LIQUID CRYSTAL DISPLAY MODULE

Product Specification

PRODUCT NUMBER	LMR5428

INTERNAL APPROVALS		
Product Manager	Engineering	Document Control
Date:	Date:	Date:

DENSITRON DISPLAYS

TABLE OF CONTENTS

REVISION RECORD

Rev.	Date	Page	Par.	Comment	ECN no.
A	11/10/08	--	--	New DCA Specification	E3917
B	03/05/09	--	--	Added ASTN and ESTN Technologies	E4011
C	08/06/09	7	--	Corrected wiring diagram	E4153
D	09/14/09	--	--	Revision Documentation Update	E4182
E	12/02/09	7	--	LCD wiring diagram added	E4217
F	12/2/10	13	--	Added Min/Max values for Vdd logic.	E4388
G	07/08/11	4,6,11	--	Jade green module thickness changed to 8.10 ± 0.50, typical luminance spec also updated	E4493
H	12/26/12	4,14,23	--	Transflective mode added	E4742
I	7/10/13	5~7, 20~24	--	Added epoxy glue to avoid separation between LCD and B/L. Sample code updated to include Read EEPROM procedure.	E4824
J	9/13/13	5~7, 11	--	Removed Epoxy Glue and added Black tape on top edge to avoid separation between LCD and B/L. Artic White B/L brightness range updated.	E4853

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	✓	✓	✓	✓	✓	✓

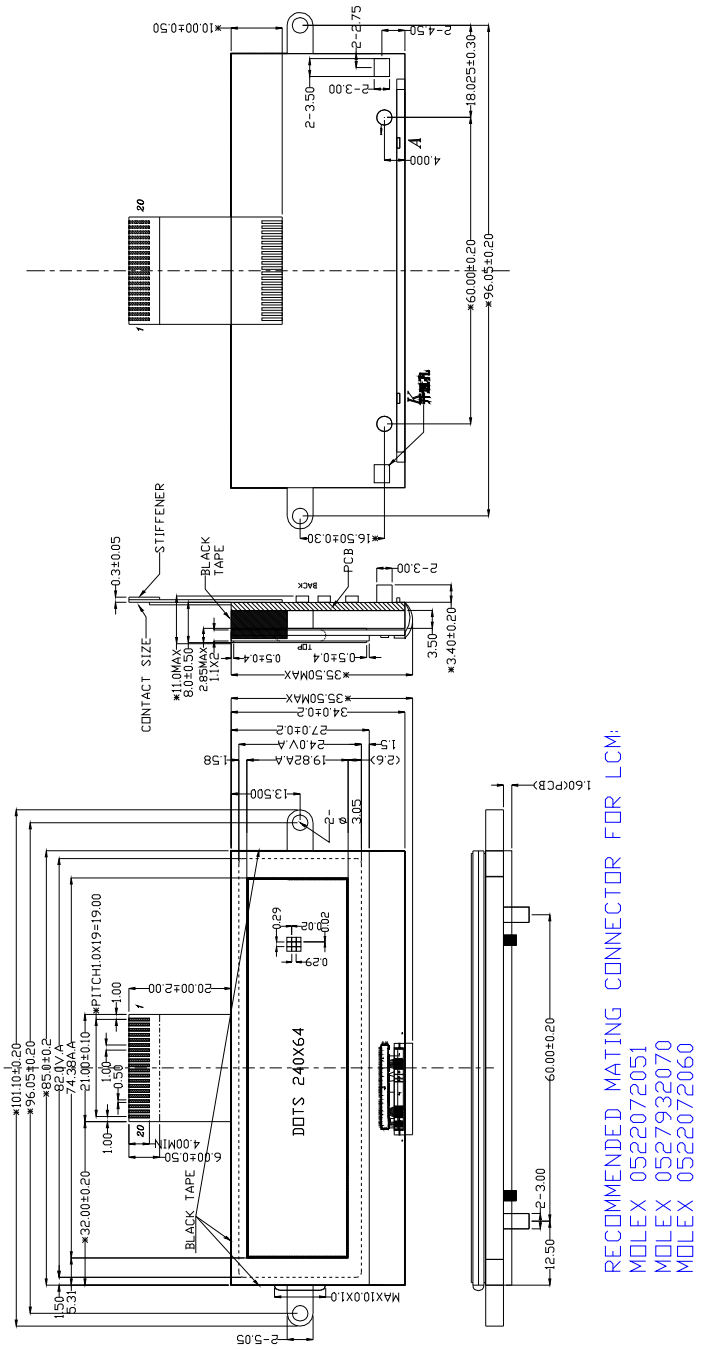
1.3 GENERAL SPECIFICATIONS

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	240 x 64	Dots
Viewing Area	82.0 (W) x 24.0 (H)	mm
Dot Size	0.29 x 0.29	mm
View Angle	12:00	O'clock
Duty Ratio	1/64	Duty
Bias	1/9	Bias
Module Operating Voltage	3.0	V
LCD Operating Voltage	12.0	V
LCD Driver	ST7529	-
RoHS Compliant	Yes	-

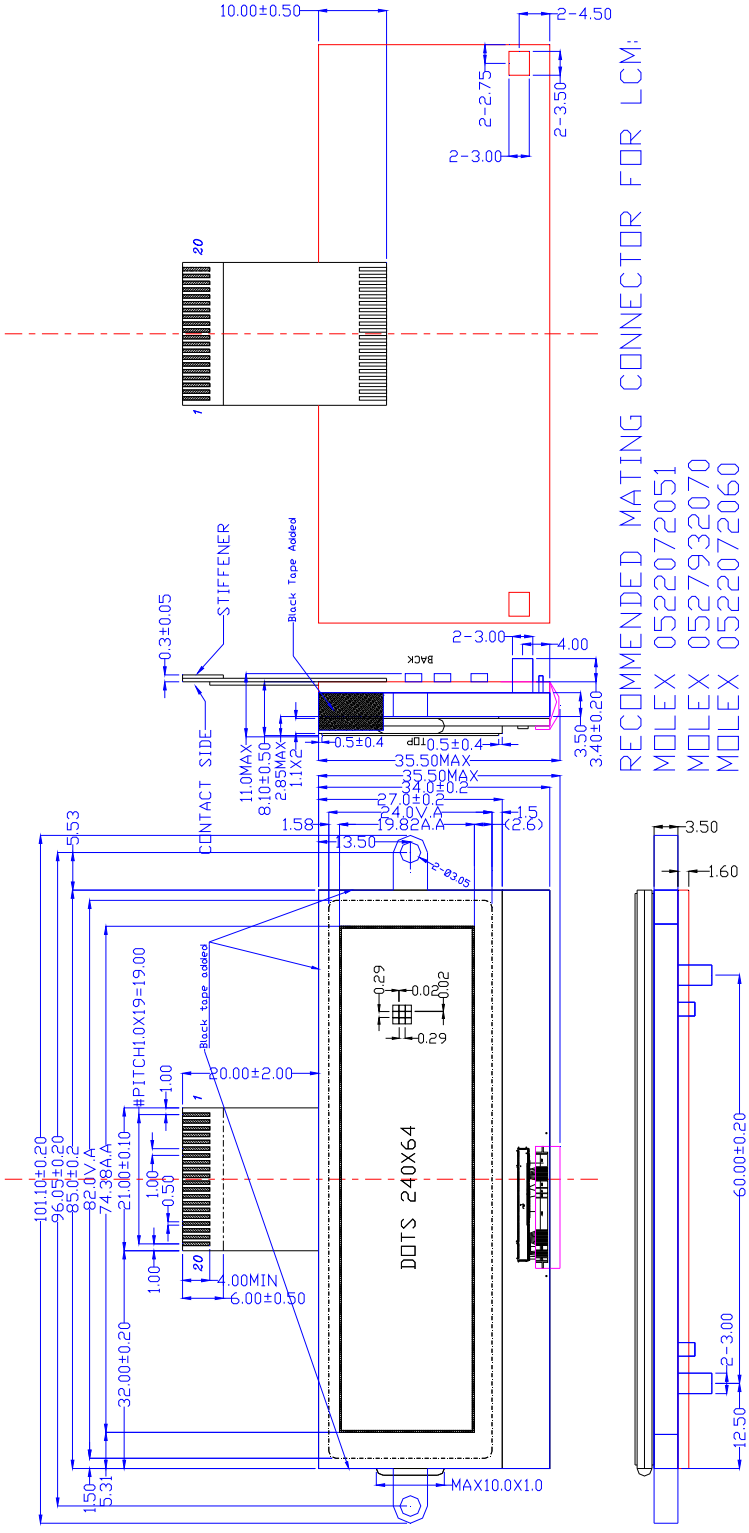
*Note 1: The Depth (D) dimension is 8.50 ± 0.50 (White LED + Yellow Filter) for Sunburst Yellow Backlight.
*Note 2: The Depth (D) dimension is 8.10 ± 0.50 for Jade Green Backlight.

2 MECHANICAL DRAWINGS AND SCHEMATICS

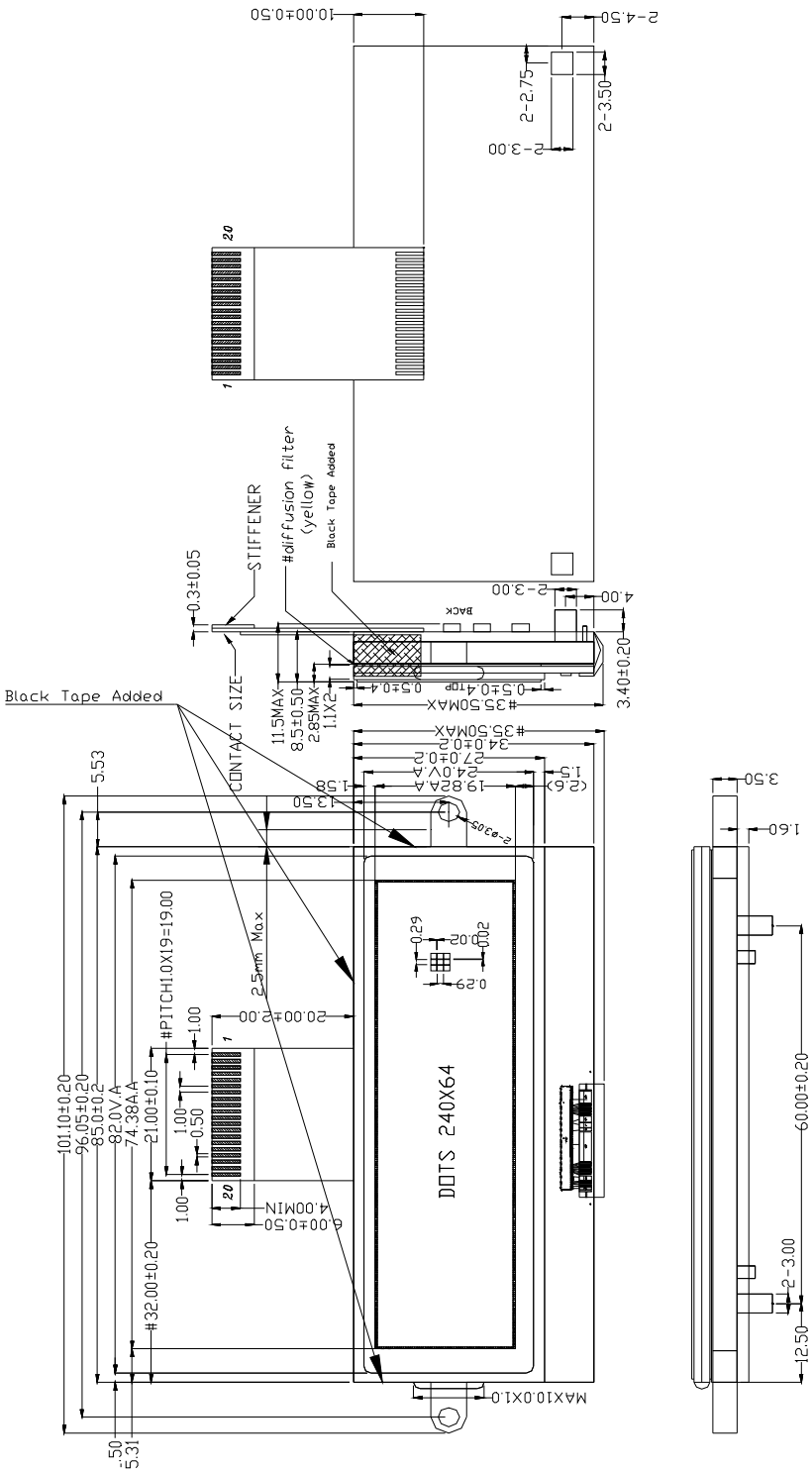
2.1 FOR ALL COLORS EXCEPT SUNBURST YELLOW AND JADE GREEN BACKLIGHT



2.2 FOR JADE GREEN BACKLIGHT



2.3 FOR SUNBURST YELLOW BACKLIGHT



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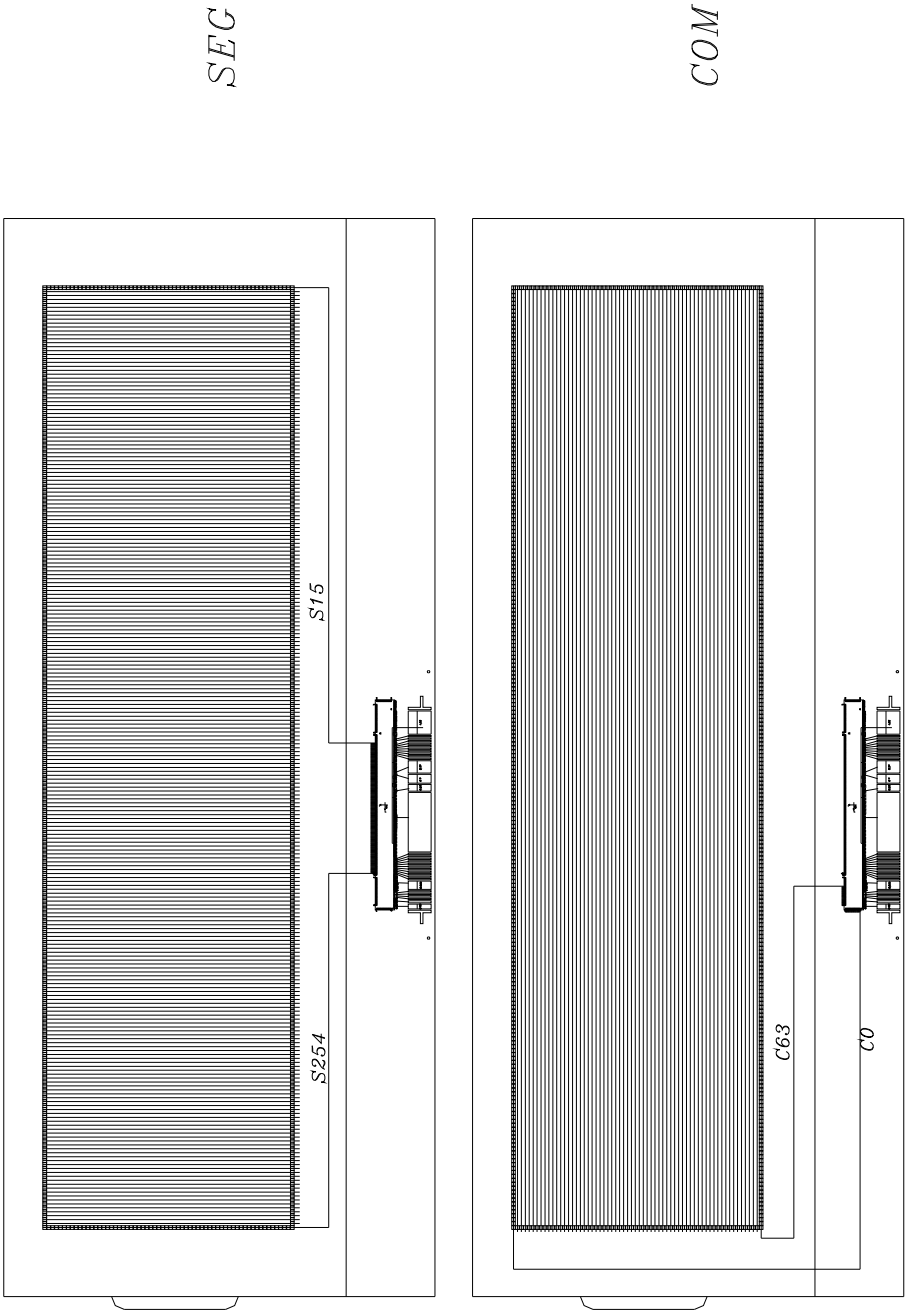
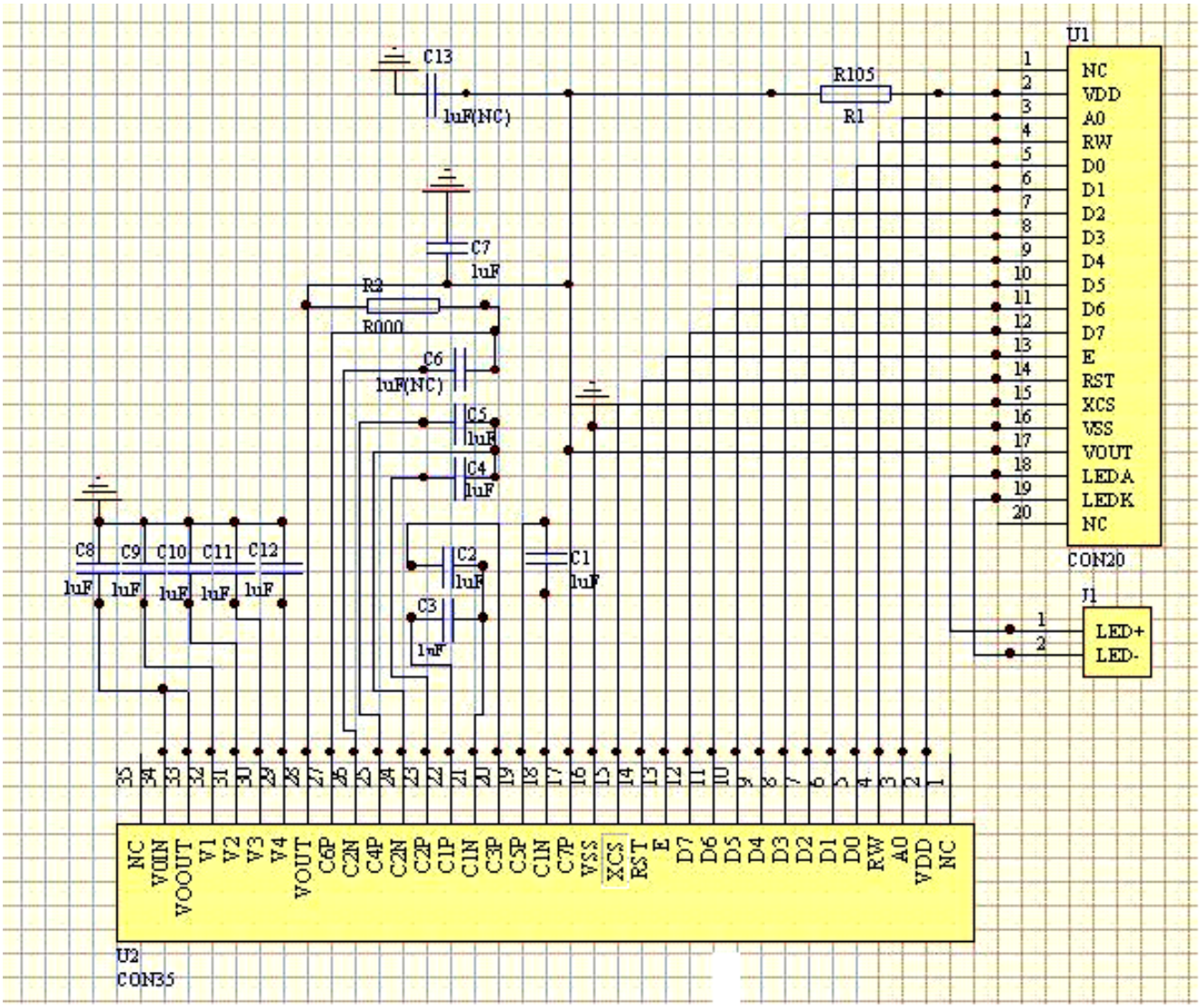
2.4 LCD WIRING DIAGRAM

Scan direction:
1.COM: COM0~COM63, COMMON SCAN (BBH)
2. SEG: SEG254~SEG15,, DATA SCAN DIRECTION(BCH)



2.5 PCB WIRING DIAGRAM

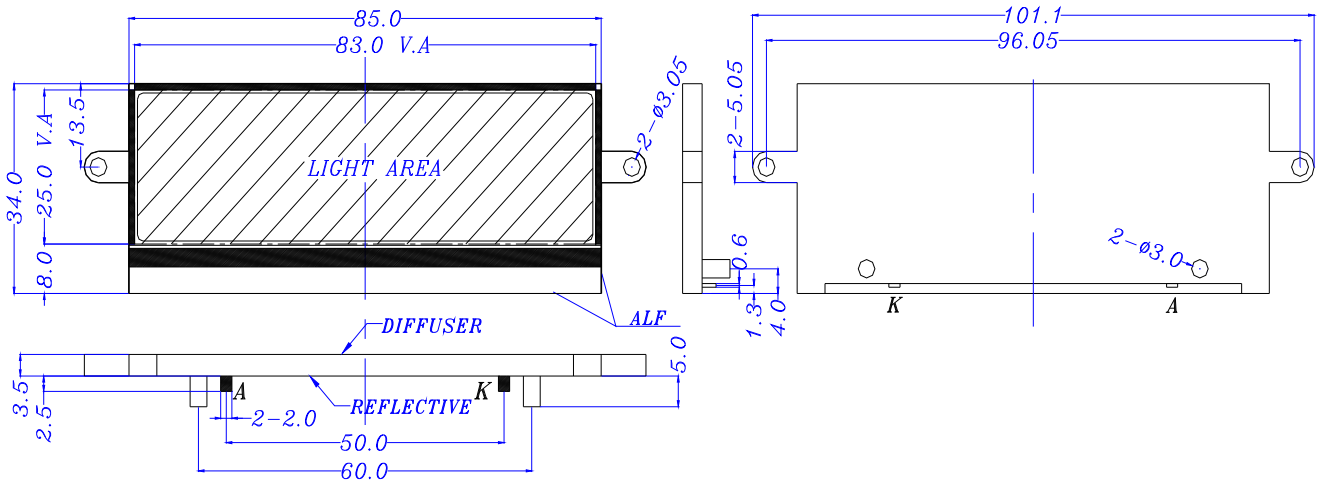


3 PIN CONNECTIONS

Pin No.	Symbol	Function
1	NC	No connection
2	VDD	Chip's power supply pin
3	A0	Register select input pin
4	RW	Read / write control input pin
5 ~ 12	D0 ~ D7	The 8-bit bi-directional data bus to be connected to the MCU in parallel interface mode
13	E	Read / write control input pin
14	RST	Reset input pin
15	XCS	Chip select input pin
16	VSS	Ground
17	VOUT	DC-DC voltage converter (No Connection)
18	LEDA	LED backlight power
19	LEDK	LED backlight power
20	NC	No connection

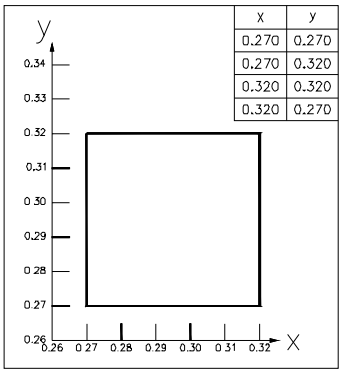
4 THE LED BACKLIGHT

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	40	60	90		
	Tangerine Orange	Lv	120	-	-		
	Sunburst Yellow	Lv	400	-	-		
	Arctic White*	Lv	530	750	960		
Dominant Wave length	Midnight Blue	λD	465	468	470	nm	
	Warm Amber	λD	584	589	594		
	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

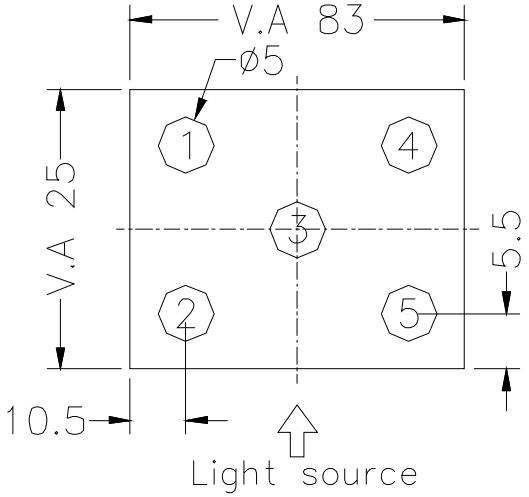


x	y
0.270	0.270
0.270	0.320
0.320	0.320
0.320	0.270

(*Coordinates for Arctic White Backlight)

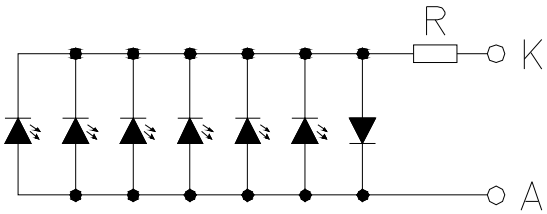
Note 1: LED lifetime for Arctic White and Midnight Blue colour is Estimated to be 20000 hrs at 15mA / LED (25°C).
Note 2: LED lifetime for all other available colors is estimated to be 15000 hrs. at 15mA (25°C).
Note 3: Please refer to the PWM White Paper at http://www.densitron.com/displays/lcd_support.aspx for background on extending LED Backlight Lifetimes.

4.3 TEST POINT



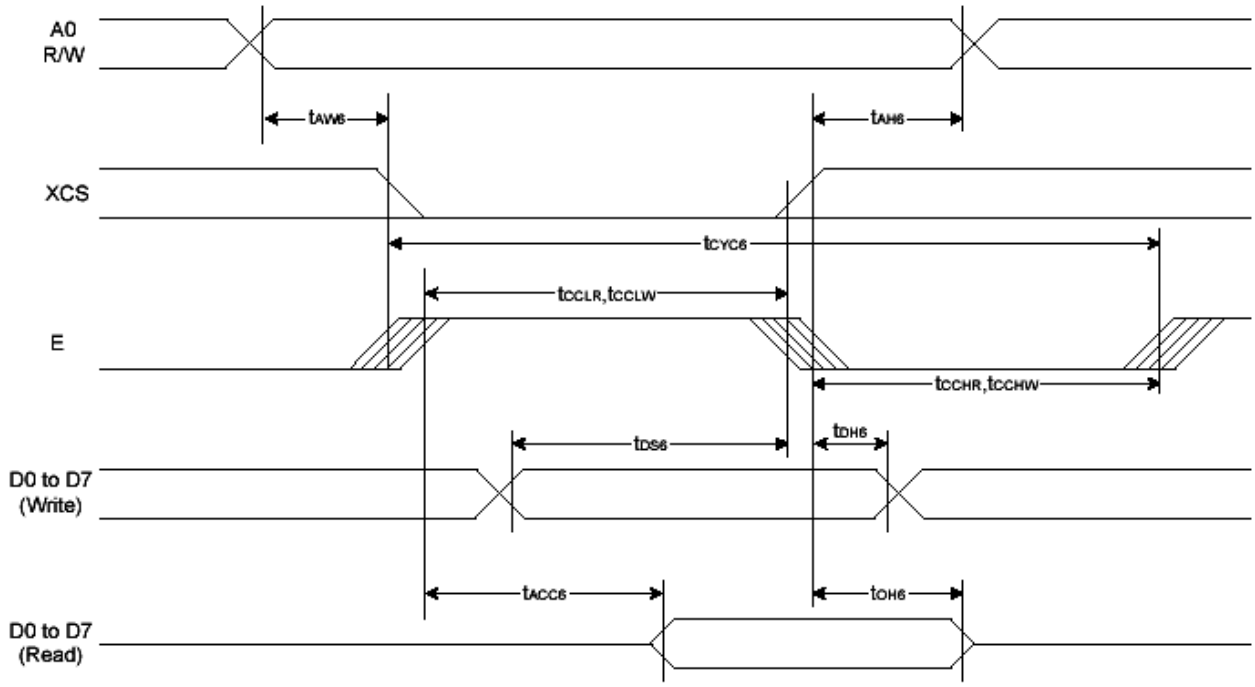
4.4 CIRCUIT DIAGRAM

LED 1 x 6 = 6 DIES, Colors: All



5 AC CHARACTERISTICS

System Bus Read/Write Characteristics 1 (For the 6800 Series MPU)



(VDD = 3.3 V , Ta = –30 to 85°C,Die)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH6	-	20	-	ns
Address setup time		tAW6	-	20	-	
System cycle time		tCYC6	-	200	-	
Enable L pulse width (WRITE)	WR	tEWLW	-	100	-	
Enable H pulse width (WRITE)		tEWHW	-	100	-	
Enable L pulse width (READ)	RD	tEWLR	-	100	-	
Enable H pulse width (READ)		tEWHR	-	100	-	
WRITE Data setup time	D0 to D7	tDS6	-	150	-	
WRITE Data hold time		tDH6	-	20	-	
READ access time		tACC6	CL = 100 pF	-	40	
READ Output disable time		tOH6	CL = 100 pF	-	30	

6 ELECTRO-OPTICAL CHARACTERISTICS FOR LCD MODULE

(Temp. = 23 ± 3 °C)

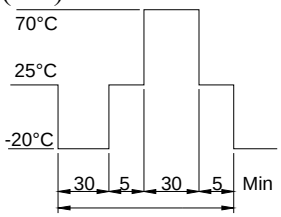
Item			Symbol		Condition	Min	Typ.	Max	Unit
Supply Voltage (Logic)			$V_{DD} - V_{SS}$		-	2.4	3.0	3.3	V
Power Requirements			Idd		-	0.63	-	1.73	mA
LCD Operating Voltage			$V_{DD} - V_O$	Normal Temp.	-10°C	-	12.3	-	V
					25°C	-	12.0	-	
					50°C	-	11.8	-	
				Wide Temp.	-20°C	-	12.4	-	
					25°C	-	12.0	-	
					80°C	-	11.6	-	
Response Time	STN		Ton		-	-	72		ms
			Toff		-	-	224		
	FSTN		Ton		-	-	64	-	
			Toff		-	-	276	-	
	ASTN		Ton		-	-	108	-	
			Toff		-	-	200	-	
	ESTN		Ton		-	-	32	-	
			Toff		-	-	388	-	
Contrast			CR		-	2	-	10.9	-
Viewing Angle	STN	12H	Θ1		CR ≥ 2.0	-	58	-	Deg.
		6H	Θ2			-	55	-	
		3H	Θ3			-	53	-	
		9H	Θ4			-	53	-	
	FSTN(Negative Mode)	12H	Θ1			-	58	-	
		6H	Θ2			-	56	-	
		3H	Θ3			-	53	-	
		9H	Θ4			-	53	-	
	FSTN(Positive Mode)	12H	Θ1			-	55	-	
		6H	Θ2			-	68	-	
		3H	Θ3			-	50	-	
		9H	Θ4			-	50	-	
	ASTN	12H	Θ1			-	60	-	
		6H	Θ2			-	40	-	
		3H	Θ3			-	50	-	
		9H	Θ4			-	50	-	
	ESTN	12H	Θ1			-	40	-	
		6H	Θ2			-	60	-	
		3H	Θ3			-	60	-	
		9H	Θ4			-	54	-	
LCD Threshold Voltage			Vth		25°C	-	10.1	-	V

POWER REQUIREMENTS

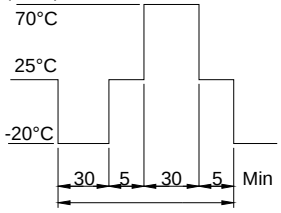
Item	Symbol	Min.	Typ.	Max.	Unit
Module	Idd	0.63	-	1.73	mA
LED	PD	-	306	-	mW

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

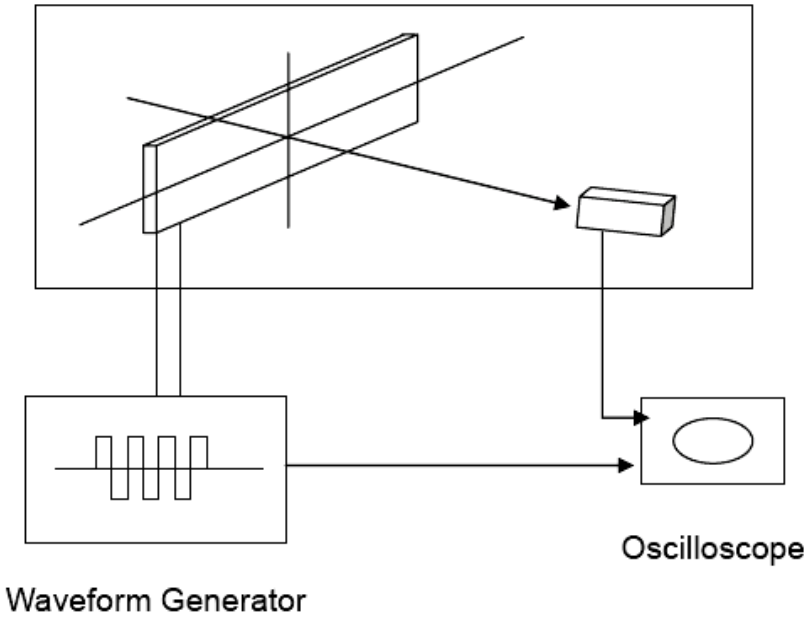
7.2 WIDE TEMP.

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

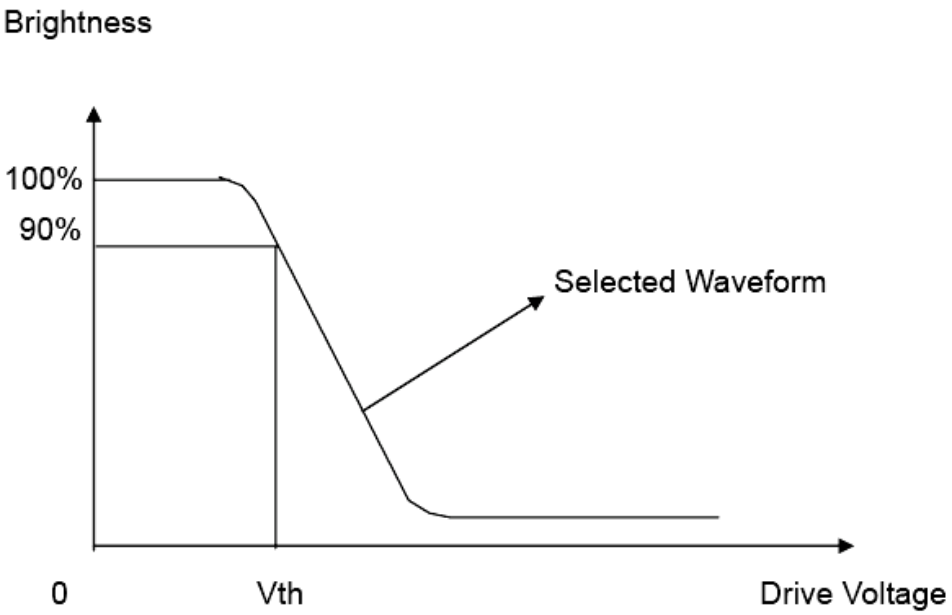
1. Threshold Voltage and Response Time Measuring.

(1) Equipment:

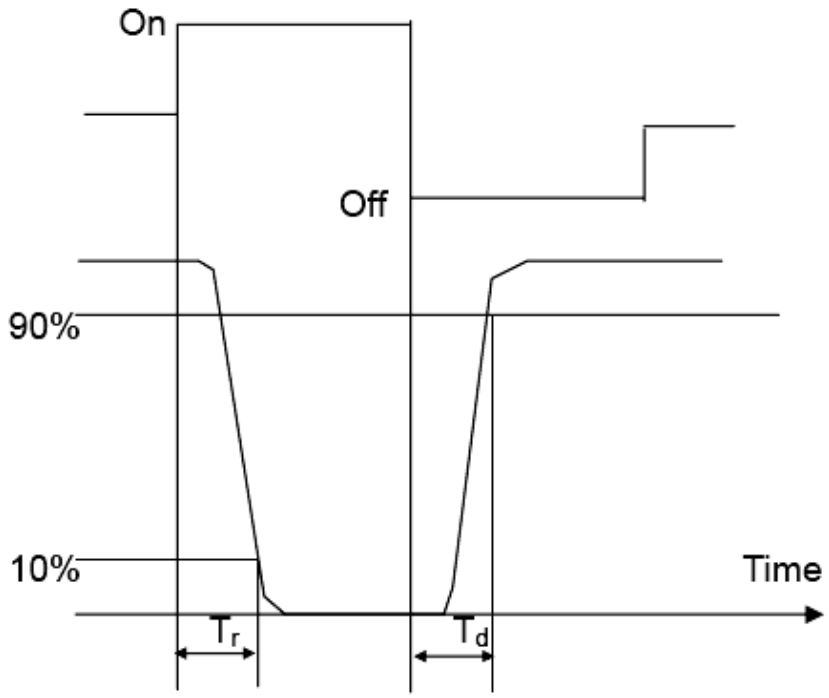


(2) Definition:

A. Threshold Voltage: (Vth)

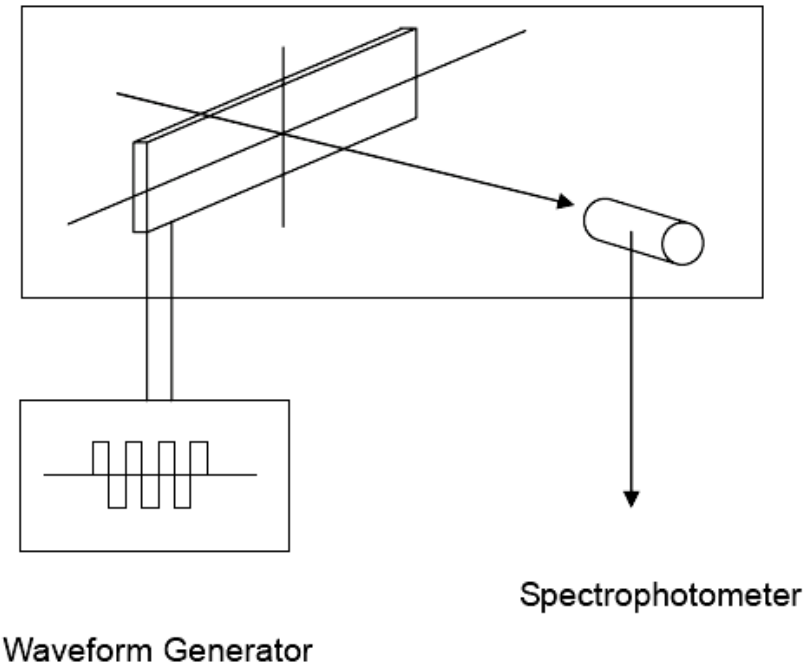


B. Response Time:



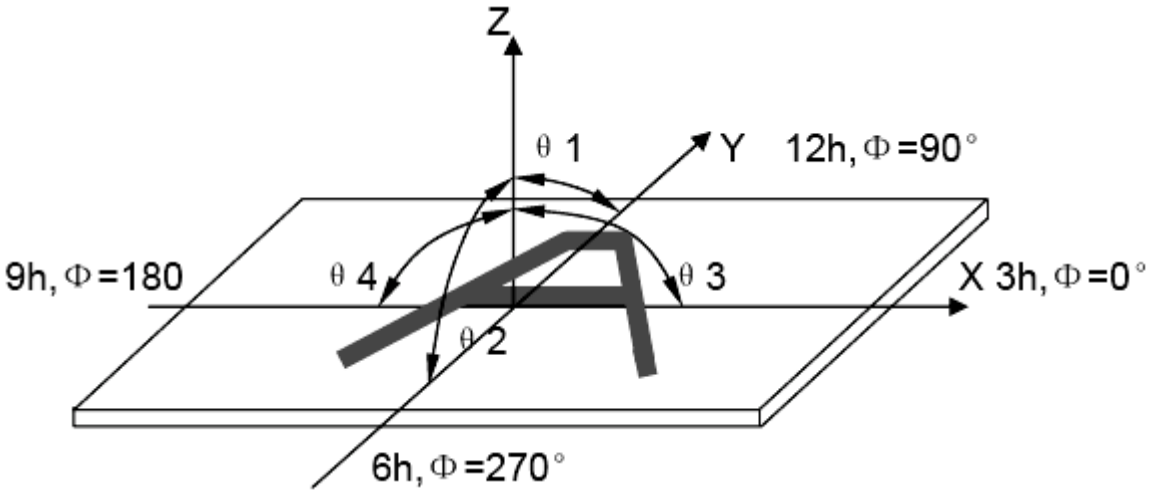
2. Contrast Measuring.

(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

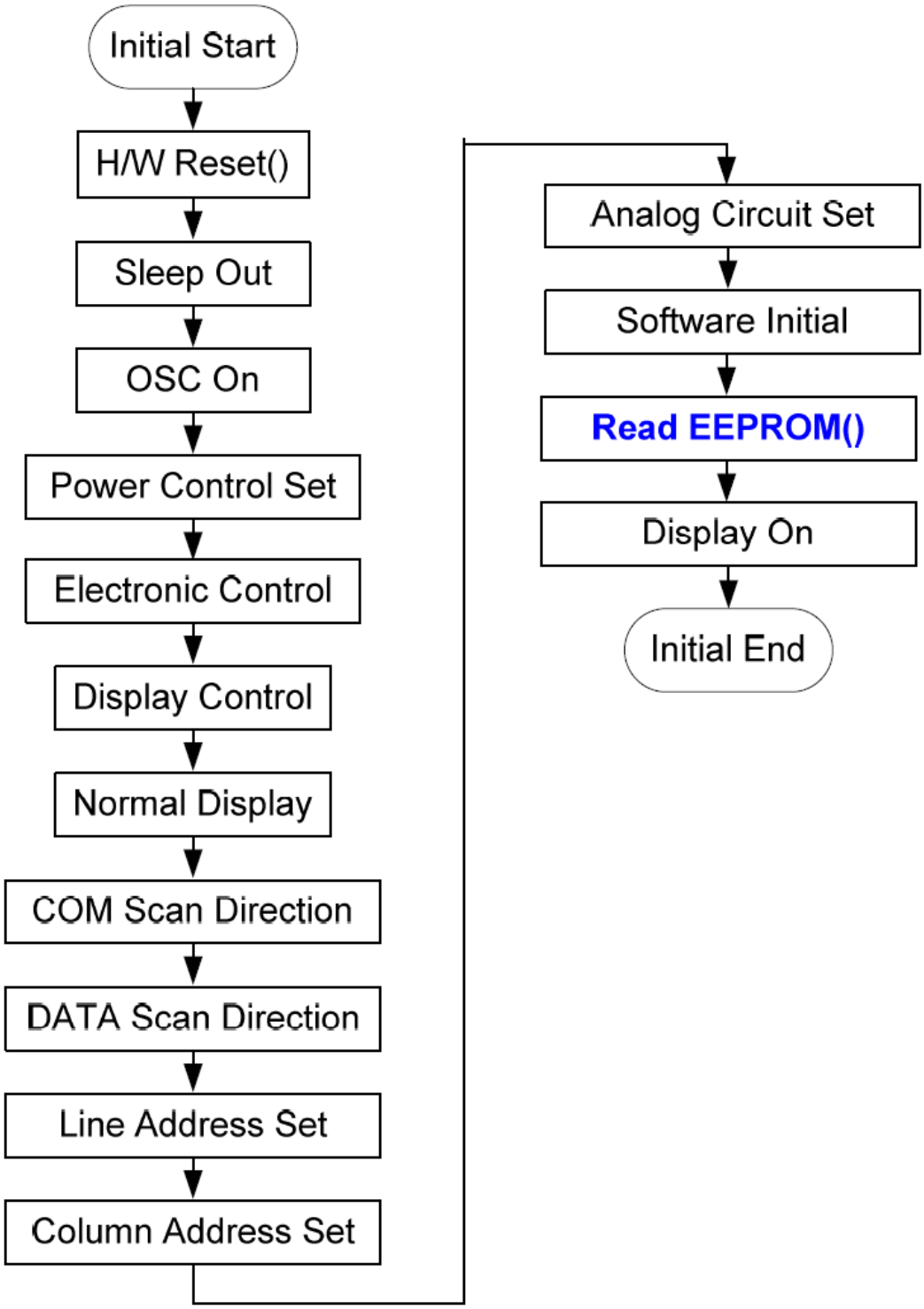
```
#include <reg52.h>
#include <intrins.h>
#include "delay.h"
//#include "isp.h"

sbit    rs      =       P2^0;
sbit    rw      =       P2^1;
sbit    e       =       P2^2;
sbit    res     =       P2^3;
sbit    cs      =       P2^4;
sfr             db      =       0x90;

#include "6800.h"
#include "image.h"
#include "lcd_test.h"

void main()
{
        unsigned char i,j;

        delay_us(0);
        delay_ms(0);
        delay_ss(0);
//      isp_init();

        while(1)
        {
                res=0;
                delay_ss(1);
                res=1;

                cs=0;

                while(1)
                {

                        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(18); // set vop        low: 00~3f              vlcd=12.0v
                write_dat(0x03);        //                      hige:00~07
0x28,0x03=13.0
                write_com(0xca);        // display control
                write_dat(0x04);        //

                write_dat(15); // 1f duty=1/64
                write_dat(0x00);        //        ;10GOOD;

                write_com(0xa6);        // normal display


                write_com(0xbb);        // com scan direction
                write_dat(0x00);        // 0~79,159~80           64COM:0~63

                write_com(0xbc);        // data scan direction
                write_dat(0x02);        //
                write_dat(0x01);        //
                write_dat(0x02);        //

                write_com(0x75);        // line address set
                write_dat(0);   // start line =0
                write_dat(63); // end line =127

                write_com(0x15);        // column address set
                write_dat(0);   // start column =0
                write_dat(79); // end column =79

                write_com(0x31);        // ext=1
                write_com(0x20);        // set gray level
                for(i=0;i<16;i++)
                {
                        write_dat(1);
                }

                write_com(0x21);
                for(i=0;i<16;i++)
                {
                        write_dat(1);
                }

                write_com(0x32);        // analog circuit set
```

```
                write_dat(0x01);        // osc frequency=000 (default)
        ****
                write_dat(0x00);        // booster efficiency=01 (default)
                write_dat(0x05);        // bias=1/9                                  ****
                write_com(0x34);        // dithering off
            ReadEEPROM();               // read eeprom flow
                write_com(0xaf);        // display on

                write_com(0x5c);        // write data
                lcd_full();
        delay_ms(200);
                lcd_line1();
                delay_ms(200);
                lcd_line2();
                delay_ms(200);
                lcd_line3();
                delay_ms(200);
                lcd_line4();
                delay_ms(200);

                lcd_erect1();
                delay_ms(200);
                lcd_erect2();
                delay_ms(200);
                lcd_erect3();
                delay_ms(200);
                lcd_erect4();
                delay_ms(200);

            /*
                write_com(0x5c);        // write data
        lcd_image(image_yes);
        delay_ss(1);
             */
                lcd_image(image_yes1);
        delay_ss(1);




            }
        }
}
```

Note: Please make sure to include EEPROM Read operation into the code, this is essential for the display contrast settings to perform at optimal conditions.

```
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

    }
```



10 PART NUMBER DESCRIPTION FOR AVAILABLE OPTIONS

LMR5428①②240G64③④⑤

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

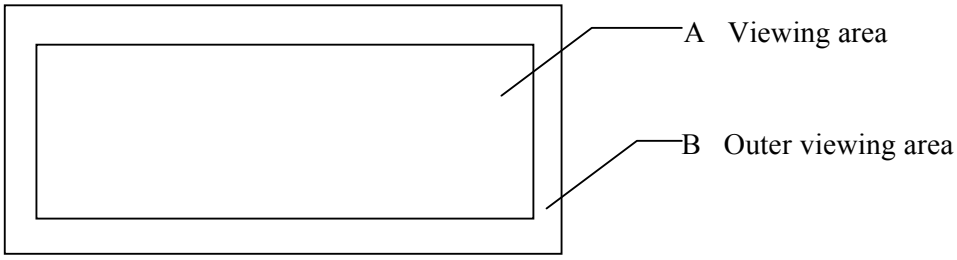
11.2.1 Delivery Inspection Standards

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

The Quality assurance levels are shown below:

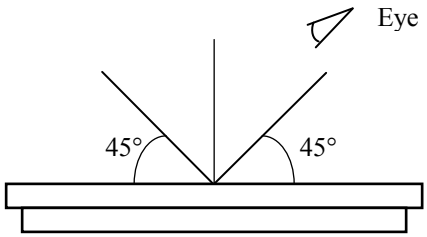
Rank	Item Inspected	Defect type	AQL	Remark
Major defect	Display	No display	0.25%	Fit/Function defect
		Over current		
		Missing segment		
		Wrong Viewing direction		
		Incorrect operation		
		No Backlight		
		Flickering Backlight		
	Dimensions	PCB and/or Bezel out of Specifications		
Minor defect	LCD	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



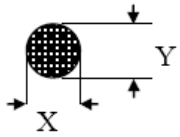
11.2.3 Visual Inspection

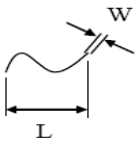
- Inspect under 2 x 20 W or one 40 W fluorescent lamp (approximately 3000 lux.) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye. (Measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted by considering clarity 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.

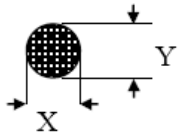


11.2.3.1 Standard of Appearance Inspection

Unit: mm

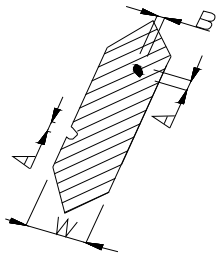
<table>
<tr><th>No.</th><th>Item</th><th>Criteria</th></tr>
<tr><td>1</td><td>Black spot,
White spot,
Dust</td><td>
Round type as shown:
Φ = (X+Y)/2


<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:


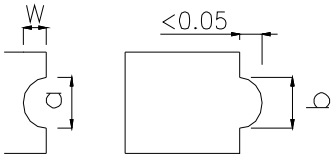
<table>
<tr><td colspan="4">Acceptable quantity</td></tr>
<tr><td>Length</td><td>Width</td><td>Zone A</td><td>Zone B</td></tr>
<tr><td>-</td><td>W ≤ 0.03</td><td>Any num r</td><td rowspan="3">Any number</td></tr>
<tr><td>L ≤ 3</td><td>0.03 < W ≤ 0.05</td><td>2</td></tr>
<tr><td>-</td><td>0.05 < W</td><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:

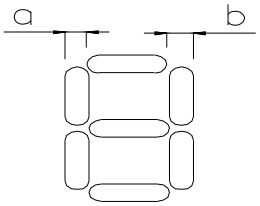
W: Segment Width

Φ = (A+B)/2


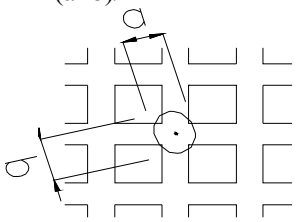
<table>
<tr><td colspan="2">Acceptable quantity</td></tr>
<tr><td>Width</td><td>Φ</td></tr>
<tr><td>W ≤ 0.4</td><td>Φ ≤ 0.2 and Φ ≤ ½W</td></tr>
<tr><td>W > 0.4</td><td>Φ ≤ 0.25 and Φ ≤ (1/3)W</td></tr>
<tr><td colspan="2">Total acceptable quantity: 1 Defect per segment.
Pin holes with Φ under 0.10 mm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

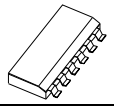
<table>
<tr><th>No.</th><th>Item</th><th>Criteria</th></tr>
<tr><td>4</td><td>Segment Deformation</td><td>
1.b. Pin hole on dot matrix display:


<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).