SPECIFICATION

耀宇科技
YAOYU TECHNOLOGY

YMFG-G160160C-1DPS(RWY)SN

April 30, 2009
Version 1.0

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RECORDS OF REVISION

DATE	REVISED NO.	REVISED DESCRIPTIONS	PREPARED	CHECKED	APPROVED
April 30,2009	1.00	FIRST ISSUE	Ynn		

CONTENTS

1. GENERAL SPECIFICATIONS：

1-1 SCOPE:

This specification covers the delivery requirements for the liquid crystal display delivered by YAOYU TECHNOLOGY to Customer。

1-2 PRODUCTS:

Liquid Crystal Display Module (LCM)

1-3 MODULE NAME:

YMFG-G160160C-1DPS(RWY)SN

2. FEATURES

Item	Standard Value
Display Type	160*160 DOTS
LCD Type	☐FSTN, Transmissive,Negative,Extened TEMP ■FSTN, Transflective,Positive,Extened TEMP ☐STN, BLUE,Transmissive,Negative,Extened TEMP ☐STN, GREY,Transflective,Positive,Extened TEMP ☐STN, Yellow-GREEN,Positive,Extended TEMP
Drive Pattern	1/160Duty, 1/13Bias
Viewing Direction	6 O'clock
Backlight Type	☐YELLOW-GREEN LED BOTTOM BL ■RED WHITE YELLOW EDGE LED BL ☐CCFL WHITE BL
Weight	TBD
Interface	8-bit 6800/8080 MPU interface and Serial interface
Driver IC	ST7529

3. MACHANICAL SPECIFICATIONS

ITEM	STANDARD VALUE	UNIT
DISPLAY FORMAT	160*160 dots	
MODULE DIMENSION	54.0(W) X 60.0(H) X 6.2(T)	mm
EFFECTTVE DISPLAY AREA	43.98(W) X42.38(H)	mm
DOT SIZE	0.255(W) X 0.245(H)	mm
DOT PITCH	0.275(W) X 0.265(H)	mm

4. ABSOLUTE MAXIMUM RATING

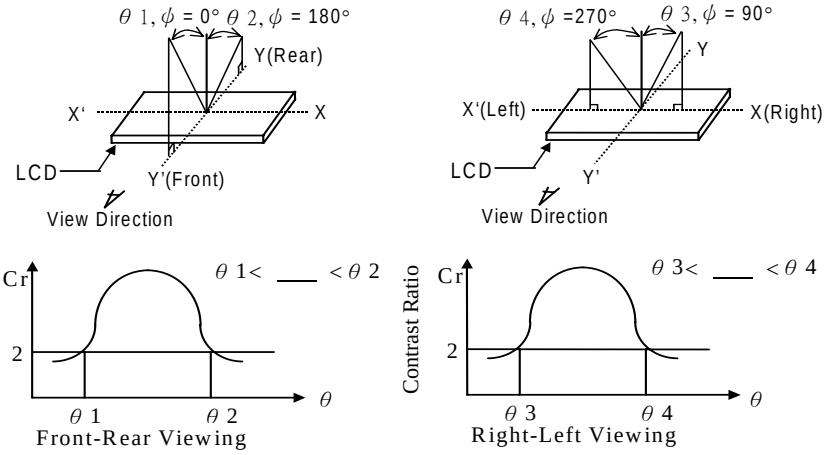
ITEM	SYMBOL	CONDITION	STANDARD VALUE			UNIT
			MIN	TYP	MAX	
POWER SUPPLY FOR LOGIC	VDD	Ta=25℃	-0.3	—	7.0	V
INPUT VOLTAGE	VIN	Ta=25℃	-0.3	—	VDD+0.3	V
Module OPERATION TEMPERATURE	TOPR	---	-20	—	+70	℃
Module STORAGE TEMPERATURE	TSTG	---	- 30	—	+80	℃
Storage Humidity	H_D	Ta < 40 °C	-		90	%RH

5. ELECTRICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Supply Voltage (logic)	Vdd-Vss	-	2.4	3.0	3.3	V
Supply Voltage (LCD)	Vlcd	Vdd=3.0V (25°C)	-	17.5	-	V
Input signal voltage	V-ih	“H” level	0.7VDD	-	VDD	V
	V-il	“L” level	VSS	-	0.3VDD	V
Output signal voltage	V-oh	“H” level	Vdd-0.6	-	-	V
	V-ol	“H” level	0	-	GND+0.6	V
Supply Current (logic)	Icc	VDD=3.0V	-	460	600	uA
Supply Voltage (LED)	V-bl	Red LED White LED Yellow LED	-	2.0 3.1 2.0	-	V
Supply Current (LED)	I-bl	Red LED White LED Yellow LED	-	60 60 60	-	mA

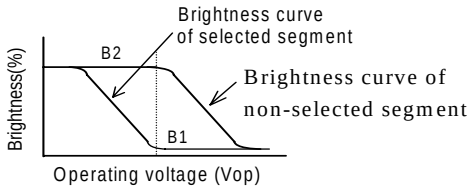
6. OPTICAL CHARACTERISTICS

(1) DEFINITION OF VIEWING ANGLE

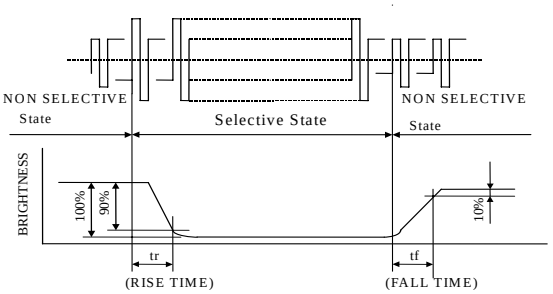


(2) DEFINITION OF CONTRAST

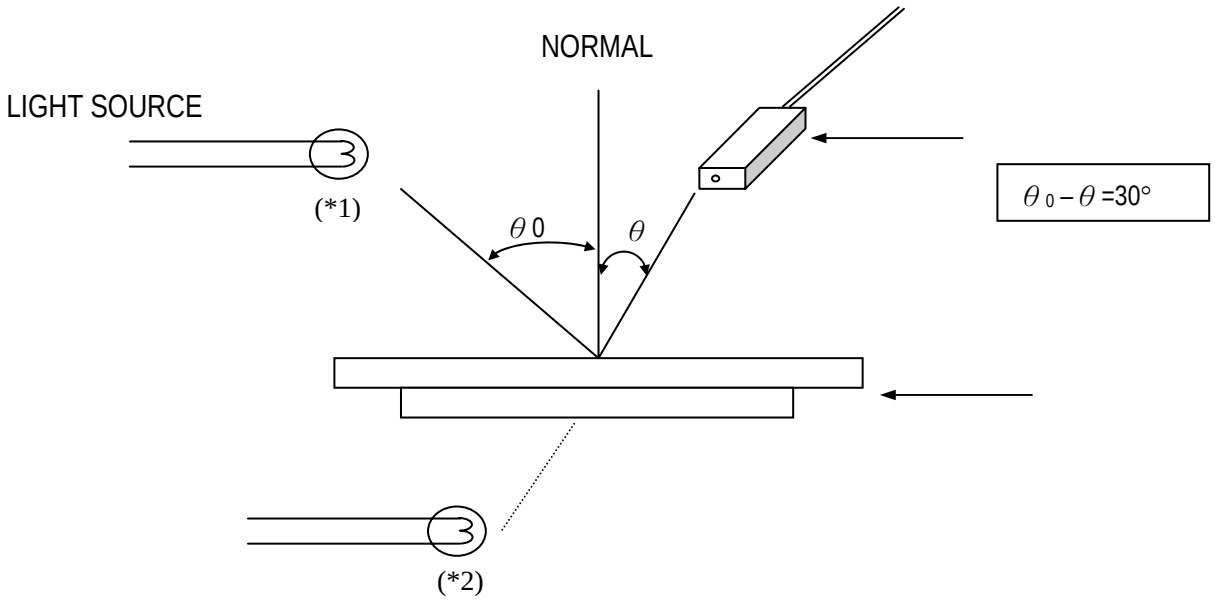
$$C.R = \frac{\text{Brightness of non-selected segment (B2)}}{\text{Brightness of selected segment (B1)}}$$



(3) DEFINITION OF RESPONSE



(4) Measuring Instruments For Electro-optical Characteristics



7.0 TIMING CHARACTERISTICS

7.1 DC CHARACTERISTICS

T_a = -30℃ to +85℃

Item		Symbol	Condition	Rating			Units	Applicable Pin
				Min.	Typ.	Max.		
Operating Voltage (1)		VDD VDD1	-	2.4	-	3.3	V	VDD*1 VDD1
Operating Voltage (2)		VDD2 VDD3 VDD4 VDD5	(Relative to VSS)	2.4	-	3.3	V	VDD2 VDD3 VDD4 VDD5
High-level Input Voltage		VIH	-	0.7 VDD	-	VDD	V	*2
Low-level Input Voltage		VIL	-	VSS	-	0.3 VDD	V	*2
High-level Output Current		IOH	VDD=2.7V VOH =2.2V	0.5	-	-	mA	*3
Low-level Output Current		IOL	VDD=2.7V VOL = 0.5V	-	-	-0.5	mA	*3
Input leakage current		ILI	VIN = VDD or VSS	-1.0	-	1.0	μA	*4
Liquid Crystal Driver ON Resistance		RON	Ta = 25℃ (Relative To VSS) V0 = 14.0V VDD = 2.7V	-	1.4	2.0	KΩ	SEGn COMn *5
Oscillator Frequency	Internal Oscillator	fOSC	1/160 duty Ta = 25℃ VDD = 2.7V CLD = 0	-	12.4	26	kHz	CL*6
	External Input	fCL		-	12.4	26	kHz	CL
	Frame frequency	fFRAME		-	78	160	Hz	SEGn

Item		Symbol	Condition	Rating			Units	Applicable Pin
				Min.	Typ.	Max.		
Internal Power	Input voltage	VDD	(Relative To VSS)	2.4	-	3.3	V	VDD
	Supply Step-up output voltage Circuit	VLCDOUT	(Relative To VSS)	-	-	18	V	VLCDOUT
	Voltage regulator Circuit Operating Voltage	VLCDIN	(Relative To VSS)	-	-	18	V	VLCDIN

*** Recommended LCD V_{OP} voltage is 12V~14V .**

Dynamic Consumption Current : During Display, with the Internal Power Supply ON.

Test pattern	Symbol	Condition	Rating			Units	Notes
			Min.	Typ.	Max.		
Display Pattern (checkerboard)	ISS	VDD = 2.8 V, V0 – VSS = 16.0 V Booster = 6x Bias = 1/12 Duty = 1/160 Bare chip Cap = 1.0uF	-	460	600	μA	*7
Power Down	ISS	Ta = 25℃	-	-	10	μA	-

Notes to the DC characteristics

1. The maximum possible V_{LCD} voltage that may be generated is dependent on voltage, temperature and (display) load, and internal clock
2. Power-down mode. During power down all static currents are switched off.
3. If external V_{LCD}, the display load current is not transmitted to I_{DD}.
4. V_{LCD} external voltage applied to VLCDIN pin; VLCDIN disconnected from VLCDOUT

References for items marked with *

*1. While a broad range of operating voltages is guaranteed, performance cannot be guaranteed if there are sudden fluctuations to the voltage while the MPU is being accessed.

*2. The A0, D0 to D5, D6 (SI), D7 (SCL),D8 to D15 /RD(E), /WR(R/W), XCS,CL , RST .

*3. The D0 to D7, D8 to D15 and CL.

*4. The A0,/RD (E), /WR(R/W), XCS, CLS, CL, RST , IF1 to IF3, M0, M1.

*5. These are the resistance values for when a 0.1 V voltage is applied between the output terminal SEGn or COMn and the various power supply terminals (V1, V2, V3, and V4). These are specified for the operating voltage range. RON = 0.1 V /ΔI (Where ΔI is the current that flows when 0.1 V is applied while the power supply is ON.)

*6. The relationship between the oscillator frequency and the frame rate frequency.

*7. It indicates the current consumed on ICs alone when the internal oscillator circuit and display are turned on.

ST7529 I/O PIN ITO Resister Limitation

PIN Name	ITO Resister
IF1~IF3, M0, M1, CLS	No Limitation
VREF, T0~T10, TCAP, CL	Floating
VDD,VDD1~5,VSS,VSS1,VSS2,VSS4, V_{LCDIN}, V_{LCDOUT}, CxP, CxN	<100Ω
V0IN, V0OUT, V1, V2, V3, V4	<500Ω
A0, RW_WR, E_RD, XCS, D0 …D15, SCL, SI	<1kΩ
RST	<10kΩ

7.2 AC CHARACTERISTICS

System BUS Read/Write Characteristics 1(For the 8080 Series MPU)

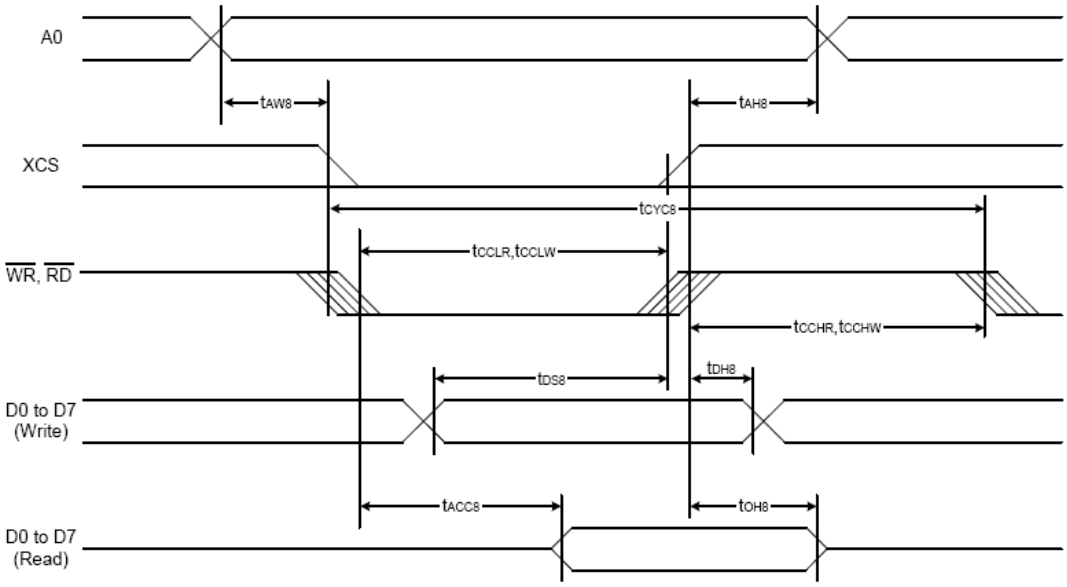


Figure 1

(VDD = 3.3V , Ta = –30 to 85℃, Die)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH8	-	20	-	ns
Address setup time		tAW8	-	20	-	
System cycle time		tCYC8	-	200	-	
Enable L pulse width (WRITE)	WR	tCCLW	-	100	-	
Enable H pulse width (WRITE)		tCCHW	-	100	-	
Enable L pulse width (READ)	RD	tCCLR	-	100	-	
Enable H pulse width (READ)		tCCHR	-	100	-	
WRITE Data setup time	D0 to D7	tDS8	-	150	-	
WRITE Address hold time		tDH8	-	20	-	
READ access time		tACC8	CL = 100 pF	-	40	
READ Output disable time		tOH8	CL = 100 pF	-	30	

(VDD = 2.7 V , Ta = –30 to 85℃ ,Die)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH8	-	20	-	ns
Address setup time		tAW8	-	30	-	
System cycle time		tCYC8	-	250	-	
Enable L pulse width (WRITE)	WR	tCCLW	-	150	-	
Enable H pulse width (WRITE)		tCCHW	-	100	-	
Enable L pulse width (READ)	RD	tCCLR	-	150	-	
Enable H pulse width (READ)		tCCHR	-	100	-	
WRITE Data setup time	D0 to D7	tDS8	-	200	-	
WRITE Address hold time		tDH8	-	20	-	
READ access time		tACC8	CL = 100 pF	-	40	
READ Output disable time		tOH8	CL = 100 pF	-	30	

*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 VDD as the reference.

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

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

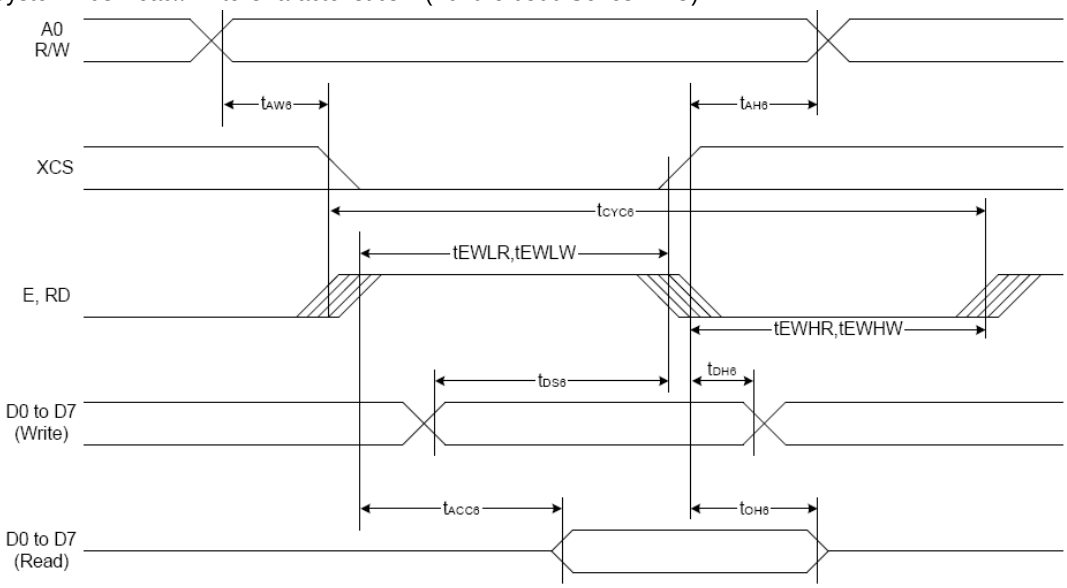


Figure 2

(VDD = 3.3 V , Ta = –30 to 85℃,Die)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH6	-	20	-	ns
Address setup time		tAW6	-	20	-	
System cycle time	E	tCYC6	-	200	-	
Enable L pulse width (WRITE)		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 Address hold time		tDH6	-	20	-	
READ access time		tACC6	CL = 100 pF	-	40	
READ Output disable time		tOH6	CL = 100 pF	-	30	

(VDD = 2.7V , Ta =–30 to 85℃, Die)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH6	-	20	-	ns
Address setup time		tAW6	-	30	-	
System cycle time	E	tCYC6	-	250	-	
Enable L pulse width (WRITE)		tEWLW	-	150	-	
Enable H pulse width (WRITE)		tEWHW	-	100	-	
Enable L pulse width (READ)	RD	tEWLR	-	150	-	
Enable H pulse width (READ)		tEWHR	-	100	-	
WRITE Data setup time	D0 to D7	tDS6	-	200	-	
WRITE Address hold time		tDH6	-	20	-	
READ access time		tACC6	CL = 100 pF	-	40	
READ Output disable time		tOH6	CL = 100 pF	-	30	

*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 VDD as the reference.

*3 tEWLW and tEWLR are specified as the overlap between XCS being “L” and E.

SERIAL INTERFACE (4-LINE Interface)

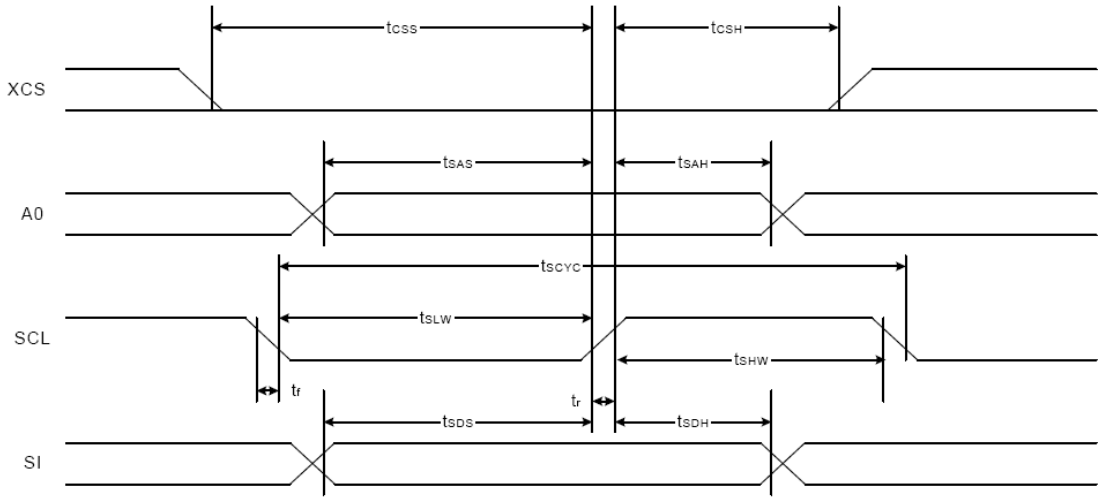


Figure 3

(V_{DD}=3.3V,Ta= –30 to 85℃,Die)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	tSCYC	-	100	-	ns
SCL “H” pulse width		tSHW	-	50	-	
SCL “L” pulse width		tSLW	-	50	-	
Address setup time	A0	tSAS	-	40	-	
Address hold time		tSAH	-	30	-	
Data setup time	SI	tSDS	-	30	-	
Data hold time		tSDH	-	30	-	
CS-SCL time	XCS	tCSS	-	20	-	
CS-SCL time		tCSH	-	50	-	

(V_{DD}=2.7V,Ta= –30 to 85℃,Die)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	tSCYC	-	110	-	ns
SCL “H” pulse width		tSHW	-	60	-	
SCL “L” pulse width		tSLW	-	50	-	
Address setup time	A0	tSAS	-	50	-	
Address hold time		tSAH	-	40	-	
Data setup time	SI	tSDS	-	40	-	
Data hold time		tSDH	-	40	-	
CS-SCL time	XCS	tCSS	-	30	-	
CS-SCL time		tCSH	-	60	-	

*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 VDD as the standard.

SERIAL INTERFACE (3-Line Interface)

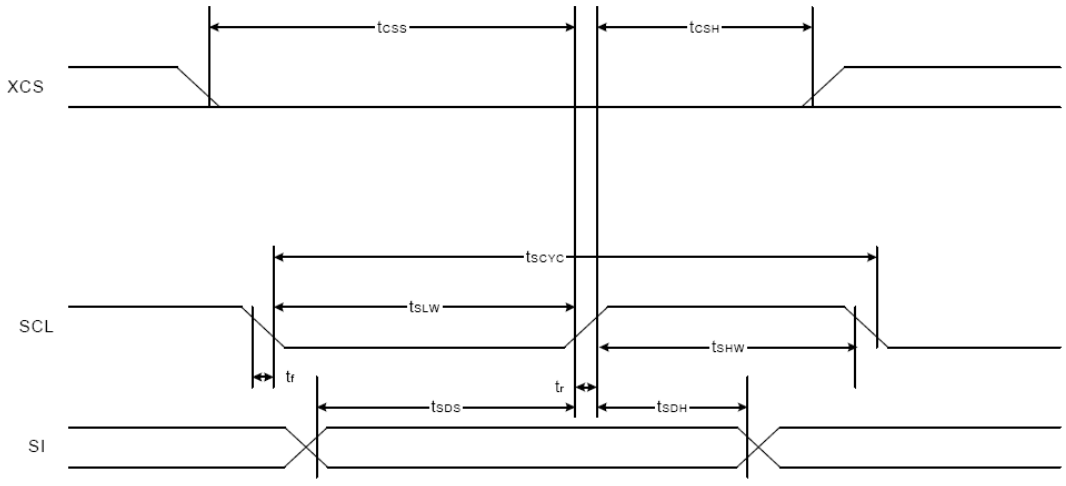


Figure 4

(V_{DD}=3.3V,Ta= –30 to 85℃,Die)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	tSCYC	-	100	-	ns
SCL “H” pulse width		tSHW	-	50	-	
SCL “L” pulse width		tSLW	-	50	-	
Data setup time	SI	tSDS	-	30	-	
Data hold time		tSDH	-	30	-	
CS-SCL time	XCS	tCSS	-	20	-	
CS-SCL time		tCSH	-	50	-	

(V_{DD}=2.7V,Ta= –30 to 85℃,Die)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	tSCYC	-	110	-	ns
SCL “H” pulse width		tSHW	-	60	-	
SCL “L” pulse width		tSLW	-	50	-	
Data setup time	SI	tSDS	-	40	-	
Data hold time		tSDH	-	40	-	
CS-SCL time	XCS	tCSS	-	30	-	
CS-SCL time		tCSH	-	60	-	

*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 VDD as the standard.

RESET TIMING

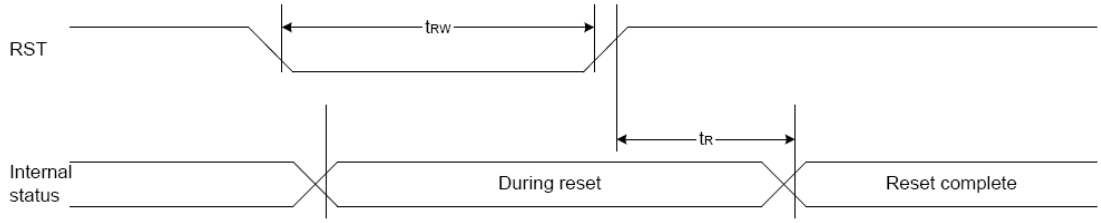


Figure 5

(VDD =3.3V , Ta = –30 to 85℃,Die)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		tR	-	-	-	1	us
Reset “L” pulse width	RST	tRW	-	1	-	-	us

(VDD = 2.7V , Ta = –30 to 85℃,Die)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		tR	-	-	-	1.5	us
Reset “L” pulse width	RST	tRW	-	1.5	-	-	us

8.0 COMMANDS

8.1 Command table

Ext=0 or Ext=1

Index	Command	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function	Hex	Parameter
1	Ext In	0	1	0	0	0	1	1	0	0	0	0	Ext=0 Set	30	None
2	Ext Out	0	1	0	0	0	1	1	0	0	0	1	Ext=1 Set	31	None

Ext=0

Index	Command	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function	Hex	Parameter
1	DISON	0	1	0	1	0	1	0	1	1	1	1	Display On	AF	None
2	DISOFF	0	1	0	1	0	1	0	1	1	1	0	Display Off	AE	None
3	DISNOR	0	1	0	1	0	1	0	0	1	1	0	Normal Display	A6	None
4	DISINV	0	1	0	1	0	1	0	0	1	1	1	Inverse Display	A7	None
5	COMSCN	0	1	0	1	0	1	1	1	0	1	1	COM Scan Direction	BB	1 byte
6	DISCTRL	0	1	0	1	1	0	0	1	0	1	0	Display Control	CA	3 bytes
7	SLPIN	0	1	0	1	0	0	1	0	1	0	1	Sleep In	95	None
8	SLPOUT	0	1	0	1	0	0	1	0	1	0	0	Sleep Out	94	None
9	LASET	0	1	0	0	1	1	1	0	1	0	1	Line Address Set	75	2 bytes
10	CASET	0	1	0	0	0	0	1	0	1	0	1	Column Address Set	15	2 bytes
11	DATSDR	0	1	0	1	0	1	1	1	1	0	0	Data Scan Direction	BC	3 bytes
12	RAMWR	0	1	0	0	1	0	1	1	1	0	0	Writing to Memory	5C	Data
13	RAMRD	0	1	0	0	1	0	1	1	1	0	1	Reading from Memory	5D	Data
14	PTLIN	0	1	0	1	0	1	0	1	0	0	0	Partial display in	A8	2 bytes
15	PTLOUT	0	1	0	1	0	1	0	1	0	0	1	Partial display out	A9	None
16	RMWIN	0	1	0	1	1	1	0	0	0	0	0	Read and Modify Write	E0	None
17	RMWOUT	0	1	0	1	1	1	0	1	1	1	0	RMW end	EE	None
18	ASCSET	0	1	0	1	0	1	0	1	0	1	0	Area Scroll Set	AA	4 bytes
19	SCSTART	0	1	0	1	0	1	0	1	0	1	1	Scroll Start Set	AB	1 byte
20	OSCON	0	1	0	1	1	0	1	0	0	0	1	Internal OSC on	D1	None
21	OSCOFF	0	1	0	1	1	0	1	0	0	1	0	Internal OSC off	D2	None
22	PWRCTRL	0	1	0	0	0	1	0	0	0	0	0	Power Control	20	1 byte
23	VOLCTRL	0	1	0	1	0	0	0	0	0	0	1	EC control	81	2 bytes
24	VOLUP	0	1	0	1	1	0	1	0	1	1	0	EC increase 1	D6	None
25	VOLDOWN	0	1	0	1	1	0	1	0	1	1	1	EC decrease 1	D7	None
26	RESERVED	0	1	0	1	0	0	0	0	0	1	0	Not Use	82	0

27	EPSRRD1	0	1	0	0	1	1	1	1	1	0	0	READ Register1	7C	None
28	EPSRRD2	0	1	0	0	1	1	1	1	1	0	1	READ Register2	7D	None
29	NOP	0	1	0	0	0	1	0	0	1	0	1	NOP Instruction	25	None
30	STREAD	0	0	1	Read Data								Status Read		
31	EPINT	0	1	0	0	0	0	0	0	1	1	1	Initial code(1)	07	1 byte

Ext=1

Index	*Command*	*A0*	*RD*	*WR*	*D7*	*D6*	*D5*	*D4*	*D3*	*D2*	*D1*	*D0*	*Function*	*Hex*	*Parameter*
1	Gray 1 Set	0	1	0	0	0	1	0	0	0	0	0	FRAME 1 Gray PWM Set	20	16 bytes
2	Gray 2 Set	0	1	0	0	0	1	0	0	0	0	1	FRAME 2 Gray PWM Set	21	16 bytes
3	ANASET	0	1	0	0	0	1	1	0	0	1	0	Analog Circuit Set	32	3 bytes
4	SWINT	0	1	0	0	0	1	1	0	1	0	0	Software Initial	34	None
5	EPCTIN	0	1	0	1	1	0	0	1	1	0	1	Control EEPROM	CD	1 byte
6	EPCOUT	0	1	0	1	1	0	0	1	1	0	0	Cancel EEPROM	CC	None
7	EPMWR	0	1	0	1	1	1	1	1	1	0	0	Write to EEPROM	FC	None
8	EPMRD	0	1	0	1	1	1	1	1	1	0	1	Read from EEPROM	FD	None

Note: The table above is for 8-bit interface. For the application of 16-bit interface, fill D15~8 with 0, and other bits are just the same with the table above.

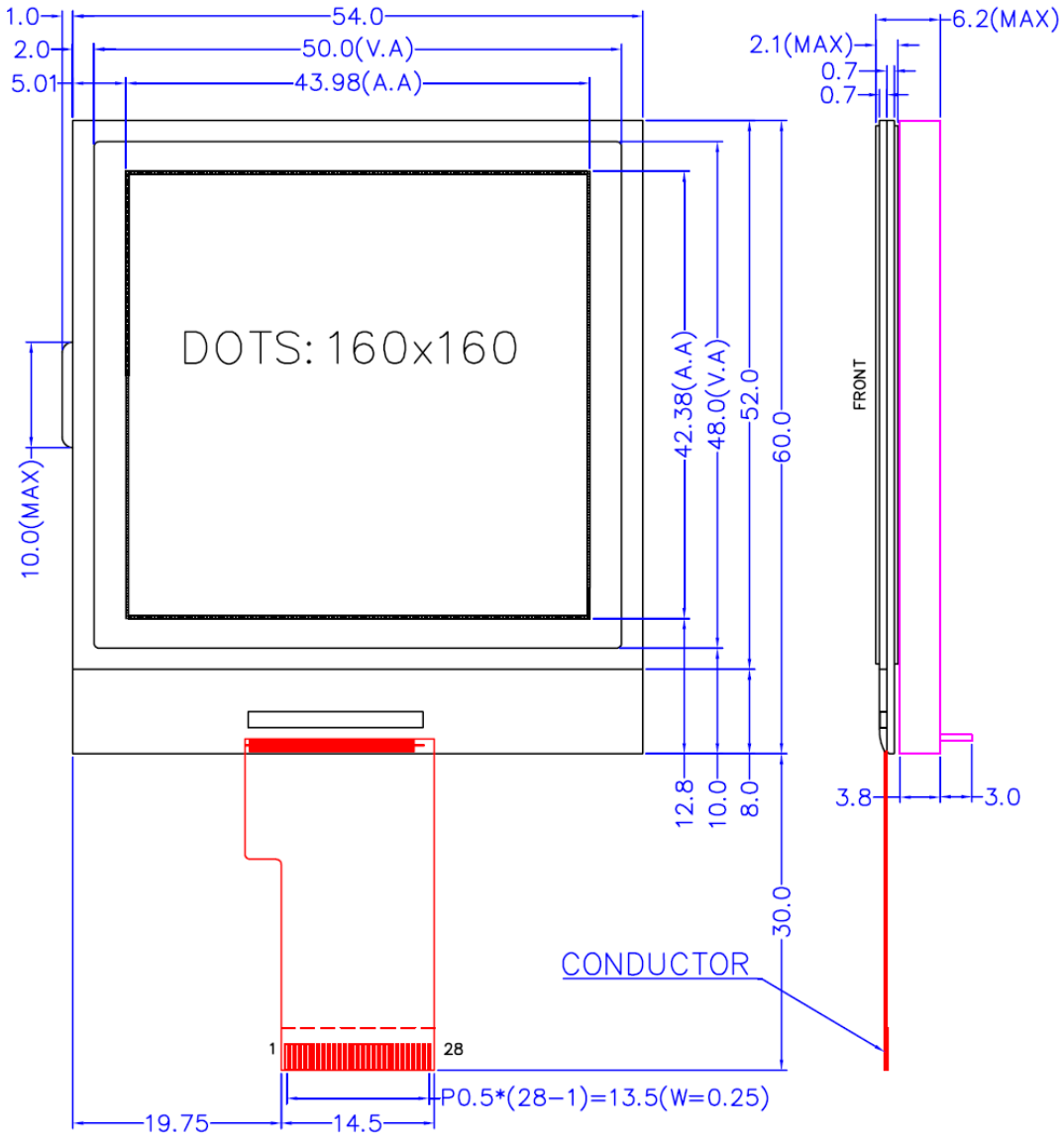
9. PIN ASSIGNMENT

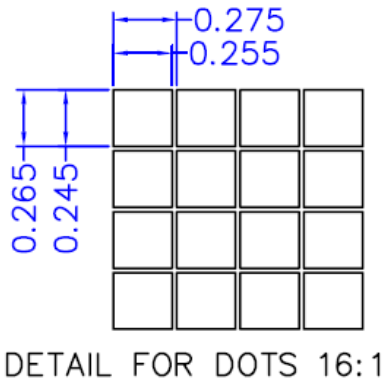
NO.	Symbol	I/O	Function
1	VSS	0V	Ground for Logic
2	VDD	+3.0V	Power supply for Logic
3.	XCS	I	Chip select input pin.
4.	SCL	I	This pin is used to input serial clock when the serial interface is selected.
5.	SI	-	This pin is used to input serial data when the serial interface is selected.
6.	IF3	I	Parallel/Serial data input select input
7.	IF2		
8.	IF1		
9.	RST	I	Reset input pin.
10.	E_RD	I	Read/Write execution control

IF1	IF2	IF3	MPU interface type
H	H	H	80 series 16-bit parallel
H	H	L	80 series 8-bit parallel
H	L	L	68 series 16-bit parallel
L	H	H	68 series 8-bit parallel
L	L	H	9-bit serial (3 line)
L	L	L	8-bit serial (4 line)

<table>
<tr><td></td><td></td><td></td><td>pin
<table>
<tr><th>MPU Type</th><th>E_RD</th><th>Description</th></tr>
<tr><td>6800-series</td><td>E</td><td>Read / Write control input pin
– RW = “H”: When E is “H”, DB0 to DB15 are in an output status.
– RW = “L”: The data on DB0 to DB15 are latched at the falling edge of the E signal.</td></tr>
<tr><td>8080-series</td><td>/RD</td><td>Read enable clock input pin
When /RD is “L”, DB0 to DB15 are in an output status.</td></tr>
</table></td></tr>
<tr><td>11.</td><td>V0</td><td rowspan="5">Supply</td><td rowspan="5">LCD driver supply voltage
Voltages should have the following relationship:
V0 ≥ V1 ≥ V2 ≥ V3 ≥ V4 ≥ VSS
When the internal power circuit is active, these voltages are generated as the following table according to the state of LCD bias.
<table>
<tr><th>LCD bias</th><th>V1</th><th>V2</th><th>V3</th><th>V4</th></tr>
<tr><td>1/N bias</td><td>(N-1) / N x V0</td><td>(N-2) / N x V0</td><td>(2/N) x V0</td><td>(1/N) x V0</td></tr>
</table>
NOTE: N = 5 to 14</td></tr>
<tr><td>12.</td><td>V1</td></tr>
<tr><td>13.</td><td>V2</td></tr>
<tr><td>14.</td><td>V3</td></tr>
<tr><td>15.</td><td>V4</td></tr>
<tr><td>16.</td><td>VLCDOUT</td><td rowspan="2">Supply</td><td>LCD driver supply voltage
VLCDOUT & VLCDIN should be connected together in FPC area.</td></tr>
<tr><td>17.</td><td>VLCDIN</td><td></td></tr>
<tr><td>18.</td><td>AVDD</td><td>3.0V</td><td>Power supply for logic.</td></tr>
<tr><td>19.</td><td>DB7</td><td rowspan="8">I/O</td><td rowspan="8"></td></tr>
<tr><td>20.</td><td>DB6</td></tr>
<tr><td>21.</td><td>DB5</td></tr>
<tr><td>22.</td><td>DB4</td></tr>
<tr><td>23.</td><td>DB3</td></tr>
<tr><td>24.</td><td>DB2</td></tr>
<tr><td>25.</td><td>DB1</td></tr>
<tr><td>26.</td><td>DB0</td><td>Data bus</td></tr>
<tr><td>27.</td><td>RW_WR</td><td>I</td><td>Read/Write execution control pin
<table>
<tr><th>MPU type</th><th>RW_WR</th><th>Description</th></tr>
<tr><td>6800-series</td><td>RW</td><td>Read / Write control input pin
RW = “H” : read
RW = “L” : write</td></tr>
<tr><td>8080-series</td><td>/WR</td><td>Write enable clock input pin
The data on DB0 to DB15 are latched at the rising edge of the /WR signal.</td></tr>
</table></td></tr>
<tr><td>28.</td><td>A0</td><td>I</td><td>Register select input pin.</td></tr>
</table>

10. OUTLINE DIMENSIONS





DETAIL FOR DOTS 16:1

11. RELIABILITY

Content of Reliability Test

Environmental Test				
No.	**Test Item**	**Content of Test**	**Test Condition**	**Applicable Standard**
1	High temperature storage	Endurance test applying the high storage temperature for a long time.	70 ℃ 200 hrs	
2	Low temperature storage	Endurance test applying the low storage temperature for a long time.	-20 ℃ 200 hrs	
3	High temperature operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	60 ℃ 200 hrs	
4	Low temperature operation	Endurance test applying the electric stress under low temperature for a long time.	-10 ℃ 200 hrs	
5	High temperature Humidity storage	Endurance test applying the high temperature and high humidity storage for a long time.	50 ℃ , 90% RH 96 hrs	MIL-202E-103B JIS-C5023
6	High temperature Humidity operation	Endurance test applying the electric stress (Voltage & Current) and temperature˜ humidity stress to the element for a long time.	50 ℃ , 90% RH 96 hrs	MIL-202E-103B JIS-C5023
7	Temperature cycle	Endurance test applying the low and high temperature cycle. -10℃ 25℃ 60℃ 30min. ⇌ 5min. ⇌ 30min. 1 cycle	-10℃ – 60℃ 10 cycles	
Mechanical Test				
8	Vibration test	Endurance test applying the vibration during transportation and using.	10-22Hz→ 1.5mmp-p 22-500Hz →1.5G Total 0.5hrs	MIL-202E-201A JIS-C5025 JIS-C7022-A-10

9	Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G half sign wave 1l msedc 3 times of each direction	MIL-202E-213B
10	Atmospheric pressure test	Endurance test applying the atmospheric pressure during transportation by air.	115 mbar 40 hrs	MIL-202E-105C
Others				
11	Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V, RS=1.5 k CS=100 pF 1 time	MIL-883B-3015.1

Supply voltage for logic system = 3V. Supply voltage for LCD system = Operating voltage at 25℃.

12. QUALITY GUARANTEE

Acceptable Quality Level

Each lot should satisfy the quality level defined as follows.

- Inspection method : MIL-STD-105E LEVEL II Normal one time sampling
- AQL

Partition	AQL	Definition
A: Major	0.4%	Functional defective as product
B: Minor	1.5%	Satisfy all functions as product but not satisfy cosmetic standard

Definition of 'LOT'

One lot means the delivery quantity to customer at one time.

Conditions of Cosmetic Inspection

Environmental condition

The inspection should be performed at the 1cm of height from the LCD module under 2 pieces of 40W white fluorescent lamps (Normal temperature 20~25℃and normal humidity 60 ± 15%RH).

Inspection method

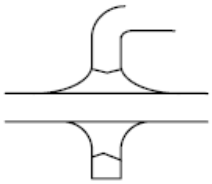
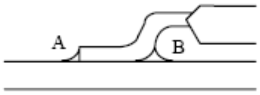
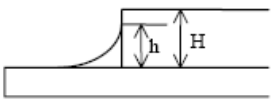
The visual check should be performed vertically at more than 30cm distance from the LCD panel.

Driving voltage

The VO value which the most optimal contrast can be obtained near the specified VO in the specification. (Within ± 0.5V of typical value at 25℃.).

13. INSPECTION CRITERIA

13.1 Module Cosmetic Criteria

No.	Item	Judgment Criterion	Partition
1	Difference in Spec.	None allowed	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing No soldering bridge No cold soldering	Major Major Major
4	Resist flaw on substrate	Invisible copper foil (′0.5mm or more) on substrate pattern	Minor
5	Accretion of metallic Foreign matter	No soldering dust No accretion of metallic foreign matters (Not exceed ′0.2mm)	Minor Minor
6	Stain	No stain to spoil cosmetic badly	Minor
7	Plate discoloring	No plate fading, rusting and discoloring	Minor
8	Solder amount 1. Lead parts	a. Soldering side of PCB Solder to form a ‘Filet’ all around the lead. Solder should not hide the lead form perfectly. (too much) b. Components side (In case of ‘Through Hole PCB’) Solder to reach the Components side of PCB. 	Minor
	2. Flat packages	Either ‘Toe’ (A) or ‘Seal’ (B) of the lead to be covered by ‘Filet’. Lead form to be assume over solder. A B 	Minor
	3. Chips	(3/2) H ≥h ≥(1/2) H 	Minor

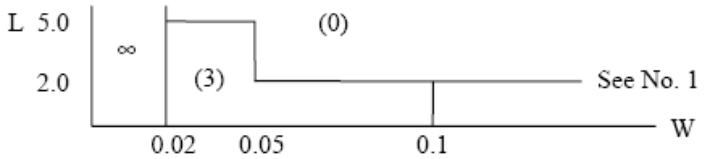
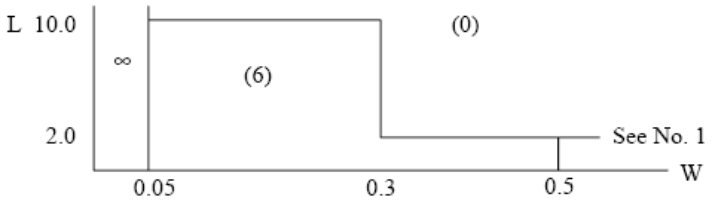
13.2 Screen Cosmetic Criteria (Non-Operating)

No.	Defect	Judgment Criterion	Partition
1	Spots	In accordance with *Screen Cosmetic Criteria (Operating) No.1*.	Minor
2	Lines	In accordance with *Screen Cosmetic Criteria (Operating) No.2*.	Minor

<table>
<tr><td>3</td><td>Bubbles in polarizer</td><td><table><tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr><tr><td>d ≤ 0.3</td><td>Disregard</td></tr><tr><td>0.3 < d ≤ 1.0</td><td>3</td></tr><tr><td>1.0 < d ≤ 1.5</td><td>1</td></tr><tr><td>1.5 < d</td><td>0</td></tr></table></td><td>Minor</td></tr>
<tr><td>4</td><td>Scratch</td><td>In accordance with spots and lines operating cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.</td><td>Minor</td></tr>
<tr><td>5</td><td>Allowable density</td><td>Above defects should be separated more than 30mm each other.</td><td>Minor</td></tr>
<tr><td>6</td><td>Coloration</td><td>Not to be noticeable coloration in the viewing area of the LCD panels. Back-lit type should be judged with back-lit on state only.</td><td>Minor</td></tr>
<tr><td>7</td><td>Contamination</td><td>Not to be noticeable.</td><td>Minor</td></tr>
</table>

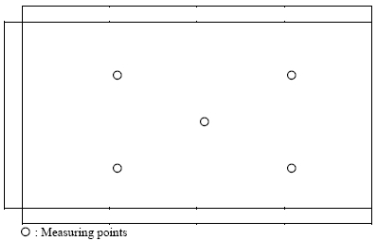
13.3. Screen Cosmetic Criteria (Operating)

<table>
<tr><th>No.</th><th>Defect</th><th>Judgment Criterion</th><th>Partition</th></tr>
<tr><td>1</td><td>Spots</td><td>A) Clear Note :<table><tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr><tr><td>d ≤ 0.1</td><td>Disregard</td></tr><tr><td>0.1 < d ≤ 0.2</td><td>3</td></tr><tr><td>0.2 < d ≤ 0.3</td><td>2</td></tr><tr><td>0.3 < d</td><td>0</td></tr></table>Including pin holes and defective dots which must be within one pixel size.
B) Unclear Size :<table><tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr><tr><td>d ≤ 0.2</td><td>Disregard</td></tr><tr><td>0.2 < d ≤ 0.5</td><td>6</td></tr><tr><td>0.5 < d ≤ 0.7</td><td>2</td></tr><tr><td>0.7 < d</td><td>0</td></tr></table></td><td>Minor</td></tr>
</table>

2	Lines	A)Clear  Note : ( ) - Acceptable Qty in active area L -Length (mm) W - Width (mm) ∞ - Disregard B) Unclear  	Minor

'Clear' = The shade and size are not changed by VO.
'Unclear' = The shade and size are changed by VO.

13.4. Screen Cosmetic Criteria (Operating) (Continued)

No.	Defect	Judgment Criterion	Partition
3	Rubbing line	Not to be noticeable.	
4	Allowable density	Above defects should be separated more than 10mm each other.	Minor
5	Rainbow	Not to be noticeable.	Minor
6	Dot size	To be 95% ~ 105% of the dot size (Typ.) in drawing. Partial defects of each dot (ex. pin-hole) should be treated as 'Spot'. (see *Screen Cosmetic Criteria (Operating) No.1*)	Minor
7	Uneven brightness (only back-lit type module)	Uneven brightness must be BMAX / BMIN ≤ 2 - BMAX : Max. value by measure in 5 points - BMIN : Min. value by measure in 5 points Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure.  	Minor

Note :

(1) Size : d = (long length + short length) / 2

(2) The limit samples for each item have priority.

(3) Complexed defects are defined item by item, but if the number of defects are defined in above table, the total number should not exceed 10.

(4) In case of 'concentration', even the spots or the lines of 'disregarded' size should be not allowed. Following three situations should be treated as 'concentration'.

- 7 or over defects in circle of ′5mm.
- 10 or over defects in circle of ′10mm.
- 20 or over defects in circle of ′20mm.

14. PRECAUTIONS FOR USING LCD MODULES

Handing Precautions

(1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.

(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.

(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents :

- Isopropyl alcohol
- Ethyl alcohol

(6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.

- Water
- Ketone
- Aromatic solvents

(7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

(8) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the˜IO cable or the backlight cable.

(9) Do not attempt to disassemble or process the LCD module.

(10) NC terminal should be open. Do not connect anything.

(11) If the logic circuit power is off, do not apply the input signals.

(12) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Be sure to ground the body when handling the LCD modules.
- Tools required for assembling, such as soldering irons, must be properly grounded.
- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

Storage Precautions

When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags (avoid high temperature~ high humidity and low temperatures below 0□C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

- Exposed area of the printed circuit board.
- Terminal electrode sections.

15. USING LCD MODULES

Liquid Crystal Display Modules

LCD is composed of glass and polarizer. Pay attention to the following items when handling.

(1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

(2) Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.).

(3) N-hexane is recommended for cleaning the adhesives used to attach front/rear polarizers and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropylalcohol.

(4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzin. Do not scrub hard to avoid damaging the display surface.

(5) Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.

(6) Avoid contacting oil and fats.

(7) Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temp erature air.

(8) Do not put or attach anything on the display area to avoid leaving marks on.

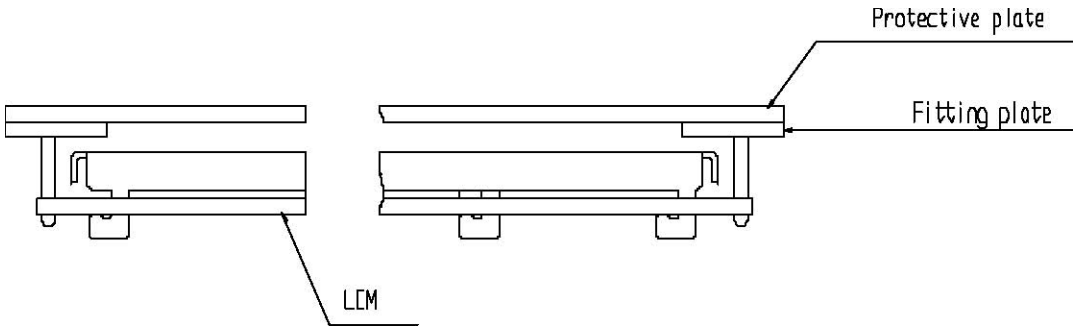
(9) Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinated to the polarizers).

(10) As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring.

Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

(1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



(2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be 0.1mm.

Precaution for Handing LCD Modules

Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

(1) Do not alter, modify or change the the shape of the tab on the metal frame.

(2) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.

(3) Do not damage or modify the pattern writing on the printed circuit board.

(4) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.

(5) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.

(6) Do not drop, bend or twist LCM.

Electro-Static Discharge Control

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

(1) Make certain that you are grounded when handing LCM.

(2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.

(3) When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.

(4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.

(5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.

(6) To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%60% is recommended.

Precaution for soldering to the LCM

(1) Observe the following when soldering lead wire, connector cable and etc. to the LCM.

- Soldering iron temperature : 280℃ 10℃.
- Soldering time : 3-4 sec.
- Solder : eutectic solder.

If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage dur to flux spatters.

(2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.

(3) When remove the electoluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

Precautions for Operation

(1) Viewing angle varies with the change of liquid crystal driving voltage (VO). Adjust VO to show the best contrast.

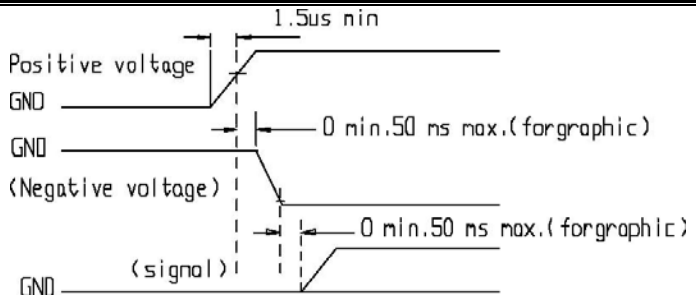
(2) Driving the LCD in the voltage above the limit shortens its life.

(3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.

(4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.

(5) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition of 40□C , 50% RH.

(6) When turning the power on, input each signal after the positive/negative voltage becomes stable.



Storage

When storing LCDs as spares for some years, the following precaution are necessary.

(1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for dessicant.

(2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0℃ and 35℃.

(3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped.)

Safety

(1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

(2) If any liquid leakes out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

Limited Warranty

Unless agreed between YAOYU and customer, YAOYU will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with YAOYU LCD acceptance standards (copies available upon request) for a period of one year from date of shipments. Cosmetic/visual defects must be returned to YAOYU within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of YAOYU limited to repair and/or replacement on the terms set forth above. YAOYU will not be responsible for any subsequent or consequential events.

Return LCM under warranty

No warranty can be granted if the precautions stated above have been disregarded.

The typical examples of violations are :

- Broken LCD glass.
- PCB eyelet's damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- soldering to or modifying the bezel in any manner.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet's, conductors and terminals.