DENSITRON DISPLAYS

LIQUID CRYSTAL DISPLAY MODULE

Product Specification

PRODUCT NUMBER	LMR5430

INTERNAL APPROVALS		
Product Manager	Engineering	Document Control
Date: 5/19/14	Date:	Date:

DENSITRON DISPLAYS

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REVISION RECORD

Rev.	Date	Page	Par.	Comment	ECN no.
A	05/08/14	--	--	New DCA Specification	E4969
B	05/19/14	9	--	Default setting for interface is SPI and 100% LED On.	E4973

1 PRODUCT SPECIFICATION

1.1 AVAILABLE FLUID AND POLARIZER TYPE

LCD TYPE		STN		FSTN		ASTN (Automotive Grade)		ESTN (For Amber and Green Backlight only)	
		Normal Temp.	Wide Temp.	Normal Temp.	Wide Temp.	Normal Temp.	Wide Temp.	Normal Temp.	Wide Temp.
Transmissive	Negative	✓	✓	✓	✓	✓	✓	✓	✓
Transflective	Positive	X	X	X	✓	X	X	X	X

1.2 AVAILABLE BACKLIGHT TYPE AND COLOR

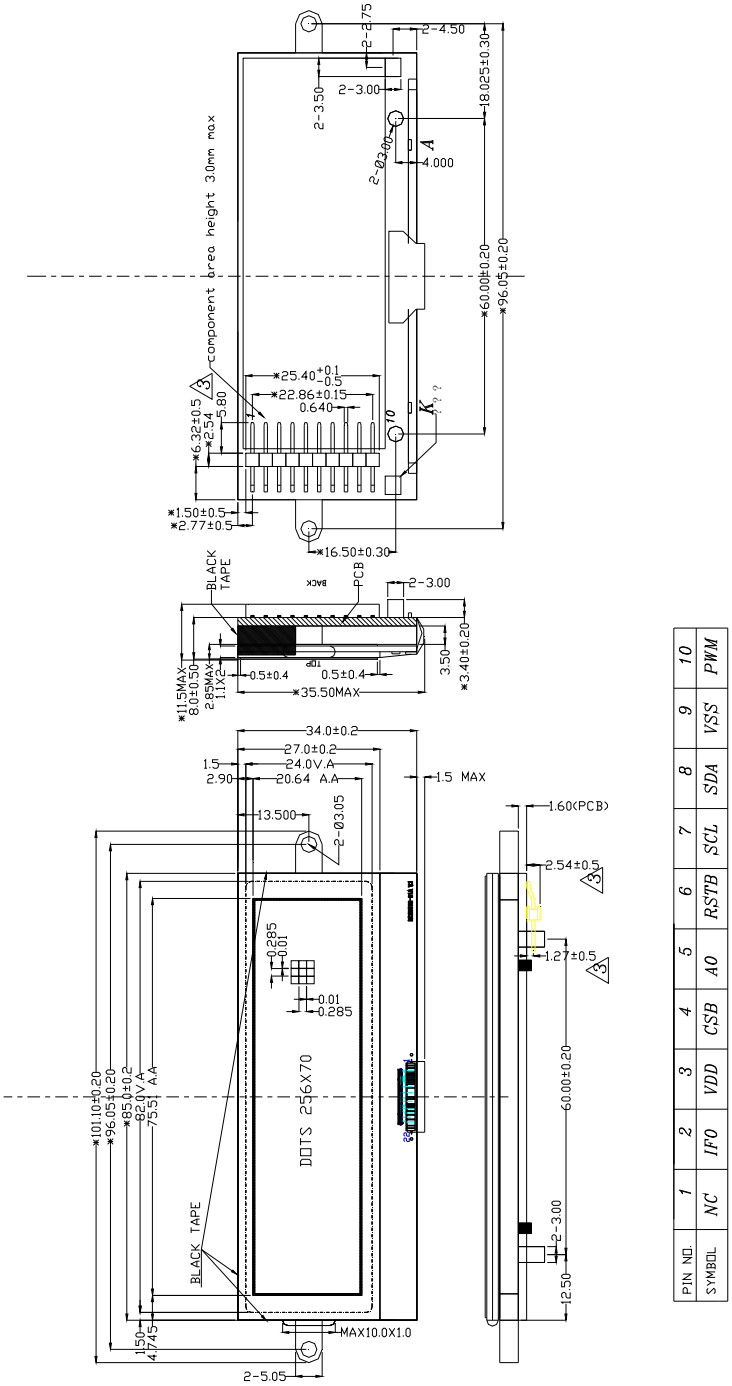
BACKLIGHT COLOR	Jade Green	Arctic White	Warm Amber	Midnight Blue	Tangerine Orange	Sunburst Yellow
Edge LED	✓	✓	✓	✓	✓	✓

1.3 GENERAL SPECIFICATIONS

ITEM	CONTENTS	UNIT
Outline Dimension	101.10 ± 0.20 (W) x 34.0 ± 0.20 (H) x 8.0 ± 0.50 (D) (*Note 1,2)(including mounting holes)	mm
Display Format	256 x 70	Dots
Viewing Area	82.0 (W) x 24.0 (H)	mm
Dot Size	0.285 x 0.285	mm
View Angle	12:00	O'clock
Duty Ratio	1/128	Duty
Bias	1/12	Bias
Module Operating Voltage	3.3	V
LCD Operating Voltage	15.0	V
LCD Driver	ST75256i,4_SPI/I2C	-
RoHS Compliant	Yes	-

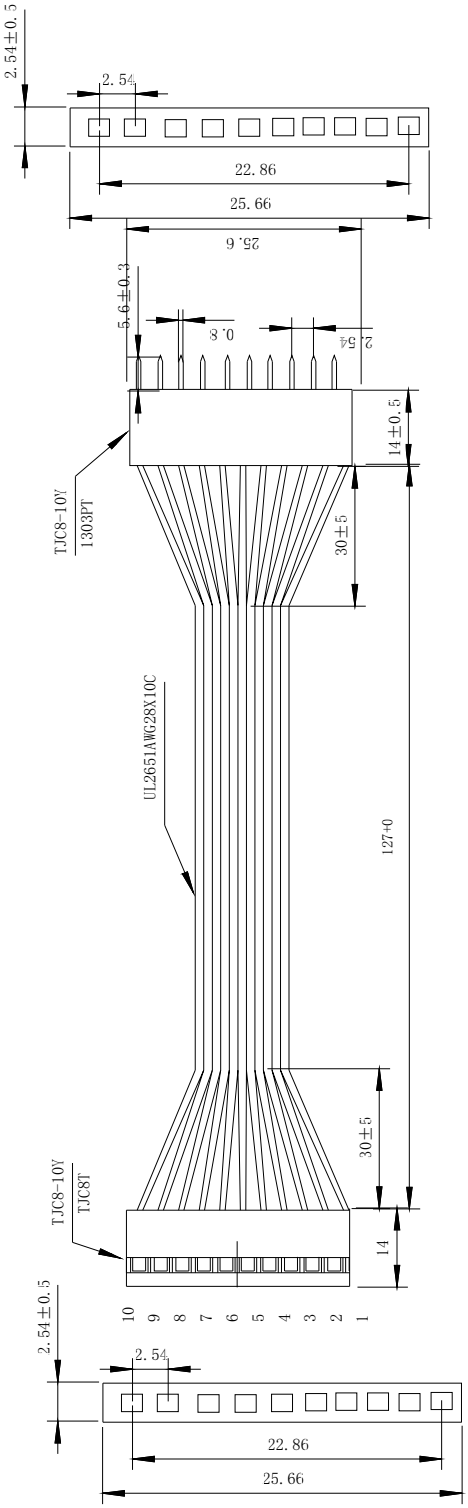
2 MECHANICAL DRAWINGS AND SCHEMATICS

2.1 FOR ALL COLORS

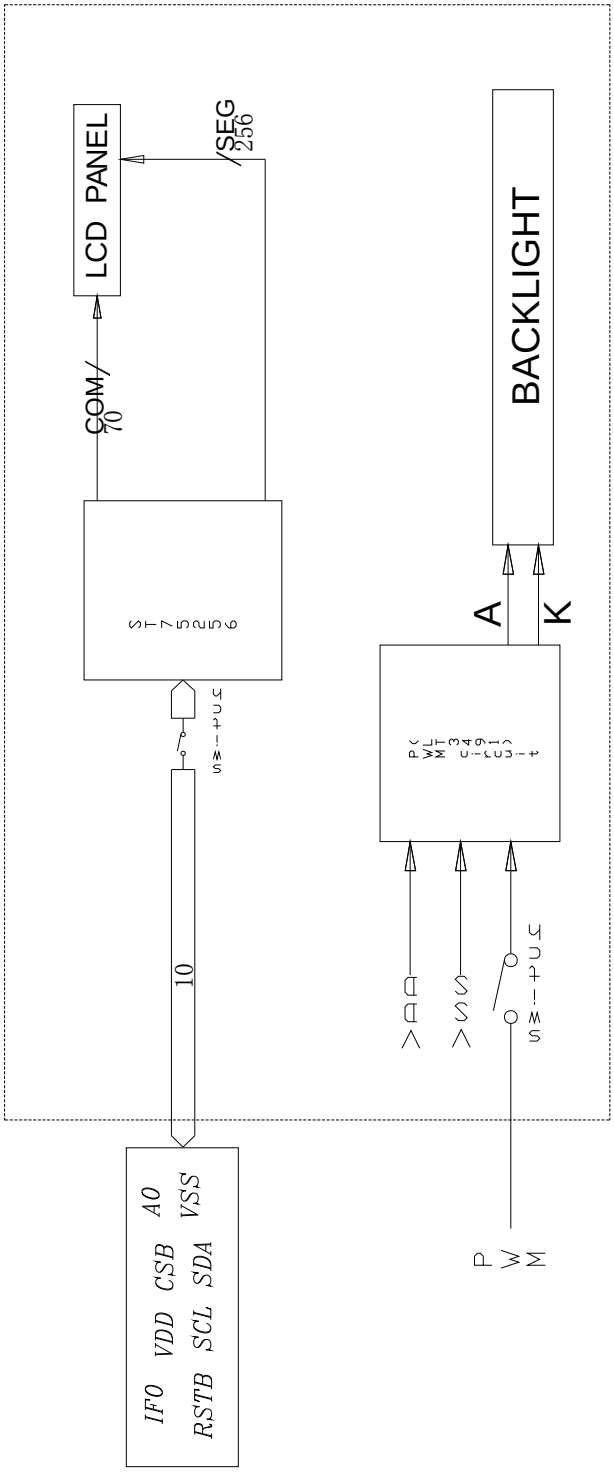


2.2 RECOMMENDED MATING CABLE DESIGN

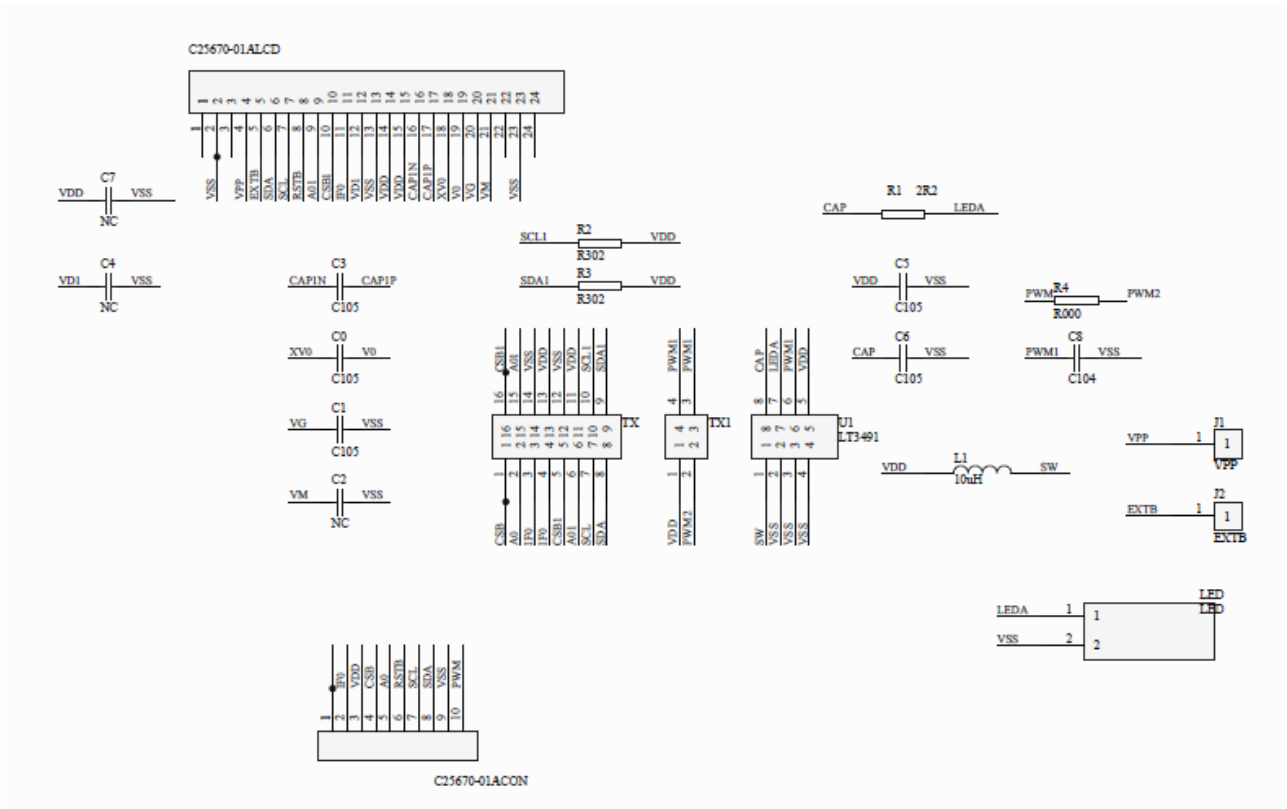
Densitron PN: 20-0172-000



2.3 LCD WIRING DIAGRAM



2.4 RECOMMENDED CIRCUIT DIAGRAM

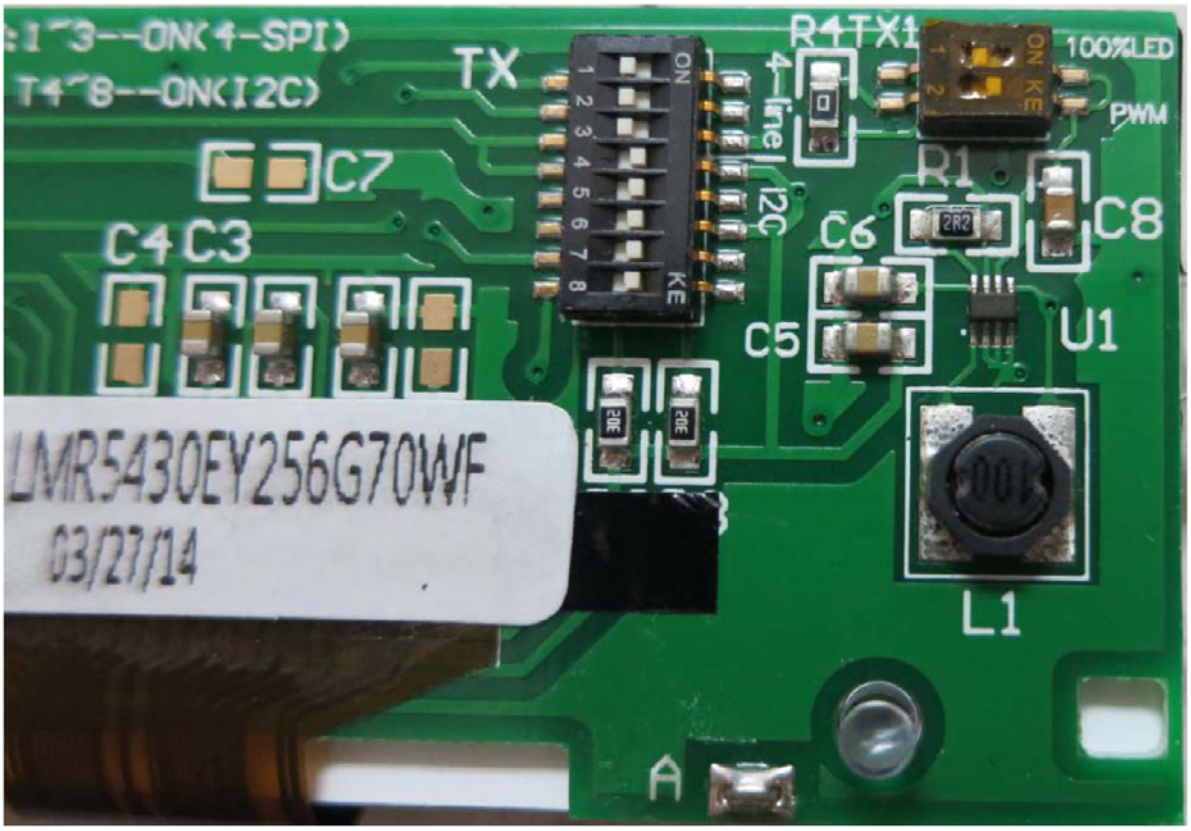


3 PIN CONNECTIONS

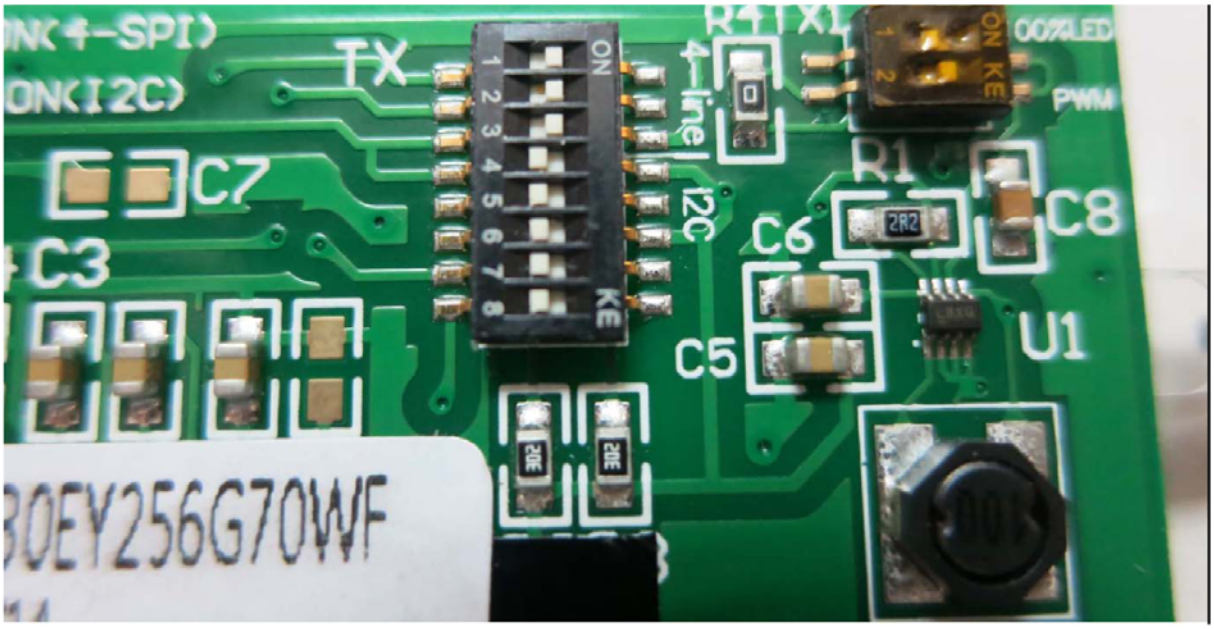
<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Function</th></tr>
<tr><td>1</td><td>NC</td><td>No connection</td></tr>
<tr><td>2</td><td>IF0</td><td>These pins select interface operation mode.
<table>
<tr><th>IF1</th><th>IF0</th><th>MPU interface type</th></tr>
<tr><td>L</td><td>L</td><td>4-line serial interface</td></tr>
<tr><td>L</td><td>H</td><td>I2C serial interface</td></tr>
</table></td></tr>
<tr><td>3</td><td>VDD</td><td>Power supply</td></tr>
<tr><td>4</td><td>CSB</td><td>Chip select input pin
There is no CSB pin in I^2C interface and it should be fixed to “L” by VSS1</td></tr>
<tr><td>5</td><td>A0</td><td>It determines whether the access is related to data or command.
A0 = "H": Indicates that D[7:0] are display data;
A0 = "L": Indicates that D[7:0] are control data.
There is no A0 pin in I2C interface and it should be fixed to “H” by VDD1.</td></tr>
<tr><td>6</td><td>RSTB</td><td>Reset input pin</td></tr>
<tr><td>7</td><td>SCL</td><td>Serial clock input</td></tr>
<tr><td>8</td><td>SDA</td><td>Serial data input</td></tr>
<tr><td>9</td><td>VSS</td><td>Ground</td></tr>
<tr><td>10</td><td>PWM</td><td>LED shutdown and dimming control</td></tr>
</table>

Note: Default setting for interface is SPI and 100% LED On.

I²C switch as shown:

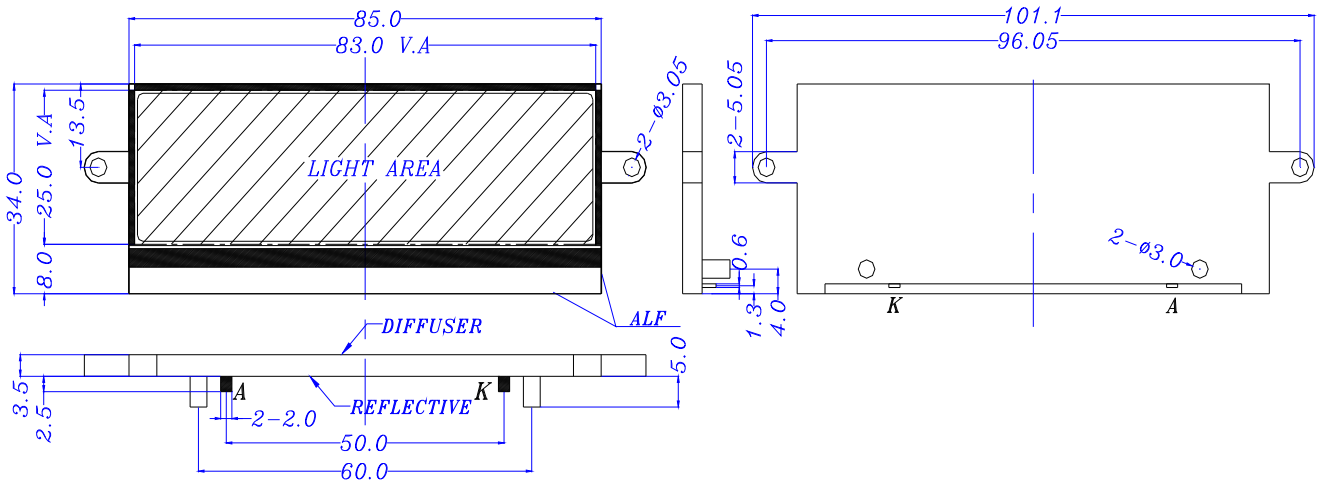


SPI 4-line switch as shown:



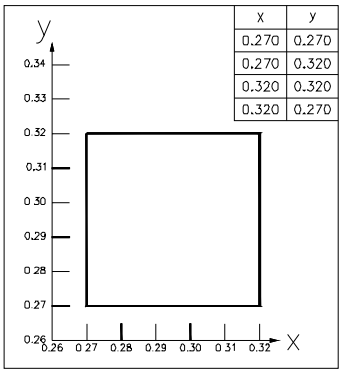
4 THE LED BACKLIGHT

4.1 MECHANICAL OUTLINE



4.2 ELECTRO-OPTICAL CHARACTERISTICS FOR BACKLIGHT

Item	Color(s)	Symbol	Min.	Typ.	Max.	Unit	Condition
Forward Voltage	All	Vf	3.2	3.4	3.6	V	If = 90 mA (Note 1, 2 & 3)
Color Coordinate	Arctic White*	x	0.270	-	0.320	-	
		y	0.270	-	0.320	-	
Uniformity	All	Avg	70	-	-	%	
Luminance	Midnight Blue	Lv	60	-	-	cd/m²	
	Warm Amber	Lv	120	-	-		
	Jade Green	Lv	60	80	-		
	Tangerine Orange	Lv	180	260	-		
	Sunburst Yellow	Lv	400	-	-		
	Arctic White*	Lv	530	750	960		
Dominant Wave length	Midnight Blue	λD	465	468	470	nm	
	Warm Amber	λD	585	590	595		
	Jade Green	λD	569	572	575		
	Tangerine Orange	λD	600	605	610		
Reverse Current (per LED)	Arctic White*, Sunburst Yellow & Midnight Blue	Ir	-	15	20	µA	Vr = 0.8 V
	Tangerine Orange, Warm Amber & Jade Green	Ir	-	-	15	µA	Vr = 3.0 V

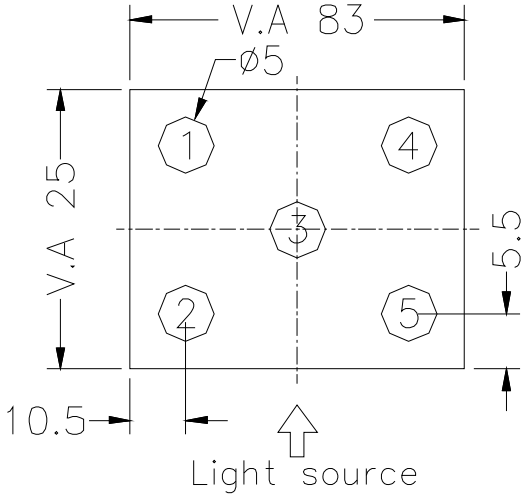


x	y
0.270	0.270
0.270	0.320
0.320	0.320
0.320	0.270

(*Coordinates for Arctic White Backlight)

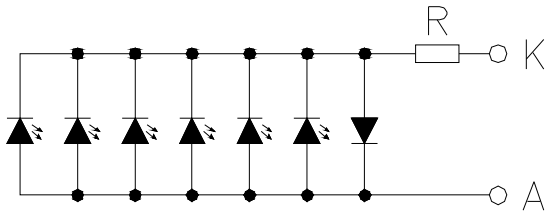
Note 1: LED lifetime for Arctic White and Midnight Blue colour is Estimated to be 20000 hrs at 15mA / LED (25°C).
Note 2: LED lifetime for all other available colors is estimated to be 15000 hrs. at 15mA (25°C).

4.3 TEST POINT



4.4 CIRCUIT DIAGRAM

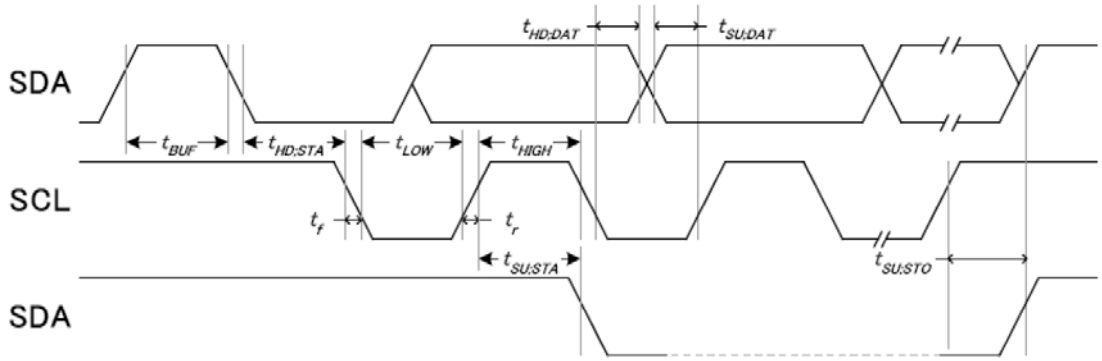
LED 1 x 6 = 6 DIES, Colors: All



5 TIMING CHARACTERISTICS

I2C (0x7e is the I2C slave address; SA0 and SA1 are internally connected to VDD1.)

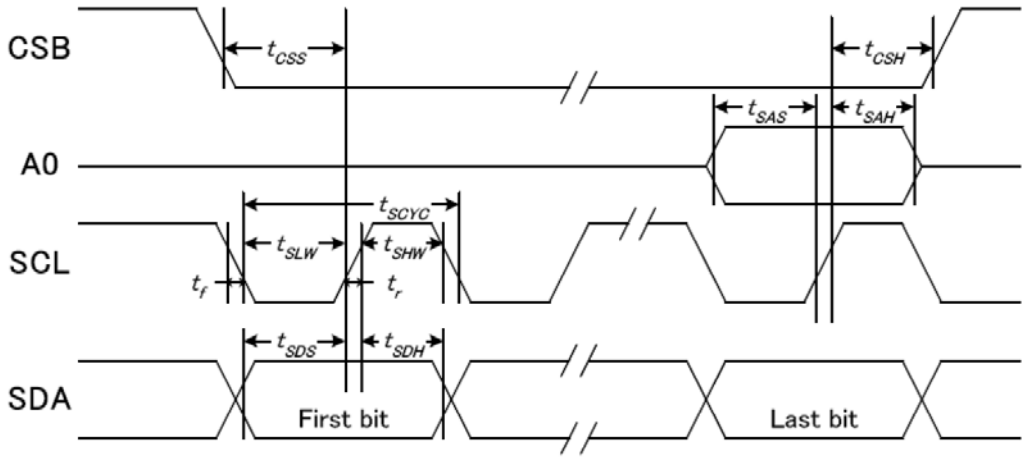
SERIAL INTERFACE (I²C Interface)



VDD1 = 1.8~3.3V, Ta =25°C

Item	Signal	Symbol	Condition	Rating		Unit
				Min.	Max.	
SCL clock frequency	SCL	fSCL		-	400	KHZ
SCL clock low period		tLOW		1.3	-	us
SCL clock high period		tHIGH		0.6	-	
Data set-up time	SDA	tSU;Data		0.1	-	
Data hold time		tHD;Data		0	0.9	
Setup time for a repeated START condition		tSU;STA		0.6	-	
Start condition hold time		tHD;STA		0.6	-	
Setup time for STOP condition		tSU;STO		0.6	-	
Bus free time between a STOP and START		tBUF		0.1	-	
Signal rise time	SCL SDA	tr		20+0.1Cb	300	ns
Signal fall time		tf		20+0.1Cb	300	
Capacitive load represented by each bus line		Cb			400	pF
Tolerable spike width on bus		tSW			50	ns

System Bus Timing for 4-Line SPI MCU Interface



VDD1 = 1.8~3.3V, Ta = 25°C

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Serial clock period	SCLK	tSCYC		60	—	ns
SCLK "H" pulse width		tSHW		30	—	
SCLK "L" pulse width		tSLW		30	—	
Address setup time	A0	tSAS		20	—	
Address hold time		tSAH		20	—	
Data setup time	SDA	tSDS		20	—	
Data hold time		tSDH		20	—	
CSB-SCLK time	CSB	tCSS		20	—	
CSB-SCLK time		tCSH		20	—	
CS "H" pulse width		tCHW		0	-	

Note:

1. The input signal rise and fall time (tr, tf) are specified at 15 ns or less.
2. All timing is specified using 20% and 80% of VDD1 as the standard.

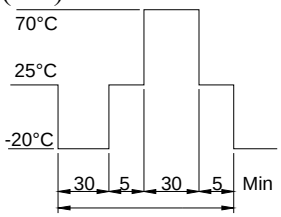
6 ELECTRO-OPTICAL CHARACTERISTICS FOR LCD MODULE

(Temp. = 23 ± 3 °C)

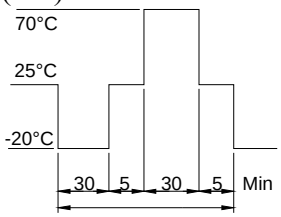
Item			Symbol	Condition	Min	Typ.	Max	Unit
Supply Voltage (Logic)			$V_{DD} - V_{SS}$	-	--	3.3	--	V
Power Requirements			Is	-	-	20	30	uA
LCD Operating Voltage			$V_{DD} - V_O$	25°C	14.8	15	15.2	V
Response Time	STN		Ton	-	-	120	180	ms
			Toff	-	-	200	300	
	FSTN		Ton	-	-	120	180	
			Toff	-	-	200	300	
	ASTN		Ton	-	-	120	180	
			Toff	-	-	200	300	
	ESTN		Ton	-	-	150	220	
			Toff	-	-	240	360	
Contrast	STN		CR	25°C	6	8	-	-
	FSTN(Neg)				60	80	-	
	FSTN(Pos)				4	4.5	-	
	ASTN				60	80	-	
	ESTN				60	80	-	
Viewing Angle	STN	12H	Θ1	CR ≥ 2.0	35	40	-	Deg.
		6H	Θ2		35	40	-	
		3H	Θ3		45	50	-	
		9H	Θ4		40	45	-	
	FSTN(Negative Mode)	12H	Θ1		25	30	-	
		6H	Θ2		25	30	-	
		3H	Θ3		35	40	-	
		9H	Θ4		35	40	-	
	FSTN(Positive Mode)	12H	Θ1		40	45	-	
		6H	Θ2		35	40	-	
		3H	Θ3		40	45	-	
		9H	Θ4		35	40	-	
	ASTN	12H	Θ1		50	55	-	
		6H	Θ2		40	45	-	
		3H	Θ3		35	40	-	
		9H	Θ4		35	40	-	
	ESTN	12H	Θ1		40	45	-	
		6H	Θ2		30	35	-	
		3H	Θ3		25	30	-	
		9H	Θ4		25	30	-	
Operating Frequency			F	25°C	-	64	-	Hz

7 RELIABILITY TEST

7.1 NORMAL TEMP.

No.	Items	Test Condition	Equipment	Test Result
1	High Temp. Storage	Temp.: 70 ± 2 °C, Time: 96 h Restore: 24 h	Tenny	Passed
2	Low Temp. Storage	Temp.: -20 ± 3 °C, Time: 96 h Restore: 24 h	Tenny	Passed
3	High Temp. Operating	Temp.: 50 ± 2 °C, Time: 24 h Restore: 24 h	Tenny	Passed
4	Low Temp. Operating	Temp.: -10 ± 2 °C, Time: 24 h Restore: 24 h	Tenny	Passed
5	High Temp. / High Humidity Storage	Temp.: 40 ± 2 °C, Hum: 95% RH Time: 96 h, Restore: 24 h	Tenny	Passed
6	Thermal Shock	Temp.: (°C)  5 Cycles, Restore: 24 h	Tenny	Passed

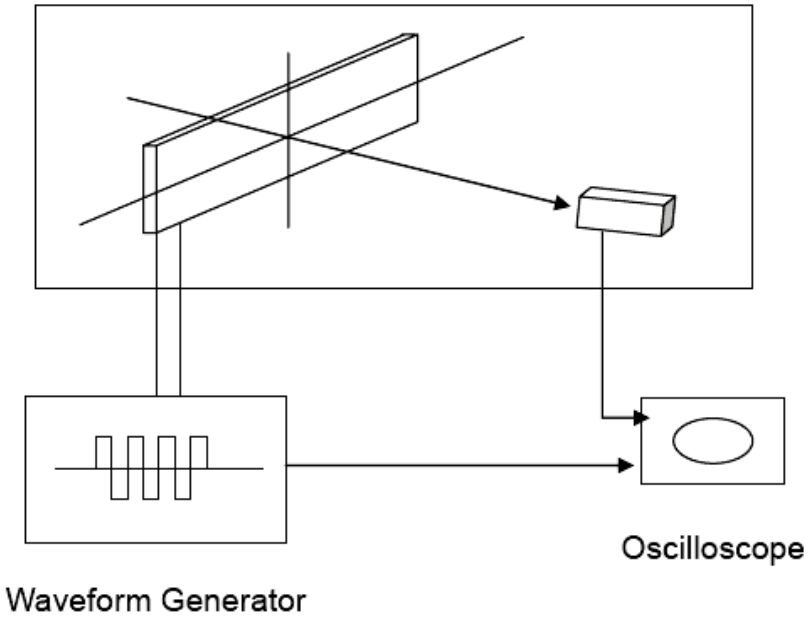
7.2 WIDE TEMP.

No.	Items	Test Condition	Equipment	Test Result
1	High Temp. Storage	Temp.: 80 ± 2 °C, Time: 96 h Restore: 24 h	Tenny	Passed
2	Low Temp. Storage	Temp.: -30 ± 3 °C, Time: 96 h Restore: 24 h	Tenny	Passed
3	High Temp. Operating	Temp.: 70 ± 2 °C, Time: 24 h Restore: 24 h	Tenny	Passed
4	Low Temp. Operating	Temp.: -20 ± 2 °C, Time: 24 h Restore: 24 h	Tenny	Passed
5	High Temp. / High Humidity Storage	Temp.: 40 ± 2 °C, Hum: 95% RH Time: 96 h, Restore: 24 h	Tenny	Passed
6	Thermal Shock	Temp.: (°C)  5 Cycles, Restore: 24 h	Tenny	Passed

8 THE LCD MEASURING METHOD AND EQUIPMENT

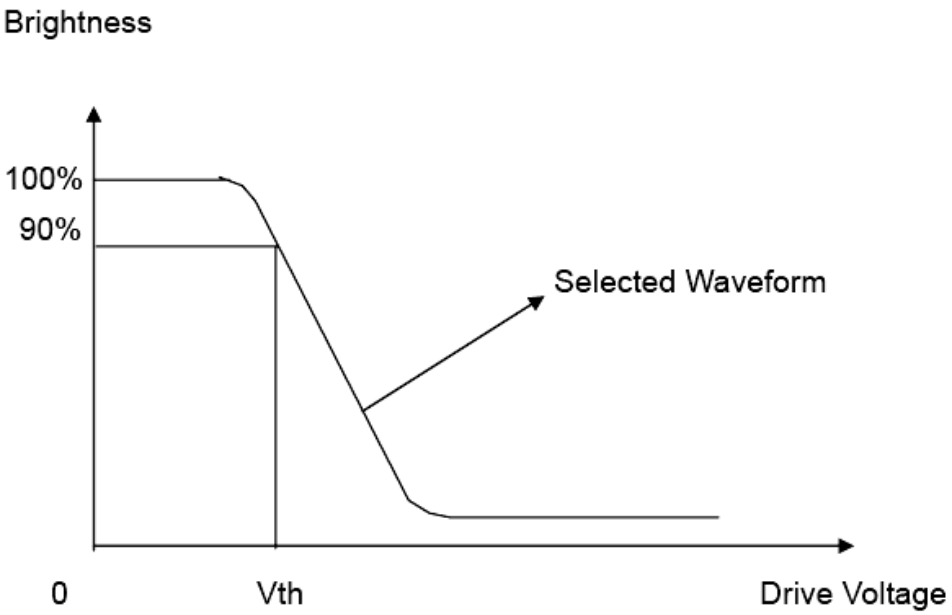
1. Threshold Voltage and Response Time Measuring.

(1) Equipment:

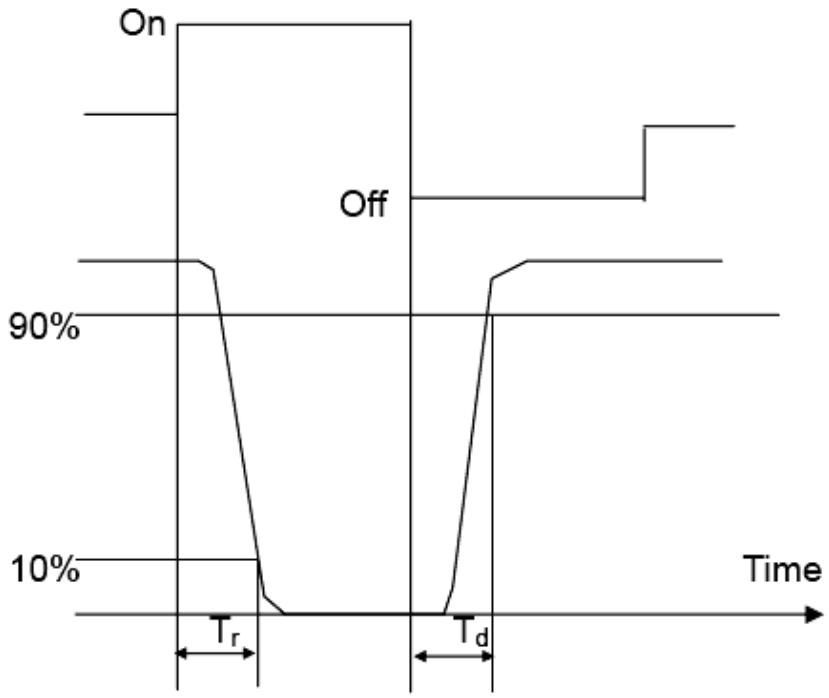


(2) Definition:

A. Threshold Voltage: (Vth)

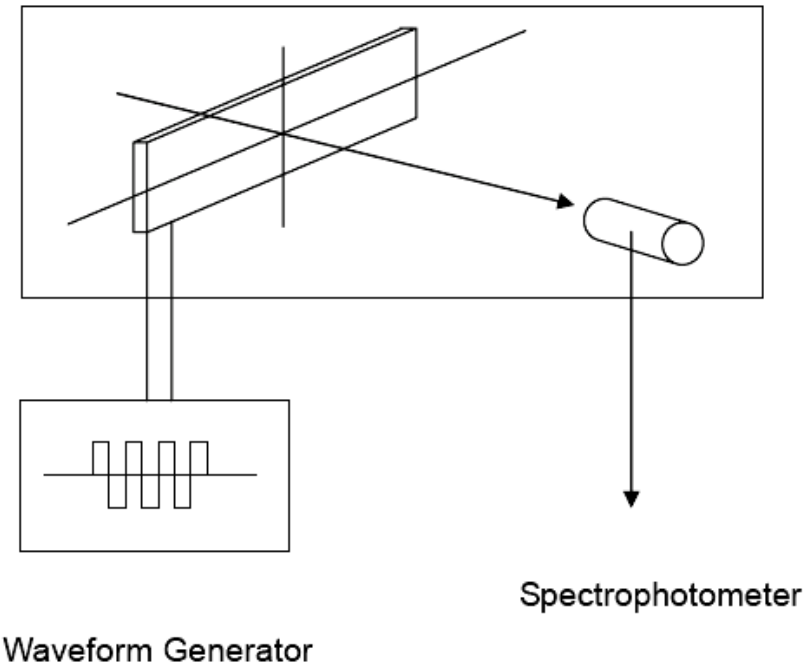


B. Response Time:



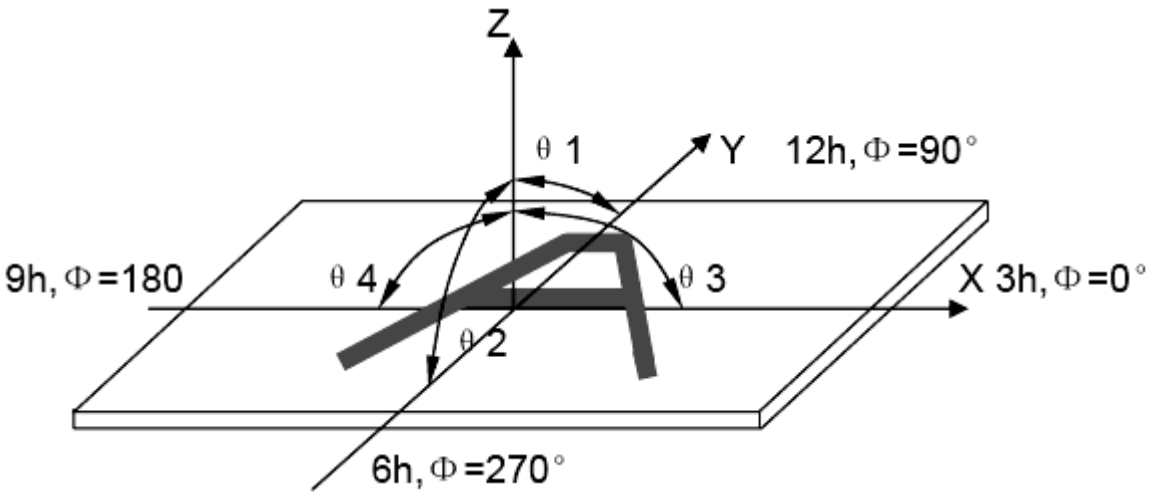
2. Contrast Measuring.

(1) Equipment:



(2) Definition:

A. Viewing Angle:



B. Contrast Ratio: (Positive)

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

9 SAMPLE CODE

For 4 Line SPI

```
/*********************************************
IC= ST75256i ¬4_spi
Vlcm=3.0v,Vlcd=9.9v,1/65duty,1/9bias
*********************************************/

#include <reg52.h>
#include <intrins.h>
#include "delay.h"
#include "isp.h"


sbit    cs      =       P1^1;
sbit    rs      =       P1^2;
sbit    res     =       P1^3;
sbit    sck     =       P1^4;
sbit    sda     =       P1^5;
sfr             db      =       0x90;

//×Ó³ÌÐòÑ¡Ôñ
//      #include "6800.h"
//      #include "8080.h"
        #include "4spi.h"  //cs cd sck sda
//      #include "3spi.h"  //cs wr da
//      #include "iic.h"

#include "lcd_test.h"
#include "image.h"

void lcd_init (void)
{
                res=0;
                delay_ms(20);
                res=1;
                delay_ms(150);


                write_com(0x31);            // Extension Command 2
                write_com(0xd7);            // Disable Auto Read
                write_dat(0x9f);

                write_com(0xe0);            // Enable OTP Read
                write_dat(0x00);            //
```

```
                delay_ms(10);
                write_com(0xe3);            // OTP Up-Load
                delay_ms(20);;                      //
                write_com(0xe1);            // OTP Control Out

                write_com(0x30);            // Extension Command 1
                write_com(0x94);            // Sleep Out
                write_com(0xae);            // Display OFF
                delay_ms(50);

                write_com(0x20);            // Power Control
                write_dat(0x0b);            // VB, VR, VF All ON

                write_com(0x81);            // Set Vop = 15V
                write_dat(0x1d);            // 1d,04=15v
                write_dat(0x04);            //

                write_com(0x31);            // Extension Command 2
                write_com(0x32);            // Analog Circuit Set
                write_dat(0x00);            //
                write_dat(0x01);            // Booster Efficiency =6KHz
                write_dat(0x02);            // Bias=1/12

                write_com(0x51);            // Booster Level x10
                write_dat(0xfb);            //

                write_com(0x30);            //  Extension Command 1
                write_com(0xf0);            //  Display Mode
                write_dat(0x10);            // Monochrome Mode

                write_com(0xca);            //  Display Control
                write_dat(0x00);            // CL Dividing Ratio =  Not Divide
                write_dat(127);                     // Duty Set  = 162 Duty
                write_dat(0x00);            // Frame Inversion

                write_com(0xbc);            //  Data Scan Direction
                write_dat(0x00);            //

                write_com(0xa6);            // 3.Inverse display:a6=normal,a7=inverse
                write_com(0x0c);            //26.Data Format Select DO=0(0x08); LSB on bottom
(Default) ;     DO=1(0x0c); LSB on top

                write_com(0x31);            //  Extension Command 2
                write_com(0x40);            //  Internal Power Supply
```

```
                write_com(0x30);            //  Extension Command 1
                write_com(0xaf);            //  Display ON

}


void lcd_off (void)
{

                write_com(0x30);            // Extension Command 1
                write_com(0xae);            // Display OFF
                write_com(0x95);            // Sleep in
                delay_ms(150);

                res=0;
                delay_ms(200);

}

void main (void)
{
        delay_us(0);
        delay_ms(0);
        delay_ss(0);
        isp_init();

        lcd_init();

//      while(1)
//      {

                write_com(0x30);            // Extension Command 1
                write_com(0xa6);            // 3.Inverse display:a6=normal,a7=inverse

                lcd_full();
                delay_ms(200);
                delay_ms(200);
                delay_ms(200);

                lcd_image(image_fksj);
                delay_ms(200);
                delay_ms(200);
                delay_ms(200);

                lcd_line();
```

```
                lcd_erect();

                delay_ms(200);
                delay_ms(200);


//              lcd_image(image_yes);
//              delay_ss(3);
//              write_com(0xa7);            // 3.Inverse display:a6=normal,a7=inverse
//              delay_ss(3);

//              lcd_image(image_huizi);
//              delay_ss(1);

                lcd_off();
//      }

}
```

==========

For I2C:

```
/*********************************************
IC= ST75256i ¬4_i2c
Vlcm=3.0v,Vlcd=9.9v,1/65duty,1/9bias
*********************************************/

#include <reg52.h>
#include <intrins.h>
#include "delay.h"
#include "isp.h"



sbit    res     =       P1^3;
sbit    sck     =       P1^4;
sbit    sda     =       P1^5;
sfr             db      =       0x90;

//×Ó³ÌÐòÑ¡Ôñ
//      #include "6800.h"
//      #include "8080.h"
//      #include "4spi.h"  //cs cd sck sda
//      #include "3spi.h"  //cs wr da
        #include "i2c.h"
```

```
//#include "lcd_test.h"
#include "image.h"

//
sbit PWM =P1^0;
unsigned char time;
unsigned char period=10;

unsigned char high=1;
/*
  higt=10
  higt=1
  higt=2
  higt=3
  higt=4
  higt=5
  higt=6
  higt=7
  higt=8
  higt=9
  higt=0
*/
timer0() interrupt 1 using 2
{
        TH0=65535/256;
        TL0=65535%256;
        if(++time==high)PWM=0;    else if(time==period)
                        {
                                time=0;
                                PWM=1;
                        }
}

void lcd_init (void)
{
                res=0;
                delay_ms(20);
                res=1;
                delay_ms(150);


                write_com(0x31);            // Extension Command 2
                write_com(0xd7);            // Disable Auto Read
                write_dat(0x9f);
```

```
write_com(0xe0);            // Enable OTP Read
write_dat(0x00);            //
delay_ms(10);
write_com(0xe3);            // OTP Up-Load
delay_ms(20);;                      //
write_com(0xe1);            // OTP Control Out

write_com(0x30);            // Extension Command 1
write_com(0x94);            // Sleep Out
write_com(0xae);            // Display OFF
delay_ms(50);

write_com(0x20);            // Power Control
write_dat(0x0b);            // VB, VR, VF All ON

write_com(0x81);            // Set Vop = 15V
write_dat(0x1d);            // 1d,04=15v
write_dat(0x04);            //

write_com(0x31);            // Extension Command 2
write_com(0x32);            // Analog Circuit Set
write_dat(0x00);            //
write_dat(0x01);            // Booster Efficiency =6KHz
write_dat(0x02);            // Bias=1/12

write_com(0x51);            // Booster Level x10
write_dat(0xfb);            //

write_com(0x30);            //  Extension Command 1
write_com(0xf0);            //  Display Mode
write_dat(0x10);            // Monochrome Mode

write_com(0xca);            //  Display Control
write_dat(0x00);            // CL Dividing Ratio ?  Not Divide
write_dat(127);                     // Duty Set  ? 162 Duty
write_dat(0x00);            // Frame Inversion

write_com(0xbc);            //  Data Scan Direction
write_dat(0x00);            //

write_com(0xa6);            // 3.Inverse display:a6=normal,a7=inverse
write_com(0x0c);            //26.Data Format Select DO=0(0x08); LSB on bottom
(Default) ;     DO=1(0x0c); LSB on top
```

```
                write_com(0x31);            //  Extension Command 2
                write_com(0x40);            //  Internal Power Supply

                write_com(0x30);            //  Extension Command 1
                write_com(0xaf);            //  Display ON

}

void lcd_off (void)
{
                write_com(0x30);            // Extension Command 1
                write_com(0xae);            // Display OFF
                write_com(0x95);            // Sleep in
                delay_ms(150);

                res=0;
                delay_ms(200);
}

void main (void)
{
        delay_us(0);
        delay_ms(0);
        delay_ss(0);

        time=0;
        TMOD=0X01;
        TH0=65535/256;
        TL0=65535%256;
        EA=1;
        ET0=1;
        TR0=1;

        isp_init();

        lcd_init();

        lcd_image(image_yes);
        delay_ss(1);

        lcd_off();


}
```

10 PART NUMBER DESCRIPTION FOR AVAILABLE OPTIONS

LMR5430①②256G70③④⑤

①

Polarizer Type

E = Transmissive Negative Mode
B= Transflective Positive Mode

②

Backlight Color

A = Warm Amber
G = Jade Green
B = Midnight Blue
W = Arctic White
O = Tangerine Orange
Y = Sunburst Yellow

③

Fluid Type and Temperature Range

S = Standard temp. range
W = Wide temp. range

④

Fluid Type and Temperature Compensation

N = STN
F = FSTN
A = ASTN (Automotive grade)
E = ESTN (For Amber and Green Backlight only)

⑤

Background Color

B = Blue mode STN (Ocean Blue)

11 QUALITY ASSURANCE SPECIFICATION

11.1 CONFORMITY

The performance, function and reliability of the shipped products conform to the Product Specification.

11.2 DELIVERY ASSURANCE

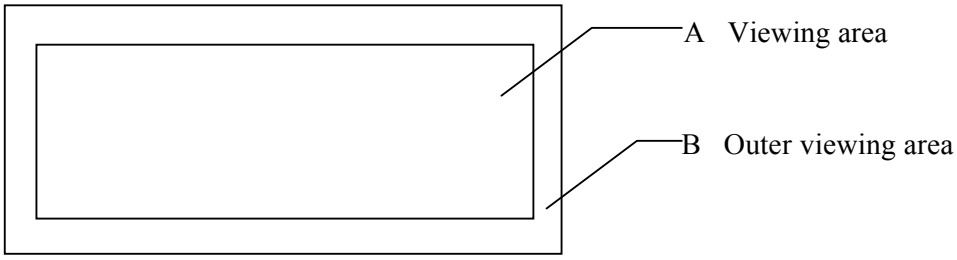
11.2.1 Delivery Inspection Standards

- IPC-AA610, Class 2 Electronic assemblies' standard.

The Quality assurance levels are shown below:

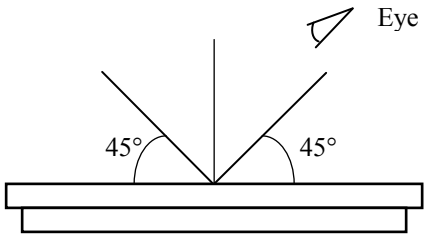
Rank	Item Inspected	Defect type	AQL	Remark
Major defect	Display	No display	0.25%	Fit/Function defect
		Over current		
		Missing segment		
		Wrong Viewing direction		
		Incorrect operation		
		No Backlight		
		Flickering Backlight		
	Dimensions	PCB and/or Bezel out of Specifications		
Minor defect	LCD	Black and White spots	1.0%	Appearance defect
		Black and White lines		
		Polarizer Scratches		
		Bubbles in Polarizer		
		Segment deformations, Pin holes		
		Color Defect		
		Glass Chips		
	COB	Wire Bonding Pad exposed		
		Insufficient covering with Resin (Wire Bonding line exposed)		
		Bubbles or Dust on COB		
	PCB	Dust or Solder balls on PCB		
		Pad Scratches		
	Tray	Particles	Every Tray	
		Total	1.0%	

11.2.2 Zone Definition



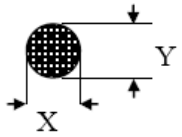
11.2.3 Visual Inspection

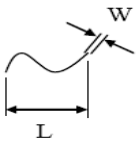
- Inspect under 2 x 20 W or one 40 W fluorescent lamp (approximately 3000 lux.) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye. (Measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted by considering clarity and crosstalk on the screen).
- Inspect the module at 45° right and left, top and bottom.
- Use the optimum viewing angle during the contrast inspection.

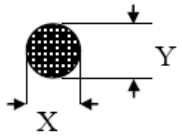


11.2.3.1 Standard of Appearance Inspection

Unit: mm

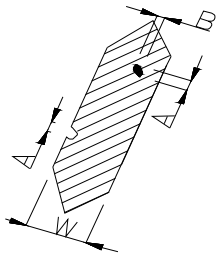
<table>
<tr><th>No.</th><th>Item</th><th>Criteria</th></tr>
<tr><td>1</td><td>Black spot,
White spot,
Dust</td><td>
Round type as shown:
Φ = (X+Y)/2


<table>
<tr><td colspan="3">Acceptable quantity</td></tr>
<tr><td>Size</td><td>Zone A</td><td>Zone B</td></tr>
<tr><td>Φ < 0.2</td><td>Any number</td><td rowspan="3">Any number</td></tr>
<tr><td>0.2 < Φ < 0.25</td><td>2</td></tr>
<tr><td>0.25 < Φ</td><td>0</td></tr>
</table>
Line type as shown:


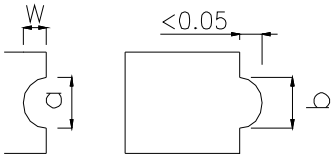
<table>
<tr><td colspan="4">Acceptable quantity</td></tr>
<tr><td>Length</td><td>Width</td><td>Zone A</td><td>Zone B</td></tr>
<tr><td>-</td><td>W ≤ 0.03</td><td>Any num r</td><td rowspan="3">Any number</td></tr>
<tr><td>L ≤ 3</td><td>0.03 < W ≤ 0.05</td><td>2</td></tr>
<tr><td>-</td><td>0.05 < W</td><td>As round type</td></tr>
</table>
Total acceptable quantity: 5
</td></tr>
<tr><td>2</td><td>Polarizer Scratch</td><td>Scratch on Protective film is permitted.
Scratch on Polarizer: Same as 1.</td></tr>
<tr><td>3</td><td>Polarizer Bubble</td><td>
Φ = (X+Y)/2


<table>
<tr><td colspan="3">Acceptable quan ity</td></tr>
<tr><td>Size</td><td>Z n A</td><td>Zone B</td></tr>
<tr><td>Φ < 0.2</td><td>Any number</td><td rowspan="4">Any number</td></tr>
<tr><td>0.2 < Φ < 0.5</td><td>3</td></tr>
<tr><td>0.5 < Φ < 1.0</td><td>1</td></tr>
<tr><td>1.0 < Φ</td><td>0</td></tr>
</table>
Total acceptable quantity: 4
</td></tr>
<tr><td>4</td><td>Segment Deformation</td><td>
1.a. Pin hole on segmented display:

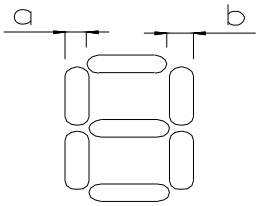
W: Segment Width

Φ = (A+B)/2


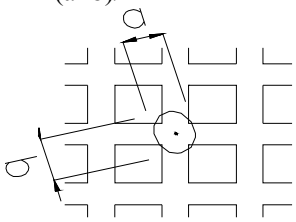
<table>
<tr><td colspan="2">Acceptable quantity</td></tr>
<tr><td>Width</td><td>Φ</td></tr>
<tr><td>W ≤ 0.4</td><td>Φ ≤ 0.2 and Φ ≤ ½W</td></tr>
<tr><td>W > 0.4</td><td>Φ ≤ 0.25 and Φ ≤ (1/3)W</td></tr>
<tr><td colspan="2">Total acceptable quantity: 1 Defect per segment.
Pin holes with Φ under 0.10 mm are acceptable.</td></tr>
</table>
</td></tr>
</table>

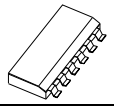
<table>
<tr><th>No.</th><th>Item</th><th>Criteria</th></tr>
<tr><td>4</td><td>Segment Deformation</td><td>
1.b. Pin hole on dot matrix display:


<table>
<tr><td colspan="2">Acceptable quantity</td></tr>
<tr><td>Size</td><td>-</td></tr>
<tr><td>a, b < 0.1</td><td>Any number</td></tr>
<tr><td>(a+b)/2 ≤ 0.1</td><td>Any number</td></tr>
<tr><td>0.5 < Φ <1.0</td><td>3</td></tr>
</table>
Total acceptable quantity: 7

2. Segments / dots with different width:


<table>
<tr><td colspan="2">Acceptable limits</td></tr>
<tr><td>a ≥ b</td><td>a/b ≤ 4/3</td></tr>
<tr><td>a < b</td><td>a/b > 4/3</td></tr>
</table>
3. Alignment layer defect:

Φ = (a+b)/2


<table>
<tr><td colspan="2">Acceptable quantity</td></tr>
<tr><td>Size</td><td>-</td></tr>
<tr><td>Φ ≤ 0.4</td><td>Any number</td></tr>
<tr><td>0.4 < Φ ≤ 1.0</td><td>5</td></tr>
<tr><td>1.0 < Φ ≤ 1.5</td><td>3</td></tr>
<tr><td>1.5 < Φ ≤ 2.0</td><td>2</td></tr>
</table>
</td></tr>
<tr><td>5</td><td>Color Uniformity</td><td>Level of samples for approval is set as the limit.</td></tr>
<tr><td>6</td><td>Backlight</td><td>The backlight color should correspond to the product specification.
Flashing / flickering and / or non-functioning backlight is not allowed.
Dust larger than 0.25 mm is not allowed.</td></tr>
<tr><td>7</td><td>COB</td><td>Exposed wire bonding pad is not allowed.
Insufficient covering with resin is not allowed. (Exposed Wire bonding line)
Dust or bubbles on the resin are not allowed.</td></tr>
<tr><td>8</td><td>PCB
  </td><td>Non-melted solder paste should not be present on the PCB.
Cold solder joints, missing solder connections, or oxidation is not allowed.
Residue or solder balls on the PCB are not allowed.
Short circuits on components are not allowed.</td></tr>
</table>

12 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 Trichlorotrifluoroethane. Do not wipe the display surface with dry or hard materials that will damage the polarizer 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 terminals 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 sunlight 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).