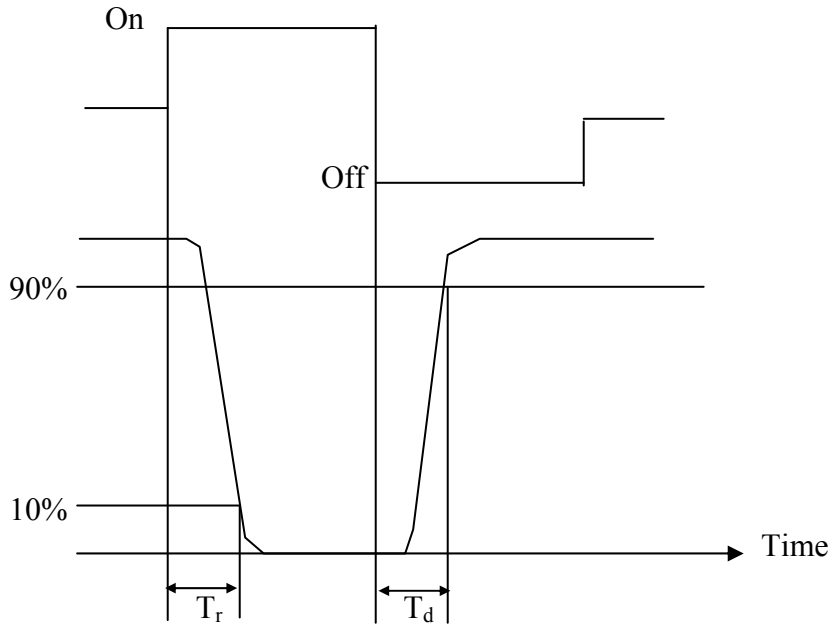
1. Threshold Voltage and Response Time Measuring:
   (1) Equipment



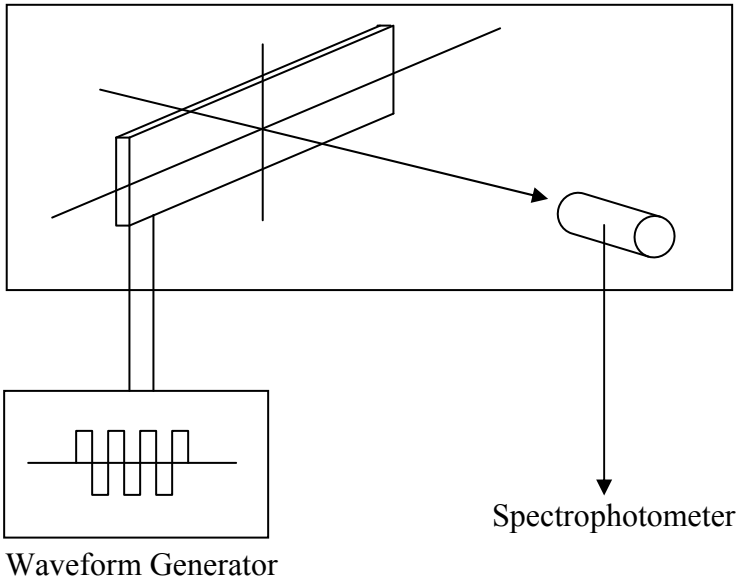
(2) Definition
   A. Threshold Voltage (Vth):



B. Response Time:

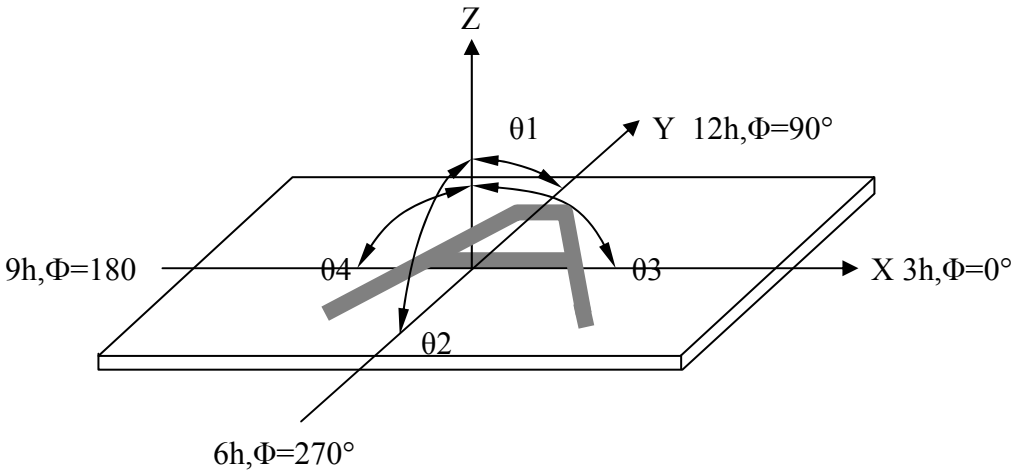


1. Contrast Measuring
   (1) Equipment



(2) Definition

A. Viewing angle:



B. Contrast Ratio (Positive)

$$CR = \frac{\text{Brightness of non-selected wave-form}}{\text{Brightness of selected wave-form}}$$

12 INITIALIZING AND PROGRAMMING

```
/*
void lcd_full(unsigned char da1)
{
        unsigned char i,j;
        for (i=0;i<128;i++)
                for (j=0;j<240;j++)
                        write_dat(da1);
}
void lcd_line1(void)
{
        unsigned char i,j;
        for (i=0;i<32;i++)
        {
                for (j=0;j<240;j++)             write_dat(0x00);
                for (j=0;j<240;j++)             write_dat(0x1f);
                for (j=0;j<240;j++)             write_dat(0x1f);
                for (j=0;j<240;j++)             write_dat(0x1f);
        }
}
void lcd_line2(void)
{
        unsigned char i,j;
        for (i=0;i<32;i++)
        {
                for (j=0;j<240;j++)             write_dat(0x1f);
                for (j=0;j<240;j++)             write_dat(0x00);
                for (j=0;j<240;j++)             write_dat(0x1f);
                for (j=0;j<240;j++)             write_dat(0x1f);
        }
}
void lcd_line3(void)
{
        unsigned char i,j;
        for (i=0;i<32;i++)
        {
                for (j=0;j<240;j++)             write_dat(0x1f);
                for (j=0;j<240;j++)             write_dat(0x1f);
                for (j=0;j<240;j++)             write_dat(0x00);
                for (j=0;j<240;j++)             write_dat(0x1f);
        }
}
void lcd_line4(void)
{
        unsigned char i,j;
        for (i=0;i<32;i++)
        {
                for (j=0;j<240;j++)             write_dat(0x1f);
                for (j=0;j<240;j++)             write_dat(0x1f);
                for (j=0;j<240;j++)             write_dat(0x1f);
                for (j=0;j<240;j++)             write_dat(0x00);
        }
}
void lcd_erect1(void)
{
        unsigned char i,j;
        for (i=0;i<128;i++)
                for (j=0;j<60;j++)
                {
                        write_dat(0x00);
```

```
                        write_dat(0x1f);
                        write_dat(0x1f);
                        write_dat(0xff);
                }
}
void lcd_erect2(void)
{
        unsigned char i,j;
        for (i=0;i<128;i++)
                for (j=0;j<240/4;j++)
                {
                        write_dat(0x1f);
                        write_dat(0x00);
                        write_dat(0x1f);
                        write_dat(0x1f);
                }
}
void lcd_erect3(void)
{
        unsigned char i,j;
        for (i=0;i<128;i++)
                for (j=0;j<240/4;j++)
                {
                        write_dat(0x1f);
                        write_dat(0x1f);
                        write_dat(0x00);
                        write_dat(0x1f);
                }
}
void lcd_erect4(void)
{
        unsigned char i,j;
        for (i=0;i<128;i++)
                for (j=0;j<240/4;j++)
                {
                        write_dat(0x1f);
                        write_dat(0x1f);
                        write_dat(0x1f);
                        write_dat(0x00);
                }
}
*/
void ReadEEPROM(void)
{
        write_com(0x30);  // Ext = 0
        write_com(0x07);  // Initial code (1)
        write_dat(0x19);
        write_com(0x31);  // Ext = 1
        write_com(0xcd);  // EEPROM ON
        write_dat(0x00);  // Entry "Read Mode"
        delay_ms(100);            // Waite for EEPROM Operation ( 100ms )
        write_com(0xfd);  // Start EEPROM Reading Operation
        delay_ms(100);            // Waite for EEPROM Operation ( 100ms )
        write_com(0xcc);  // Exist EEPORM Mode
        write_com(0x30);  // Ext = 0
}
void lcdreset(unsigned char VOL)//
{
        unsigned char i;
        res=0;
        delay_ss(1);
```

```
        res=1;
        cs=0;
        write_com(0x30);   // ext=0
        write_com(0x94);   // sleep out
        write_com(0xd1);   // osc on
        write_com(0x20);   // power control set
        write_dat(0x08);   // booster must be on first
        delay_ms(2);
        write_com(0x20);   // power control set
        write_dat(0x0b);   // booster,regulator follower on
        write_com(0x81);   // electronic control
        write_dat(VOL);    // set vop low: 00~3f          0x35,0x03=13.55
        write_dat(0x03);   // hige:00~07        0x1e,0x03=12.5
        write_com(0xca);   // display control
        write_dat(0x04);   //
        write_dat(0x1f);   // 1f duty=1/128
        write_dat(0x00);   //
        write_com(0xa6);   // normal display
        write_com(0xbb);   // com scan direction
        write_dat(0x01);   // 0~79,159~80
        write_com(0xbc);   // data scan direction
        write_dat(0x02);   //
        write_dat(0x01);   //
        write_dat(0x02);   //
        write_com(0x75);   // line address set
        write_dat(0x00);   // start line =0
        write_dat(0x7f);   // end line =127
        write_com(0x15);   // column address set
        write_dat(0x05);   // start column =0
        write_dat(0x54);   // end column =79

        write_com(0x31);   // ext=1
        write_com(0x32);   // analog circuit set
        write_dat(0x00);   // osc frequency=000 (default)
        write_dat(0x00);   // booster efficiency=01 (default)
        write_dat(0x02);   // 1/12=0x02 lease
        write_com(0x34);   // dithering off
        ReadEEPROM();              // read eeprom flow
        write_com(0xaf);   // display on
        write_com(0x5c);   // write data pointer

        write_com(0x31);   // ext=1
        write_com(0x34);   // dithering off
        write_com(0x20);   // set gray level,32 level
        for(i=0;i<33;i=i+2) write_dat(i);
        write_com(0x21);
  for(i=0;i<33;i=i+2)       write_dat(i);
        ReadEEPROM();              // read eeprom flow
        write_com(0x30);   // ext=1
        write_com(0xaf);   // display on
        write_com(0x5c);// write data
}
void lcd_image(unsigned char code *p)
{
  unsigned char i,j,k,l;
        int a;
  write_com(0x30);          // ext=0
        write_com(0x75);   // line address set
        write_dat(80);             // start line =80
        write_dat(127);            // end line =127
        write_com(0x5c);   // write data
```

```
        for (i=0;i<48;i++)
        {
         for(j=0;j<240/8;j++)
         {
                l=*p;
                for(k=0;k<8;k++)
                {
                        if((l&0x80)==0)         write_dat(0xff);
                        else                    write_dat(0x00);
                l=l<<1;
                }
                p++;
         }
        }
        a=p;
        write_com(0x30);  // ext=0
        write_com(0x75);  // line address set
        write_dat(0);               // start line =0
        write_dat(79);              // end line =127
        write_com(0x5c);  // write data
        for (i=0;i<80;i++)
        {
//       p=a+2400-(i+1)*30;
         for (j=0;j<240/8;j++)
         {
                l=*p;
                for(k=0;k<8;k++)
                {
                        if((l&0x80)==0)         write_dat(0xff);
                        else                    write_dat(0x00);
                l=l<<1;
                }
                p++;
         }
        }
}
void lcd_gray_image(unsigned char code *p)
{
   unsigned char i,j,k,l,m;
   write_com(0x30);          // ext=0
        write_com(0x75);  // line address set
        write_dat(80);              // start line =80
        write_dat(127);             // end line =127
        write_com(0x5c);  // write data
        for (i=0;i<48;i++)
        {
                for(j=0;j<60;j++)
                {
                        l=*p;
                        for(k=0;k<4;k++)
                        {
                                m=(l&0xD0)>>6;
                                switch(m)
                                {       case 0:   write_dat(0xff);break;
                                        case 1:   write_dat(0x81);break;
                                        case 2:   write_dat(0x41);break;
                                        case 3:   write_dat(0x00);break;
                                }
                                l=l<<2;
                        }
                        p++;
```

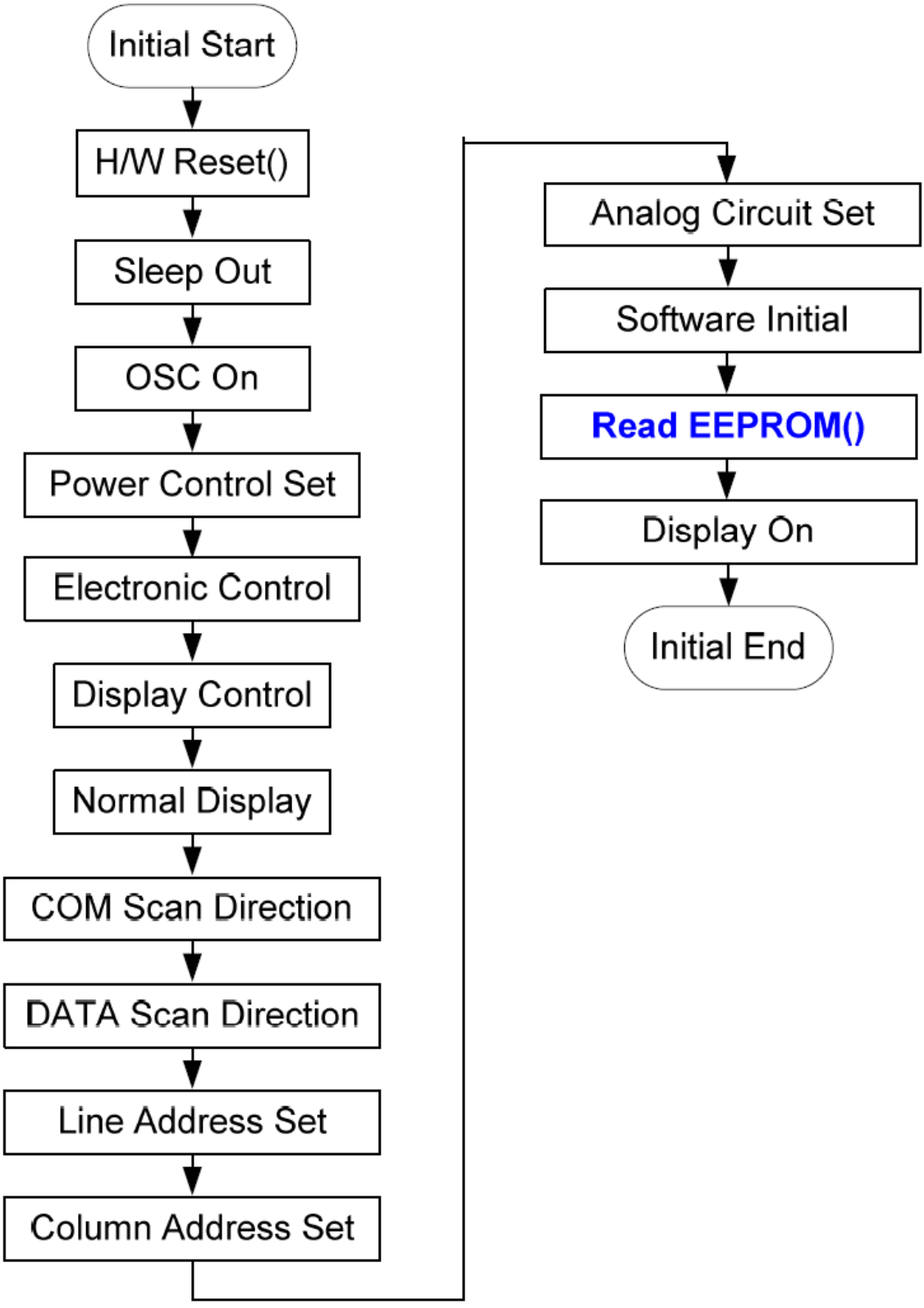
```
                }
        }
        write_com(0x30);  // ext=0
        write_com(0x75);  // line address set
        write_dat(0);                   // start line =0
        write_dat(79);                  // end line =79
        write_com(0x5c);  // write data
        for (i=0;i<80;i++)
        {
                for(j=0;j<60;j++)
                {
                        l=*p;
                        for(k=0;k<4;k++)
                        {
                                m=(l&0xD0)>>6;
                                switch(m)
                                {
                                        case 0:   write_dat(0xff);break;
                                        case 1:   write_dat(0x81);break;
                                        case 2:   write_dat(0x41);break;
                                        case 3:   write_dat(0x00);break;
                                }
                                l=l<<2;
                        }
                        p++;
                }
        }
}
void testlcd(unsigned char i)
{
        switch(i)
        {
                case 0:   lcd_image(image_yes1);
                                        break;
                case 1:   lcd_image(image_yes2);
                                        break;
                case 2:   lcd_gray_image(image_yes3);
                                        break;
                case 3:   lcd_gray_image(image_yes4);
                                        break;
                case 4:   lcd_image(image_yes5);
                                        break;
                case 5:   lcd_image(image_yes6);
                                        break;
                case 6:   lcd_image(image_yes7);
                                        break;
                case 7:   lcd_image(image_yes8);
                                        break;
        }
}
```

NOTE: Please make sure to follow the Read EEPROM procedure for the optimal contrast setting.

```
void ReadEEPROM( void )
    {

        Write( COMMAND, 0x0030 );          // Ext = 0
        Write( COMMAND, 0x0007 );          // Initial code (1)
        Write( DATA, 0x0019 );
        Write( COMMAND, 0x0031 );          // Ext = 1
        Write( COMMAND, 0x00CD );          // EEPROM ON
        Write( DATA, 0x0000 );             // Entry "Read Mode"
        Delay( 100ms );                    // Waite for EEPROM Operation ( 100ms )
        Write( COMMAND, 0x00FD );          // Start EEPROM Reading Operation
        Delay( 100ms );                    // Waite for EEPROM Operation ( 100ms )
        Write( COMMAND, 0x00CC );          // Exist EEPORM Mode
        Write( COMMAND, 0x0030 );          // Ext = 0

    }
```



13 PART NUMBER DESCRIPTION FOR AVAILABLE OPTIONS

TSR5413①②240G128③④⑤

①

Polarizer Type

E = Transmissive Negative Mode
B = Transflective Positive Mode

②

Backlight Color

G = Jade Green
B = Midnight Blue
W = Arctic White
O = Tangerine Orange
Y = Sunburst Yellow
T = RGB Type

③

Fluid Type and Temperature Range

W = Wide temp. range

④

Fluid Type and Temperature Compensation

N = STN
F = FSTN

⑤

Background Color

B = Blue mode STN (Ocean Blue)

14 STANDARD SPECIFICATIONS FOR PRODUCT QUALITY

1. Manner of Test:

   1.1- The Test must be under 40w Fluorescent Light and The Distance of View Must Be At 30cm.
   1.2- The Test Direction Is Based On Around 15°- 45° of Vertical Line.

2. Definition of Defects:

   2.1- Major Defects
   Non-Display, Segment Missing, Over Current, Segment Short, Sealant Softens, Wrong Polarizer Direction
   2.2- Minor Defects: The Others.

3. Major Defects Should Be In AQL 0.25, and The Minor In AQL 1.00.

4. Inspection Item and Standards

Item	The standard of quality inspection	Checking Manner	Quality Ratio
Frame	Smooth and even surface, no crack, no scratch, no rust, and not be bent out of shape. The range between convex and concave is: d≤0.35mm and the frame must be connected to the ground.	Checking With Eyes And Using Vernier Caliper, Multimeter	100%
LCD	1. The major defects would be rejected. 2. No scratch and no dust on the LCD glass surface. 3. D ≤ 0.15mm n≤2 diameter of bubble: d≤0.5 n≤2 damaged size of polarizer: d≤0.15mm, n≤2. 4. No scratch and dust between the LCD and LED.	Check It When Displaying	100%
The Relative Position of LCD and Frame	1. The LCD should not be twisted. 2. The LCD graphic should be in the middle position of the frame.	Checking With Eyes	100%
The Relative Position of PCB Panel and Frame	1. The frame installing direction must be correct. 2. The twisted angle of the pin is from 45°to 60°. 3. The pin is vertical to PCB panel and it should be in the middle position of the installing holes.	Checking With Eyes	100%
LED	1. The led would be yellow-green. 2. The led would be uniform.	Checking With Eyes	100%
Function Test	1. The major defects must be reject. 2. Test flow chart (see attached chart) 3. Background changes evenly and no disorderly displaying phenomenon. 4. Display no shortage.	Check It When Displaying	100%

Note: D = Diameter, N = Quantity, Unit = mm

15 HANDLING PRECAUTIONS

Safety
If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes.
If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Mounting and Design
Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface.
When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean. Design the system so that no input signal is given unless the power supply voltage is applied.

Caution during LCD cleaning
Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotriflorothane. Do not wipe the display surface with dry or hard materials that will damage the polariser surface. Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

Caution against static charge
As the display uses C-MOS LSI drivers, connect any unused input terminal to VDD or VSS. Do not input any signals before power is turned on. Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

Packaging
Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height.
To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

Caution during operation
It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life. Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation.
Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged. If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once. Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

Storage
Store the display in a dark place where the temperature is 25°C ± 10°C and the humidity below 50%RH.
Store the display in a clean environment, free from dust, organic solvents and corrosive gases.
Do not crash, shake or jolt the display (including accessories).