

LIQUID CRYSTAL DISPLAY MODULE

Product Specification

PRODUCT NUMBER	LMR5419
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INTERNAL APPROVALS		
Product Manager	Engineering	Document Control
Date:	Date:	Date:

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REVISION RECORD

Rev.	Date	Page	Par.	Comment	ECN no.
A	07/17/13	--	--	New DCA Specification	E4833
B	11/21/13	9	--	B/L Spec updated.	E4897
C	1/13/14	4,9,16	--	Electrical spec updated	E4910
D	2/7/14	22	--	Added Recommended schematic	E4922

1 PRODUCT SPECIFICATION

1.1 AVAILABLE FLUID AND POLARIZER TYPE

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

1.2 AVAILABLE BACKLIGHT TYPE AND COLOR

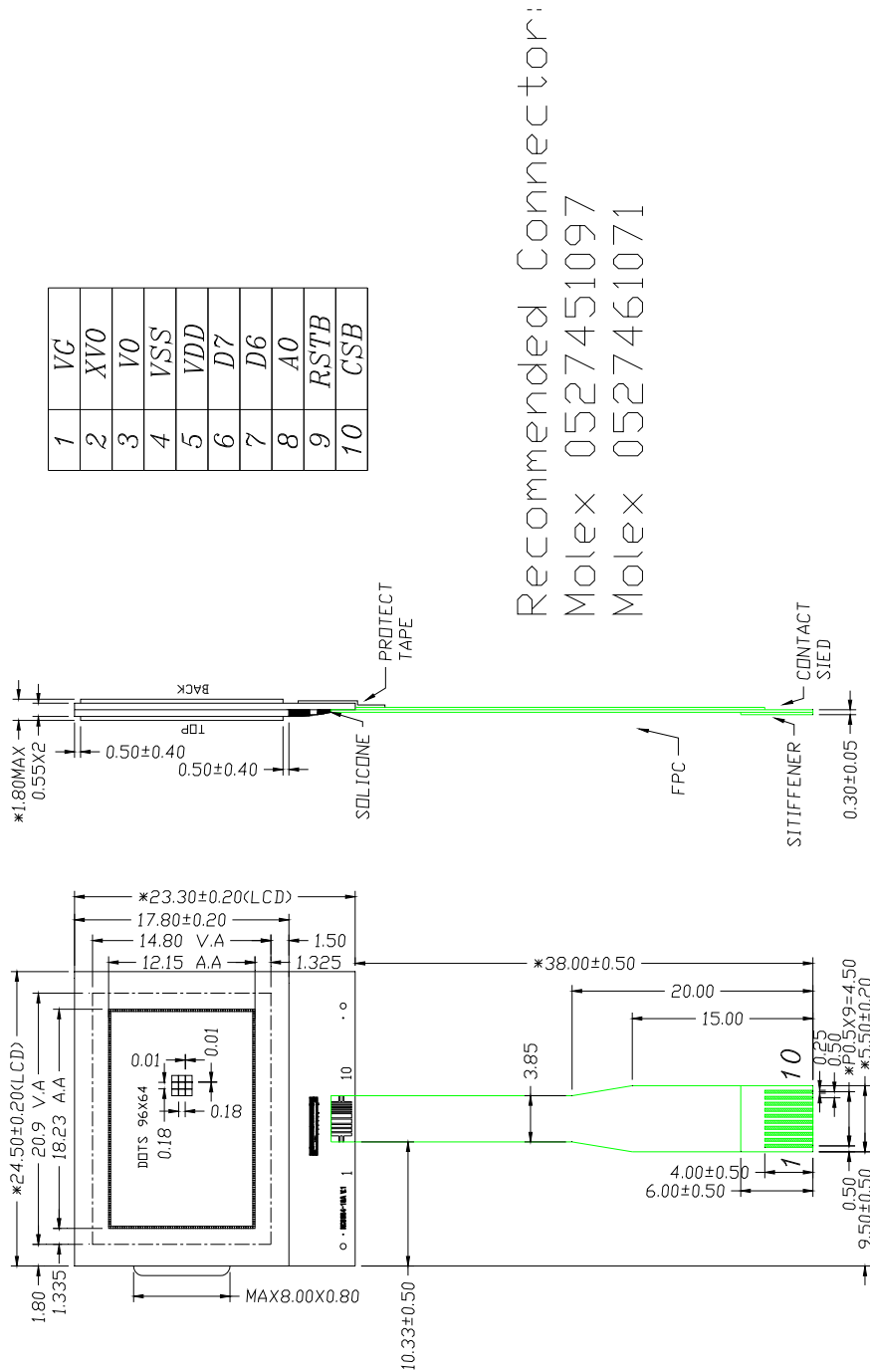
BACKLIGHT COLOR	Jade Green	Arctic White	Warm Amber	Midnight Blue	Tangerine Orange	Sunburst Yellow	Fireburst Red
Edge LED	✓	✓	✓	✓	✓	✓	✓

1.3 GENERAL SPECIFICATIONS

ITEM	CONTENTS	UNIT
Outline Dimension (with B/L)	36.7 ± 0.50 (W) x 25.5 ± 0.50 (H) x 7.0 ± 0.50 (D)	mm
Display Format	96 x 64	Dots
Viewing Area	20.9 (W) x 14.8 (H)	mm
Dot Size	0.18 x 0.18	mm
View Angle	12:00	O'clock
Duty Ratio	1/65	Duty
Bias	1/9	Bias
Module Operating Voltage	3.0	V
LCD Operating Voltage	9.0~10.5	V
LCD Driver	ST7567-G4 (serial mode)	-
Operating/Storage temperature	-20~+70 / -30~80	°C
RoHS Compliant	Yes	-

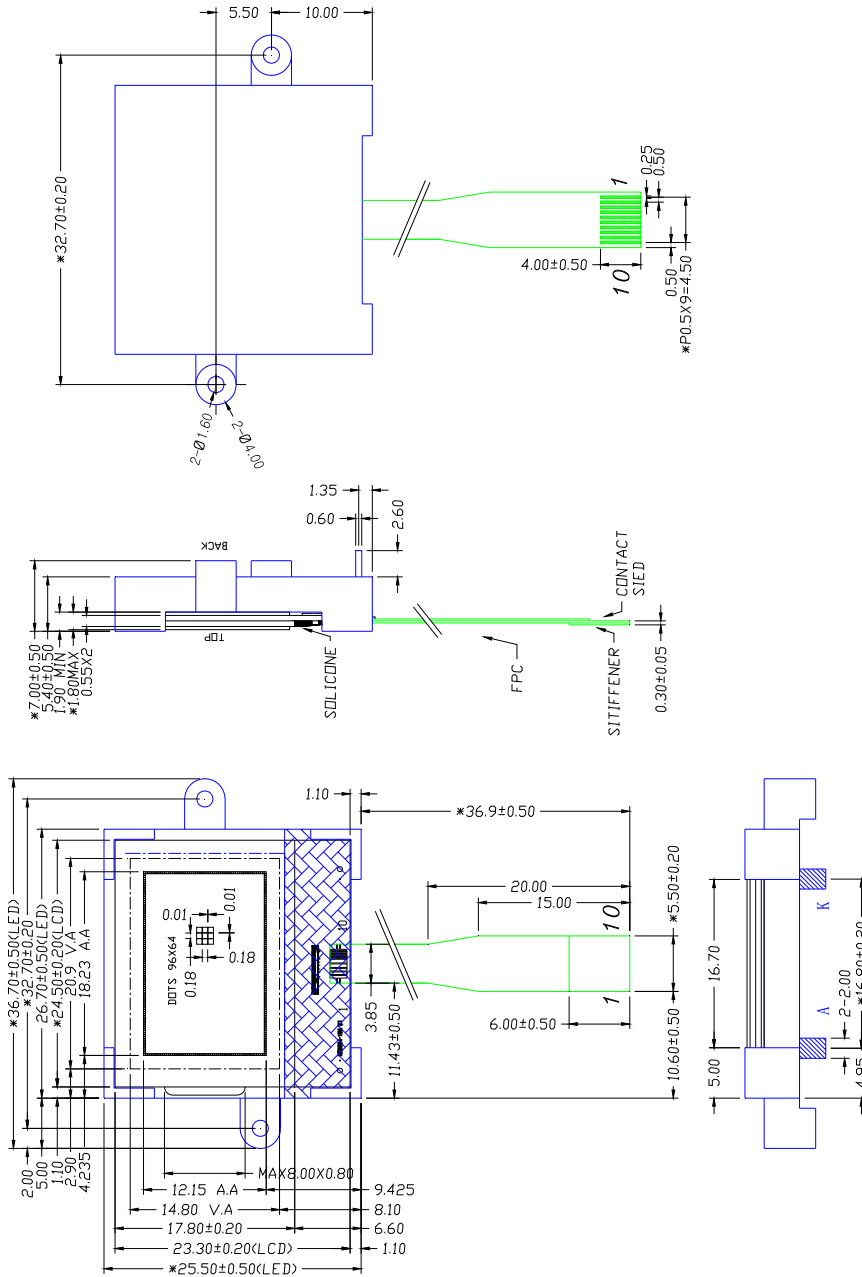
2 MECHANICAL DRAWINGS AND SCHEMATICS

2.1 REFLECTIVE MODE

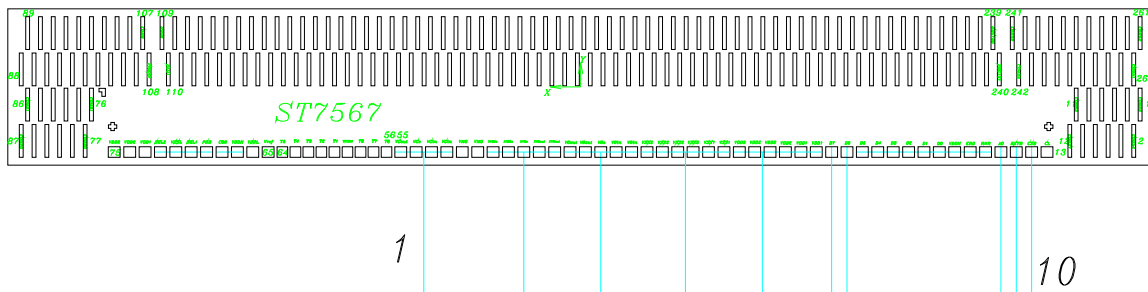
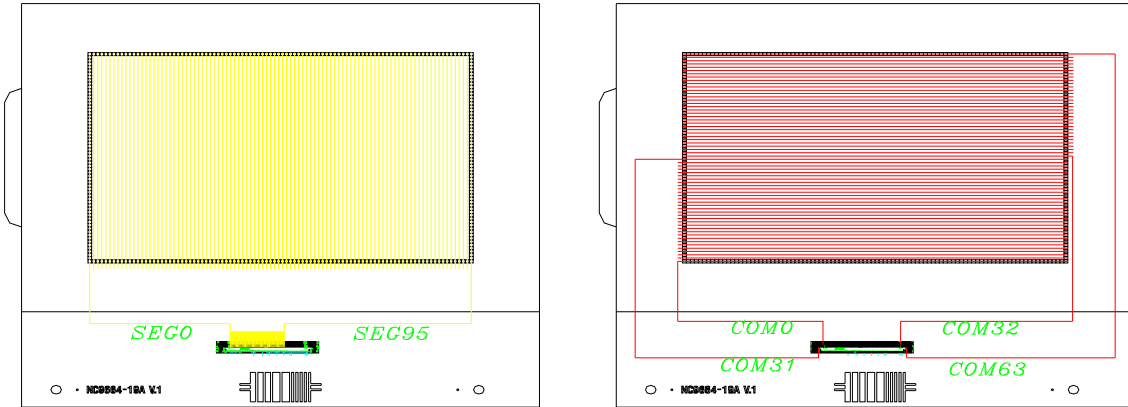


2.2 FOR ALL B/L COLORS

1	VC
2	XV0
3	V0
4	VSS
5	VDD
6	D7
7	D6
8	A0
9	RSTB
10	CSB



2.3 LCD WIRING DIAGRAM



1	2	3	4	5	6	7	8	9	10
VG	XV0	V0	VSS	VDD1,2,3	D7	D6	A0	RSTB	CSB

3 PIN CONNECTIONS

Pin No.	Symbol	Function
1	VG	VG is the LCD driving voltage for segment circuit.
2	XV0	XV0 is the LCD driving voltage for common circuits at positive frame.
3	V0	V0 is the LCD driving voltage for common circuits at negative frame.
4	VSS	Ground
5	VDD	Power input.
6	D7(SDA)	Serial Data input
7	D6(SCL)	Serial clock input
8	A0	A0="H": Indicates that signals on D[7:0] are display data A0="L": Indicates that signals on D[7:0] are command
9	RSTB	Hardware reset input pin. When RSTB is "L", internal initialization is executed and the internal registers will be initialized.
10	CSB	Chip select input pin. Interface access is enabled when CSB is "L". When CBS is non-active (CBS="H"), D[7:0] pins are high impedance.

4 THE LED BACKLIGHT

4.1 ELECTRO-OPTICAL CHARACTERISTICS FOR BACKLIGHT

Item	Color(s)	Symbol	Min.	Typ.	Max.	Unit	Condition
Forward Voltage	All	V _f	3.2	3.5	3.8	V	If = 30 mA, each chip (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	L _v	480	600	720	cd/m ²	
	Fireburst Red	L _v	270	340	400		
	Warm Amber	L _v	520	650	780		
	Jade Green	L _v	2290	2870	3440		
	Tangerine Orange	L _v	800	1010	1210		
	Sunburst Yellow	L _v	2400	3300	4200		
	Arctic White	L _v	2490	3120	3740		
Dominant Wave length	Midnight Blue	λ _D	465	468	471	nm	
	Warm Amber	λ _D	600	603	606		
	Jade Green	λ _D	520	523	526		
	Tangerine Orange	λ _D	587	590	593		
	Fireburst Red	λ _D	620	623	626		
	Sunburst Yellow	λ _D	569	572	575		

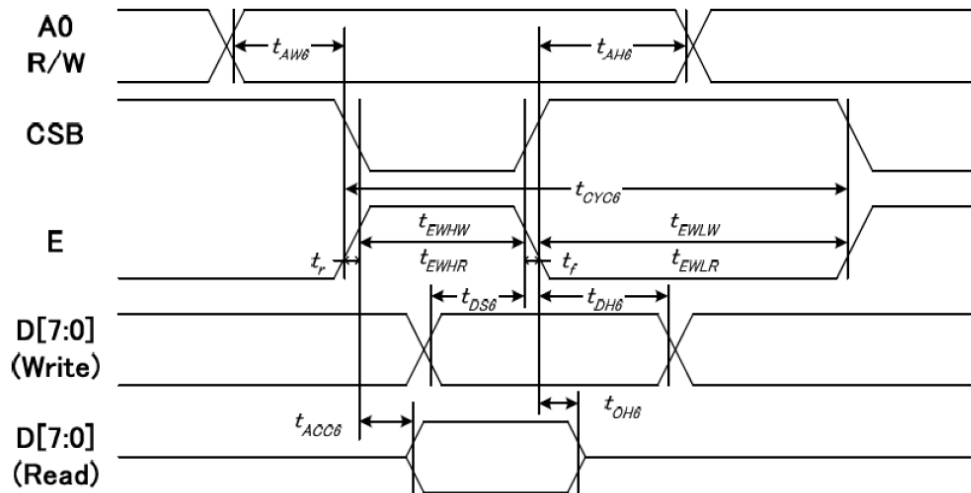
Reverse Current (per LED)	Arctic White, Midnight Blue	Ir	-	-	10	μA	V _r = 5.0 V each chip
	Tangerine Orange, Warm Amber & Jade Green	Ir	-	-	10	μA	V _r = 5.0 V

Note 1: LED lifetime for Arctic White and Midnight Blue colour is Estimated to be 20000 hrs at 20mA / LED (25°C).

Note 2: LED lifetime for all other available colors is estimated to be 15000 hrs. at 15mA (25°C).

5 TIMING CHARACTERISTICS

System Bus Timing for 6800 Series MPU



(VDD1 = 3.3V, Ta = 25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW6		0	—	ns
Address hold time		tAH6		10	—	
System cycle time	E	tCYC6		240	—	
Enable L pulse width (WRITE)		tEHLW		80	—	
Enable H pulse width (WRITE)		tEHWLW		80	—	
Enable L pulse width (READ)		tEHLR		80	—	
Enable H pulse width (READ)	tEWHHR		140	—		
Write data setup time	D[7:0]	tDS6		40	—	
Write data hold time		tDH6		10	—	
Read data access time	D[7:0]	tACC6	CL = 16 pF	—	70	
Read data output disable time		tOH6	CL = 16 pF	5	50	

(VDD1 = 2.8V, Ta = 25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW6		0	—	ns
Address hold time		tAH6		0	—	
System cycle time	E	tCYC6		400	—	
Enable L pulse width (WRITE)		tEHLW		220	—	
Enable H pulse width (WRITE)		tEHWLW		180	—	
Enable L pulse width (READ)		tEHLR		220	—	
Enable H pulse width (READ)	tEWHHR		180	—		
Write data setup time	D[7:0]	tDS6		40	—	
Write data hold time		tDH6		20	—	
Read data access time	D[7:0]	tACC6	CL = 16 pF	—	140	
Read data output disable time		tOH6	CL = 16 pF	10	100	

(VDD1 = 1.8V, Ta = 25°C)

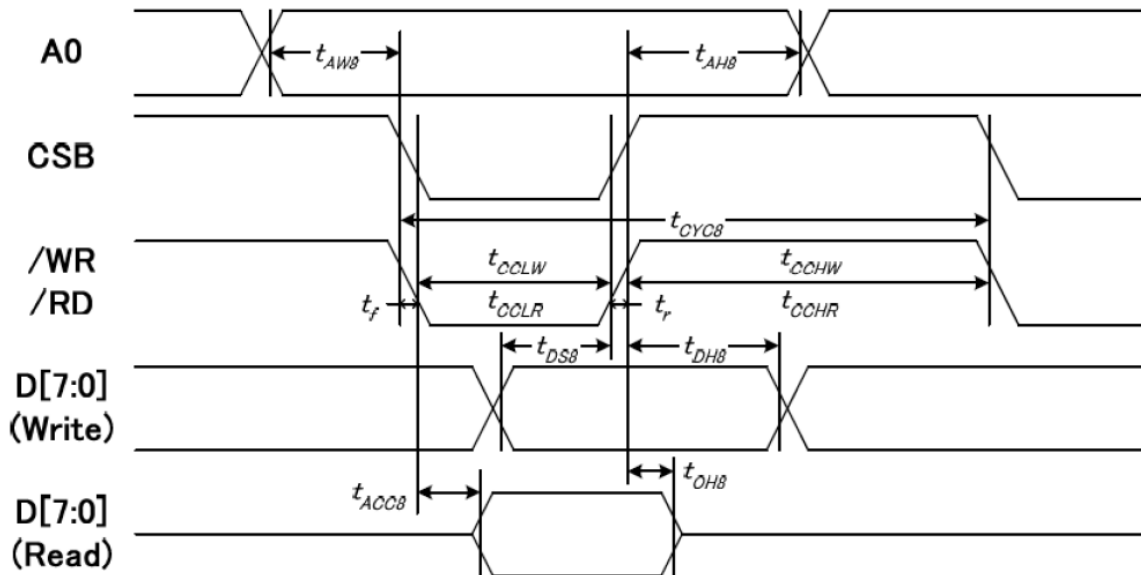
Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW6		0	—	ns
Address hold time		tAH6		0	—	
System cycle time	E	tCYC6		640	—	
Enable L pulse width (WRITE)		tEWLW		360	—	
Enable H pulse width (WRITE)		tEWHW		280	—	
Enable L pulse width (READ)		tEWLR		360	—	
Enable H pulse width (READ)		tEWHR		280	—	
Write data setup time	D[7:0]	tDS6		80	—	
Write data hold time		tDH6		20	—	
Read data access time		tACC6	CL = 16 pF	—	240	
Read data output disable time		tOH6	CL = 16 pF	10	200	

*1 The input signal rise time and fall time (tr, tf) is specified at 15 ns or less. When the system cycle time is extremely fast, (tr + tf) ≤ (tCYC6 - tEWLW - tEWHW) for (tr + tf) ≤ (tCYC6 - tEWLR - tEWHR) are specified.

*2 All timing is specified using 20% and 80% of VDD1 as the reference.

*3 tEWLW and tEWLR are specified as the overlap between CSB being "L" and E.

System Bus Timing for 8080 Series MPU



(VDD1 = 3.3V , Ta =25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW8		0	—	ns
Address hold time		tAH8		10	—	
System cycle time	/WR	tCYC8		240	—	
/WR L pulse width (WRITE)		tCCLW		80	—	
/WR H pulse width (WRITE)		tCCHW		80	—	
/RD L pulse width (READ)	RD	tCCLR		140	—	
/RD H pulse width (READ)		tCCHR		80	—	
WRITE Data setup time	D[7:0]	tDS8		40	—	
WRITE Data hold time		tDH8		20	—	
READ access time		tACC8	CL = 16 pF	—	70	
READ Output disable time		tOH8	CL = 16 pF	5	50	

(VDD1 = 2.8V , Ta =25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW8		0	—	ns
Address hold time		tAH8		0	—	
System cycle time	/WR	tCYC8		400	—	
/WR L pulse width (WRITE)		tCCLW		220	—	
/WR H pulse width (WRITE)		tCCHW		180	—	
/RD L pulse width (READ)	RD	tCCLR		220	—	
/RD H pulse width (READ)		tCCHR		180	—	
WRITE Data setup time	D[7:0]	tDS8		40	—	
WRITE Data hold time		tDH8		20	—	
READ access time		tACC8	CL = 16 pF	—	140	
READ Output disable time		tOH8	CL = 16 pF	10	100	

(VDD1 = 1.8V, Ta = 25°C)

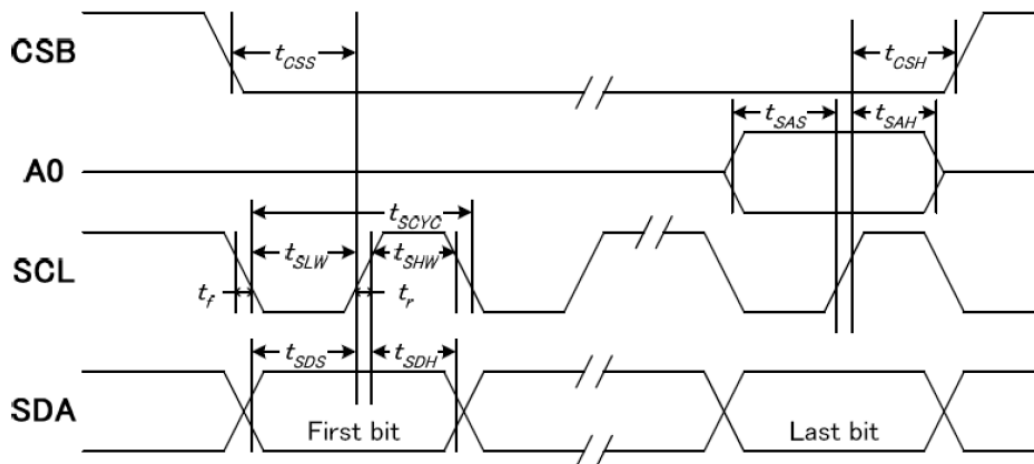
Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW8		0	—	ns
Address hold time		tAH8		0	—	
System cycle time	/WR	tCYC8		640	—	
/WR L pulse width (WRITE)		tCCLW		360	—	
/WR H pulse width (WRITE)		tCCHW		280	—	
/RD L pulse width (READ)	RD	tCCLR		360	—	
/RD H pulse width (READ)		tCCHR		280	—	
WRITE Data setup time	D[7:0]	tDS8		80	—	
WRITE Data hold time		tDH8		20	—	
READ access time		tACC8	CL = 16 pF	—	240	
READ Output disable time		tOH8	CL = 16 pF	10	200	

*1 The input signal rise time and fall time (tr, tf) is specified at 15 ns or less. When the system cycle time is extremely fast, (tr + tf) ≤ (tCYC8 - tCCLW - tCCHW) for (tr + tf) ≤ (tCYC8 - tCCLR - tCCHR) are specified.

*2 All timing is specified using 20% and 80% of VDD1 as the reference.

*3 tCCLW and tCCLR are specified as the overlap between CSB being "L" and WR and RD being at the "L" level.

System Bus Timing for 4-Line Serial Interface



(VDD1 = 3.3V , Ta =25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Serial clock period	SCLK	tSCYC		50	—	ns
SCLK "H" pulse width		tSHW		25	—	
SCLK "L" pulse width		tSLW		25	—	
Address setup time	A0	tSAS		20	—	
Address hold time		tSAH		10	—	
Data setup time	SDA	tSDS		20	—	
Data hold time		tSDH		10	—	
CSB-SCLK time	CSB	tCSS		20	—	
CSB-SCLK time		tCSH		40	—	

(VDD1 = 2.8V , Ta =25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Serial clock period	SCLK	tSCYC		100	—	ns
SCLK "H" pulse width		tSHW		50	—	
SCLK "L" pulse width		tSLW		50	—	
Address setup time	A0	tSAS		30	—	
Address hold time		tSAH		20	—	
Data setup time	SDA	tSDS		30	—	
Data hold time		tSDH		20	—	
CSB-SCLK time	CSB	tCSS		30	—	
CSB-SCLK time		tCSH		60	—	

(VDD1 = 1.8V , Ta =25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Serial clock period	SCLK	tSCYC		200	—	ns
SCLK "H" pulse width		tSHW		80	—	
SCLK "L" pulse width		tSLW		80	—	
Address setup time	A0	tSAS		60	—	
Address hold time		tSAH		30	—	
Data setup time	SDA	tSDS		60	—	
Data hold time		tSDH		30	—	
CSB-SCLK time	CSB	tCSS		40	—	
CSB-SCLK time		tCSH		100	—	

*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)		$V_{DD} - V_{SS}$	-	2.4	3.0	3.3	V		
Power Requirements(Logic)		I_{dd}	-	-	-	300	uA		
LCD Operating Voltage		$V_0 - V_{SS}$	STN/ ASTN/ FSTN Positive	-20°C	-	9.4	-	V	
				25°C	8.8	9.0	9.2		
				70°C	-	8.6	-		
			ESTN /FSTN Negative	-20°C	-	10.9	-		
				25°C	10.3	10.5	10.7		
				80°C	-	10.1	-		
Response Time	STN	T_{on}	-	-	162	-	ms		
		T_{off}	-	-	128	-			
	FSTN (Positive)	T_{on}	-	-	110	-			
		T_{off}	-	-	185	-			
	FSTN (Negative)	T_{on}	-	-	148	-			
		T_{off}	-	-	184	-			
	ASTN	T_{on}	-	-	90	-			
		T_{off}	-	-	200	-			
	ESTN	T_{on}	-	-	100	-			
		T_{off}	-	-	220	-			
	Contrast	STN	CR	-	2	3		-	-
		FSTN (Positive)			2	3		6	
FSTN (Negative)		2			10	-			
ASTN		2			100	-			
ESTN					60				

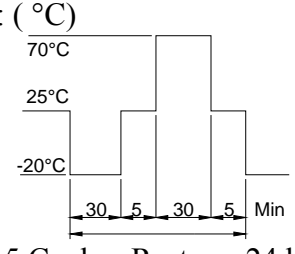
Viewing Angle	STN	12H	θ1	CR ≥ 2	-	50	-	Deg.
		6H	θ2		-	35	-	
		3H	θ3		-	35	-	
		9H	θ4		-	33	-	
	FSTN	12H	θ1		-	50	-	
		6H	θ2		-	33	-	
		3H	θ3		-	42	-	
		9H	θ4		-	42	-	
	ASTN	12H	θ1		-	50	-	
		6H	θ2		-	45	-	
		3H	θ3		-	45	-	
		9H	θ4		-	45	-	
	ESTN	12H	θ1		-	50	-	
		6H	θ2		-	45	-	
		3H	θ3		-	45	-	
		9H	θ4		-	45	-	

POWER REQUIREMENTS

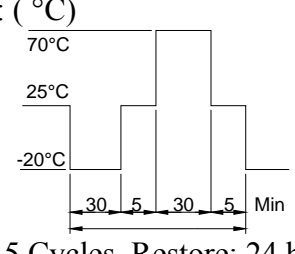
Item	Symbol	Min.	Typ.	Max.	Unit
LED	PD	-	-	0.114	W

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

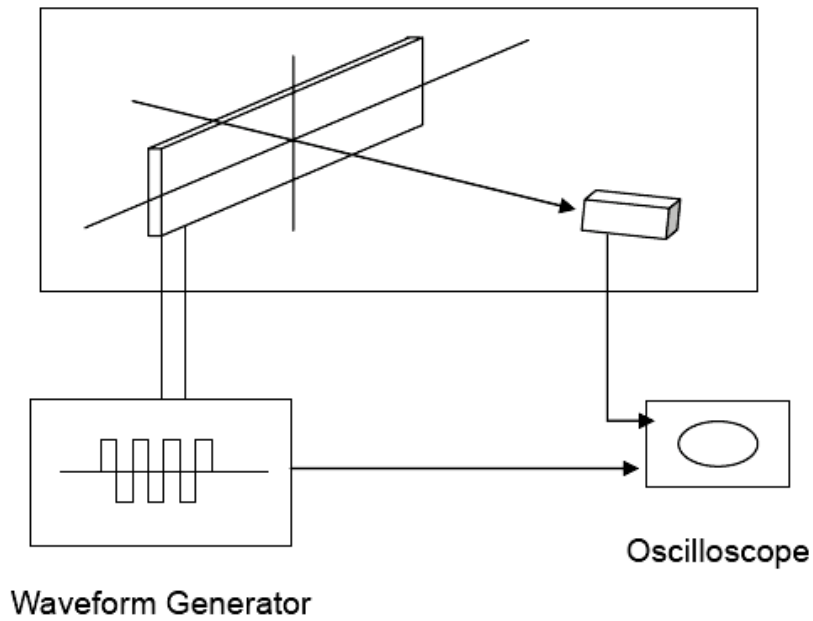
7.2 WIDE TEMP.

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.

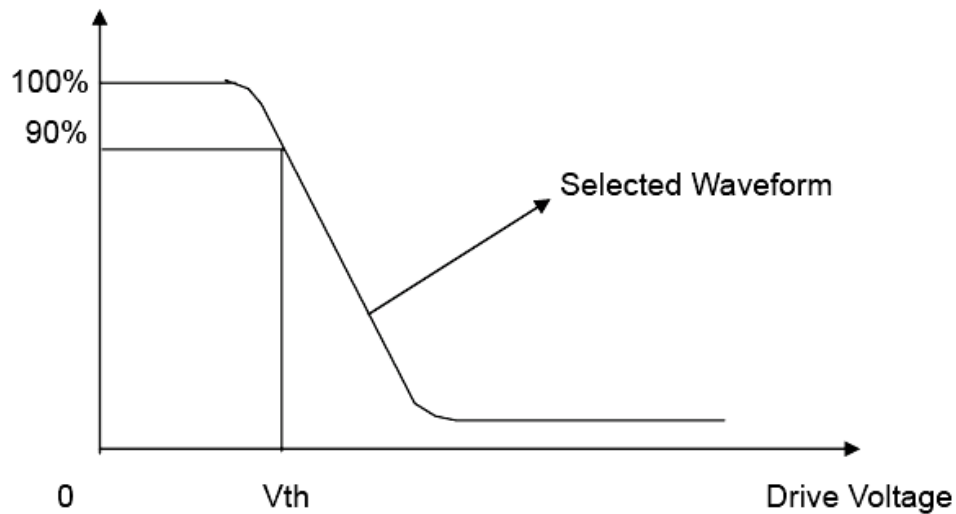
(1) Equipment:



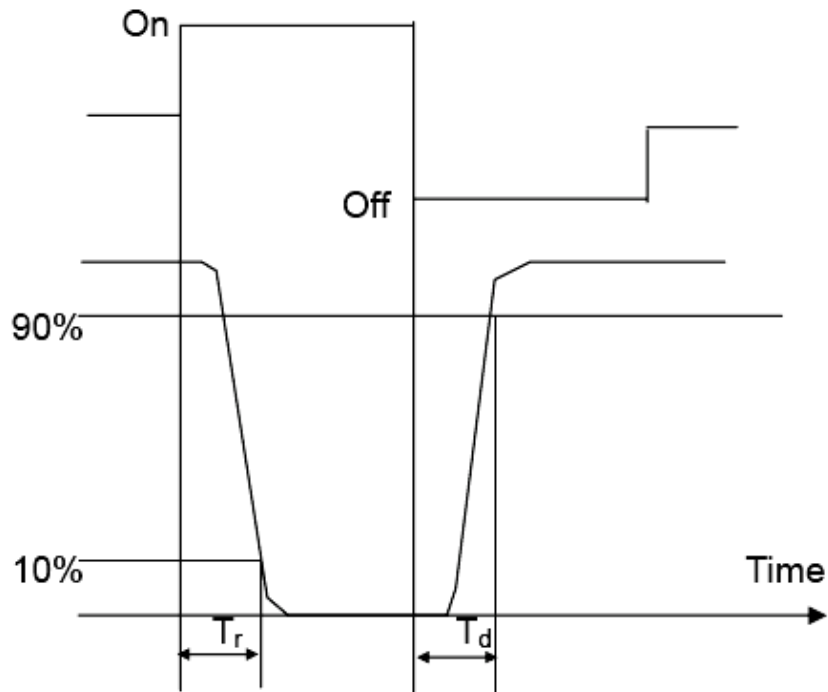
(2) Definition:

A. Threshold Voltage: (V_{th})

Brightness

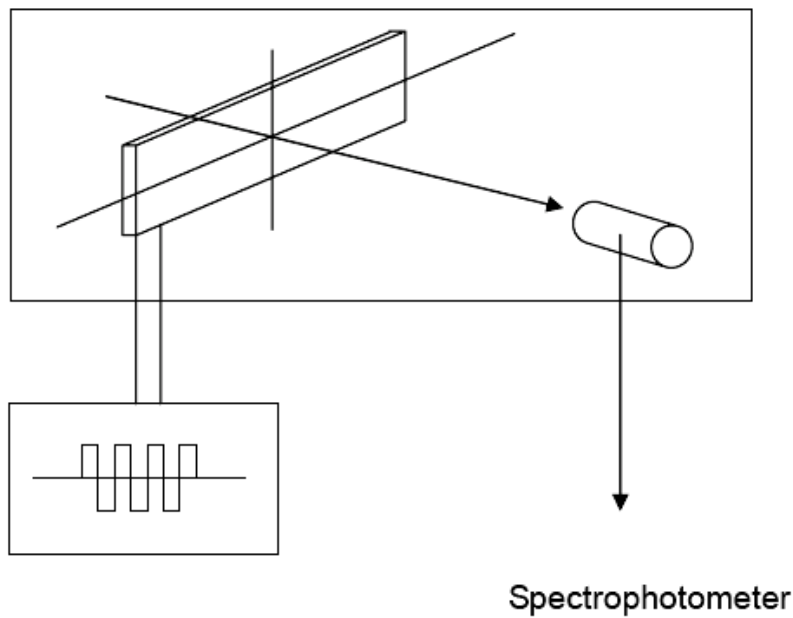


B. Response Time:



2. Contrast Measuring.

(1) Equipment:

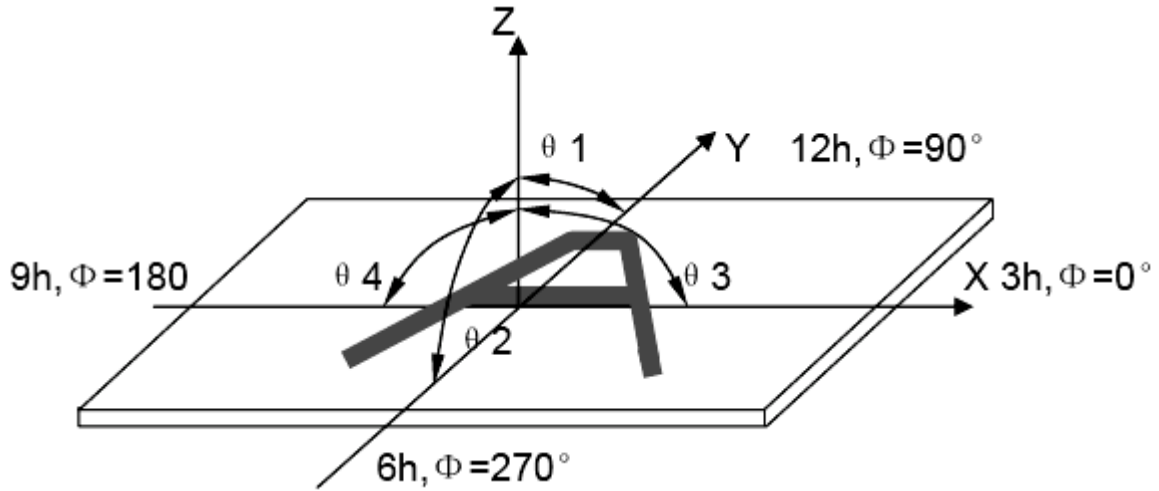


Waveform Generator

Spectrophotometer

(2) Definition:

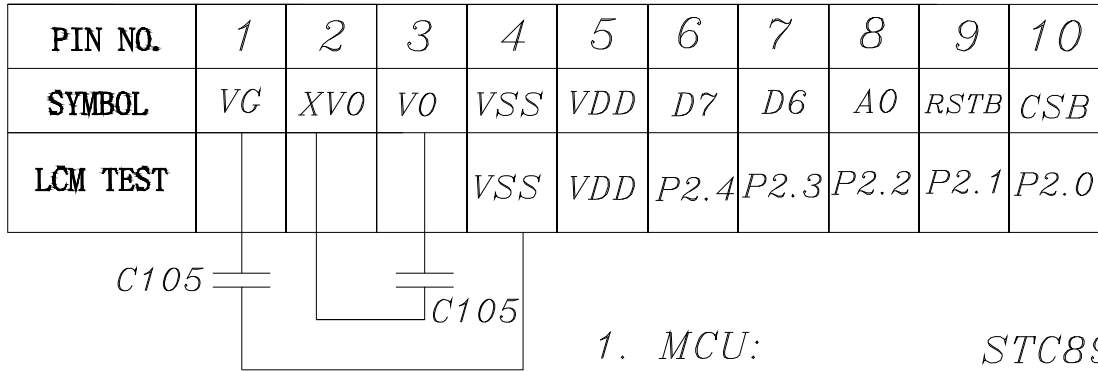
A. Viewing Angle:



B. Contrast Ratio: (Positive)

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

9 RECOMMENDED CIRCUIT SCHEMATIC



10 SAMPLE CODE

```

/*****
Vlcm=3.0v,Vlcd=9.9v,1/65duty,1/9bias
*****/

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

/*
//Ò³¼$½Ó¿ÚÑ¿Ïñ
sbit  rs    =    P2^2;
sbit  res   =    P2^3;
sbit  cs0   =    P2^4;
sbit  cs1 = P2^5;
sbit  cs2 = P2^6;

//_6800
sbit  rw    =    P2^0;
sbit  e     =    P2^1;

//_8080
sbit  wr    =    P2^0;
sbit  rd    =    P2^1;

sfr          db    =    0x90;

//_spi_iic
sbit  sck= P2^1;
sbit  sda = P2^0;
*/

sbit  cs0 = P2^0;
sbit  res = P2^1;
sbit  rs  = P2^2;
sbit  sck = P2^3;
sbit  sda = P2^4;
sfr    db = 0x90;

//×Ó³ÏÐòÑ¿Ïñ
//  #include "6800.h"
//  #include "8080.h"
//  #include "4spi.h" //cs cd sck sda
//  #include "3spi.h" //cs wr da

```

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```

//      #include "iic.h"

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

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

    while(1)
    {
        cs0=0;                //Ä£¿éÑ;Ôñ

        res=0;                //Ä£¿é, 'Î»
        delay_ms(100);
        res=1;

        write_com(0xa2);      // 1/9bias
        write_com(0xa0);      // adc direction: normal
        write_com(0xc8);      // com direction: reverse
        write_com(0x25);      // Ra/Rb
        write_com(0x81);      // set v0=9.0
        write_com(27);
        write_com(0x2c);      // vc,vr,vf
        write_com(0x2e);
        write_com(0x2f);
        write_com(0x40);      // RAM display start line address
        write_com(0xaf);      // display on
//      write_com(0xa5);      // display all points
//      delay_ms(200);
//      delay_ms(200);

        write_com(0xa4);      // display normal

        lcd_full();           // È«ÏÔ
        delay_ms(200);
        delay_ms(200);
        delay_ms(200);
//      write_com(0x60);      // COMÆøÊ¼ÐÐ32
        lcd_fk();             // È«ÏÔ
        delay_ms(200);
        delay_ms(200);
    }
}

```



```

delay_ms(200);
lcd_image(image_yes); //Í¼ÐÎ
delay_ms(200);
delay_ms(200);
delay_ms(200);

write_com(0x43); // ,Ä±äÆðÊ¼ÐÐÊµÏÖ×ß°áÑ-»·
lcd_line();
delay_ms(200);
delay_ms(100);
write_com(0x42);
delay_ms(200);
delay_ms(100);
write_com(0x41);
delay_ms(200);
delay_ms(100);
write_com(0x40);
delay_ms(200);
delay_ms(200);

lcd_erect(0xff,0x00,0x00,0x00); // ×ßÊúÑ-»·
delay_ms(200);
lcd_erect(0x00,0xff,0x00,0x00);
delay_ms(200);
lcd_erect(0x00,0x00,0xff,0x00);
delay_ms(200);
lcd_erect(0x00,0x00,0x00,0xff);
delay_ms(200);

// lcd_image(image_yes1); //Í¼ÐÎ
// delay_ms(200);

delay_ss(3);

}
}

```

11 PART NUMBER DESCRIPTION FOR AVAILABLE OPTIONS

LMR5419①②96G64③④⑤

①

Polarizer Type

A=Reflective Positive Mode
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
R = Fireburst Red

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 Red Backlight only)

⑤

Background Color

B = Blue mode STN (Ocean Blue)

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12 QUALITY ASSURANCE SPECIFICATION

12.1 CONFORMITY

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

12.2 DELIVERY ASSURANCE

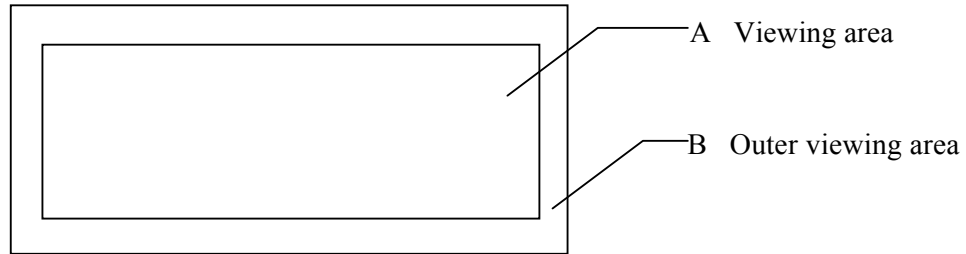
11.2.1 Delivery Inspection Standards

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

The Quality assurance levels are shown below:

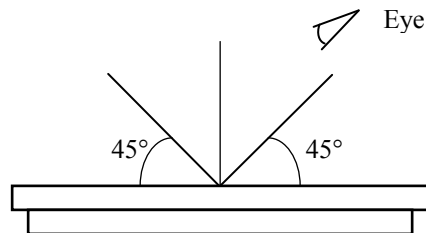
Rank	Item Inspected	Defect type	AQL	Remark		
Major defect	Display	No display	0.25%	Fit/Function defect		
		Over current				
		Missing segment				
		Wrong Viewing direction				
		Incorrect operation				
		No Backlight				
	Flickering Backlight					
	Dimensions	PCB and/or Bezel out of Specifications		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

11.2.2 Zone Definition



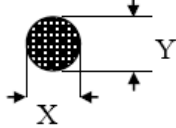
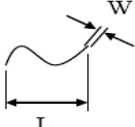
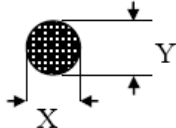
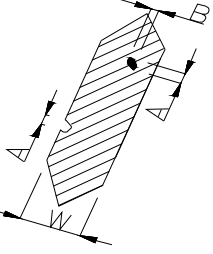
11.2.3 Visual Inspection

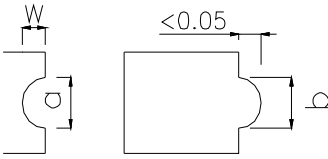
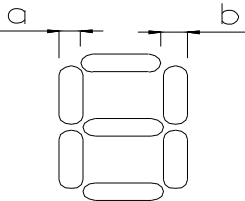
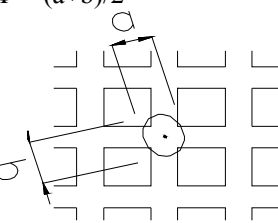
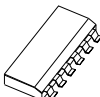
- ❖ Inspect under 2 x 20 W or one 40 W fluorescent lamp (approximately 3000 lux.) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye. (Measuring position).
- ❖ Appearance is inspected at the best contrast voltage (best contrast is adjusted by considering clarity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

No.	Item	Criteria																															
1	Black spot, White spot, Dust	<p>Round type as shown: $\Phi = (X+Y)/2$</p>  <table border="1" data-bbox="787 436 1279 604"> <thead> <tr> <th colspan="3">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>$\Phi < 0.2$</td> <td>Any number</td> <td rowspan="3">Any number</td> </tr> <tr> <td>$0.2 < \Phi < 0.25$</td> <td>2</td> </tr> <tr> <td>$0.25 < \Phi$</td> <td>0</td> </tr> </tbody> </table> <p>Line type as shown:</p>  <table border="1" data-bbox="669 640 1351 808"> <thead> <tr> <th colspan="4">Acceptable quantity</th> </tr> <tr> <th>Length</th> <th>Width</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>$W \leq 0.03$</td> <td>Any number</td> <td rowspan="3">Any number</td> </tr> <tr> <td>$L \leq 3$</td> <td>$0.03 < W \leq 0.05$</td> <td>2</td> </tr> <tr> <td>-</td> <td>$0.05 < W$</td> <td>As round type</td> </tr> </tbody> </table> <p>Total acceptable quantity: 5</p>	Acceptable quantity			Size	Zone A	Zone B	$\Phi < 0.2$	Any number	Any number	$0.2 < \Phi < 0.25$	2	$0.25 < \Phi$	0	Acceptable quantity				Length	Width	Zone A	Zone B	-	$W \leq 0.03$	Any number	Any number	$L \leq 3$	$0.03 < W \leq 0.05$	2	-	$0.05 < W$	As round type
Acceptable quantity																																	
Size	Zone A	Zone B																															
$\Phi < 0.2$	Any number	Any number																															
$0.2 < \Phi < 0.25$	2																																
$0.25 < \Phi$	0																																
Acceptable quantity																																	
Length	Width	Zone A	Zone B																														
-	$W \leq 0.03$	Any number	Any number																														
$L \leq 3$	$0.03 < W \leq 0.05$	2																															
-	$0.05 < W$	As round type																															
2	Polarizer Scratch	Scratch on Protective film is permitted. Scratch on Polarizer: Same as 1.																															
3	Polarizer Bubble	<p>$\Phi = (X+Y)/2$</p>  <table border="1" data-bbox="808 1035 1279 1234"> <thead> <tr> <th colspan="3">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>$\Phi < 0.2$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$0.2 < \Phi < 0.5$</td> <td>3</td> </tr> <tr> <td>$0.5 < \Phi < 1.0$</td> <td>1</td> </tr> <tr> <td>$1.0 < \Phi$</td> <td>0</td> </tr> </tbody> </table> <p>Total acceptable quantity: 4</p>	Acceptable quantity			Size	Zone A	Zone B	$\Phi < 0.2$	Any number	Any number	$0.2 < \Phi < 0.5$	3	$0.5 < \Phi < 1.0$	1	$1.0 < \Phi$	0																
Acceptable quantity																																	
Size	Zone A	Zone B																															
$\Phi < 0.2$	Any number	Any number																															
$0.2 < \Phi < 0.5$	3																																
$0.5 < \Phi < 1.0$	1																																
$1.0 < \Phi$	0																																
4	Segment Deformation	<p>I.a. Pin hole on segmented display:</p> <p>W: Segment Width</p> <p>$\Phi = (A+B)/2$</p>  <table border="1" data-bbox="738 1491 1299 1738"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Width</th> <th>Φ</th> </tr> </thead> <tbody> <tr> <td>$W \leq 0.4$</td> <td>$\Phi \leq 0.2$ and $\Phi \leq \frac{1}{2}W$</td> </tr> <tr> <td>$W > 0.4$</td> <td>$\Phi \leq 0.25$ and $\Phi \leq (1/3)W$</td> </tr> </tbody> </table> <p>Total acceptable quantity: 1 Defect per segment. Pin holes with Φ under 0.10 mm are acceptable.</p>	Acceptable quantity		Width	Φ	$W \leq 0.4$	$\Phi \leq 0.2$ and $\Phi \leq \frac{1}{2}W$	$W > 0.4$	$\Phi \leq 0.25$ and $\Phi \leq (1/3)W$																							
Acceptable quantity																																	
Width	Φ																																
$W \leq 0.4$	$\Phi \leq 0.2$ and $\Phi \leq \frac{1}{2}W$																																
$W > 0.4$	$\Phi \leq 0.25$ and $\Phi \leq (1/3)W$																																

No.	Item	Criteria																												
4	Segment Deformation	<p>1.b. Pin hole on dot matrix display:</p>  <table border="1" data-bbox="876 325 1307 493"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> </thead> <tbody> <tr> <td>Size</td> <td>-</td> </tr> <tr> <td>$a, b < 0.1$</td> <td>Any number</td> </tr> <tr> <td>$(a+b)/2 \leq 0.1$</td> <td>Any number</td> </tr> <tr> <td>$0.5 < \Phi < 1.0$</td> <td>3</td> </tr> </tbody> </table> <p>2. Segments / dots with different width:</p>  <table border="1" data-bbox="876 703 1307 808"> <thead> <tr> <th colspan="2">Acceptable limits</th> </tr> </thead> <tbody> <tr> <td>$a \geq b$</td> <td>$a/b \leq 4/3$</td> </tr> <tr> <td>$a < b$</td> <td>$a/b > 4/3$</td> </tr> </tbody> </table> <p>3. Alignment layer defect:</p> <p>$\Phi = (a+b)/2$</p>  <table border="1" data-bbox="876 955 1307 1155"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> </thead> <tbody> <tr> <td>Size</td> <td>-</td> </tr> <tr> <td>$\Phi \leq 0.4$</td> <td>Any number</td> </tr> <tr> <td>$0.4 < \Phi \leq 1.0$</td> <td>5</td> </tr> <tr> <td>$1.0 < \Phi \leq 1.5$</td> <td>3</td> </tr> <tr> <td>$1.5 < \Phi \leq 2.0$</td> <td>2</td> </tr> </tbody> </table>	Acceptable quantity		Size	-	$a, b < 0.1$	Any number	$(a+b)/2 \leq 0.1$	Any number	$0.5 < \Phi < 1.0$	3	Acceptable limits		$a \geq b$	$a/b \leq 4/3$	$a < b$	$a/b > 4/3$	Acceptable quantity		Size	-	$\Phi \leq 0.4$	Any number	$0.4 < \Phi \leq 1.0$	5	$1.0 < \Phi \leq 1.5$	3	$1.5 < \Phi \leq 2.0$	2
Acceptable quantity																														
Size	-																													
$a, b < 0.1$	Any number																													
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$0.5 < \Phi < 1.0$	3																													
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$0.4 < \Phi \leq 1.0$	5																													
$1.0 < \Phi \leq 1.5$	3																													
$1.5 < \Phi \leq 2.0$	2																													
5	Color Uniformity	Level of samples for approval is set as the limit.																												
6	Backlight	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.																												
7	COB	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.																												
8	 PCB	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.																												

13 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 electrochemical 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).

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