APPROVAL

PART NO.	DESCRITION	REMARKS
HT2002L	**LCD MODULE** (176 × RGB × 220 Dots)	**This is ROHS compliant**

CUSTOMER APPLICATION P/N	
APPROVED BY	
DATE	

PLEASE KINDLY FIND AND APPROVE THE SPECIFICATIONS INSERTED
HEREIN AND RETURN ONE COPY HERE OF WITH YOUR SIGNATURE OF APPROVAL.

PERPARED BY	CHECKED BY	CONFIRMED BY

HYES **HYES Optoelectronics, Inc.**
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REVISION HISTORY

Date	Rev. No.	Page	Summary
Dec. 04, 2007	-	ALL	- 1'st Issue
Dec. 13, 2007	A	4	- Update the weight
		9	- Update the viewing and contrast
		13	- Update the initial code

C O N T E N T S

1. Basic Specfications

1.1 Display Specifications

Item	Description	Note
Resolution	176 × RGB × 220	
Display mode	TFT, Normally White, Transmissive	262K Color
Viewing direction	6 O'clock	
Driving method	528Ch-Source, 220Ch-Gate	
Backlighting	LED, White (3 chips in parallel)	
Diver IC	LGDP4524, COG	
Others	80-Series, 16/8-Bit Parallel Data	

1.2 Mechanical Specifications

Item	Specification	Unit
Module Size (W × H × T)	38.4 × 51.4 × 2.35	mm
Viewing Area (W × H)	-	mm
Active Area (W × H)	31.68 × 39.6	mm
Dot Size (W × H)	0.05 × 0.17	mm
Dot Pitch (W × H)	0.06 × 0.18	mm
Weight	About 6	g

1.3 Outline Dimension

NO.	NAME
1	GND
2	ID
3	RESET
4	DB0
5	DB1
6	DB2
7	DB3
8	DB4
9	DB5
10	DB6
11	DB7
12	DB8
13	DB9
14	DB10
15	DB11
16	DB12
17	DB13
18	DB14
19	DB15
20	RD
21	WR
22	RS
23	CS
24	VCC
25	GND
26	VCCIO
27	IM0
28	XN
29	YP
30	XP
31	YN
32	GND
33	LED1+
34	LED2+
35	LED3+
36	LED4(NC)
37	LED-
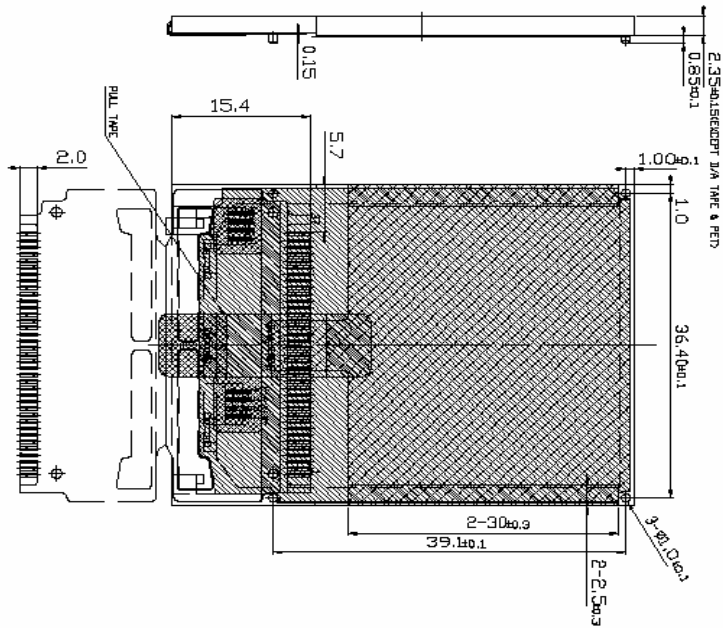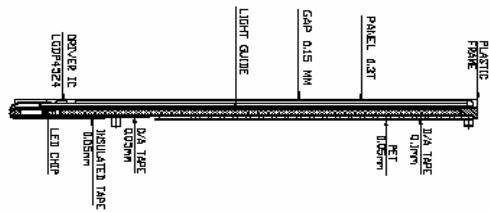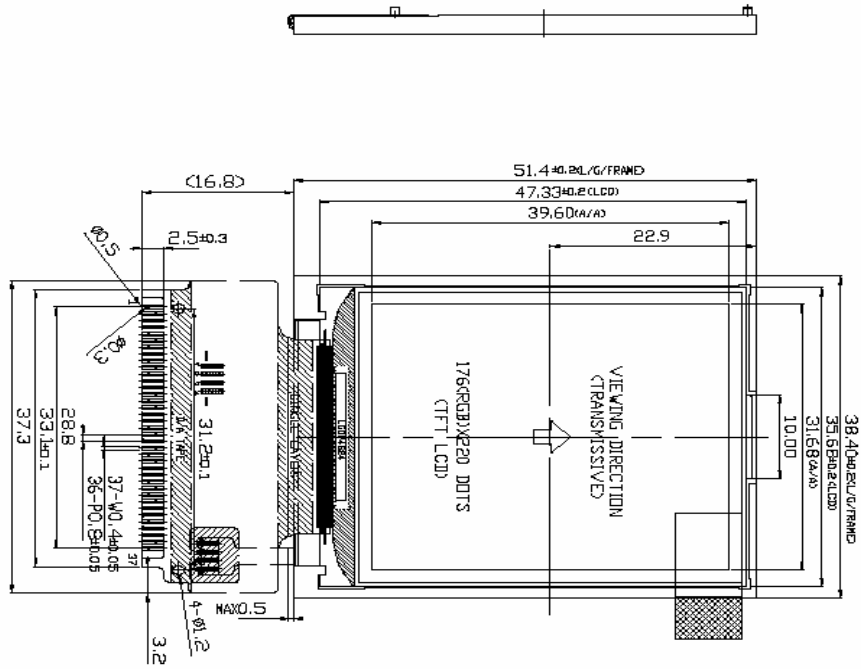
NOTE
1.GENERAL TOLERANCE ±0.2
2.BACKLIGHT LED USED 3 CHIP
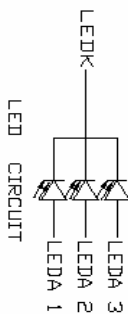
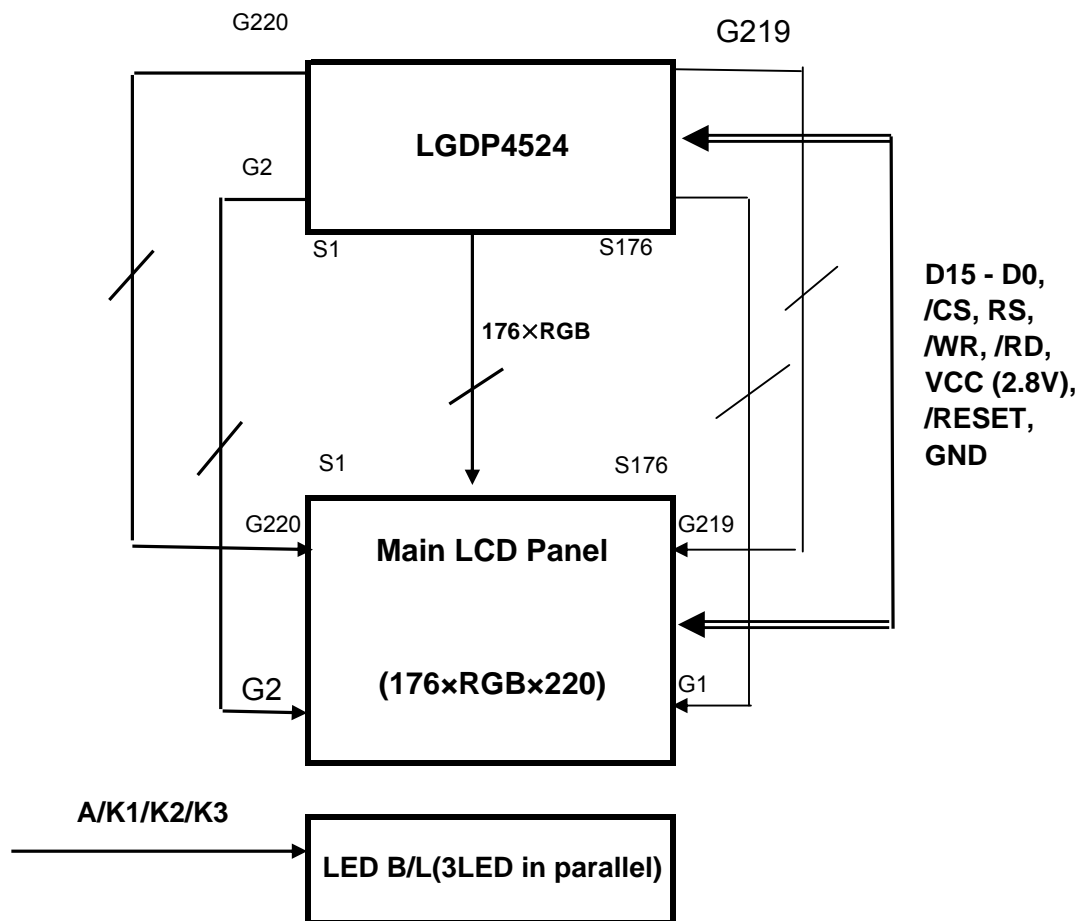| Date : Dec. 13, 2007	TECHNICAL SPECIFICATION	
HYES LCM	HT2002L	Page 5 of 23

1.4 Block Diagram

G220

G219

LGDP4524

G2

S1   S176

**D15 - D0,
/CS, RS,
/WR, /RD,
VCC (2.8V),
/RESET,
GND**

176×RGB

S1   S176

G220

Main LCD Panel

G219

(176×RGB×220)

G2

G1

A/K1/K2/K3

LED B/L(3LED in parallel)

1.5 Schematic

Pin Function

IMO=0   80-system 16-bit interface
IMO=1   80-system 8-bit interface

2. Electrical Characteristics

2.1 Absolute Maximum Ratings

Item		Symbol	Value			Unit	Condition	Remark
			Min.	Typ.	Max			
Supply Voltage Range	Logic	V_{CC}	- 0.3	-	4.5	V	Ta =25℃	
	LCD	VGH	- 0.3	-	18.0	V	Ta =26℃	
		VGL	-18	-	0.3	V	Ta =25℃	
Input Voltage		V_{IN}	Vss - 0.3	-	VCC	V	Ta =25℃	

2-2 Environmental Conditions

Item	Symbol	Min.	Max.	Unit
Operating temperature	Topr	-20	70	℃
Storage temperature	Tstg	-30	80	℃
Humidity (Ambient temperature=Ta)	Ta ≤ 60℃		90% RH max.	

2-3 DC Characteristics

Items		Sysbol	Spec. Value			Unit	Condition
			MiN.	Typ.	Max.		
Operating voltage	Logic	VCC	2.72	2.8	2.88	V	
	Gate	VGH	12	-	18	V	
		VGL	-11	-	-7	V	
Input current		ICC	-	7.0	120	mA	Ta=25℃
Input voltage	High level	V_{IH}	$0.8V_{CC}$	-	V_{CC}	V	-
	Low level	V_{IL}	-0.3	-	$0.2V_{CC}$	V	-

3. Optical Characteristics

Transmissive mode

(Ta = 25℃)

Item		Symbol	Min.	Typ.	Max.	Unit	Condition	Note
Viewing Angle	U	U	10	15	-	Deg	Cr > 10	
	D	D	35	45	-			
	L	L	40	45	-			
	R	R	40	45	-			
Contrast ratio		Cr	150	300	-	-	θ = 0 Ø = 0	
Response Time		Tr + Tf	-	25	-	ms	θ = 0 Ø = 0	
CIE Coordi - nate	R	(x,y)	0.58,0.29	0.63,0.34	0.68,0.39		θ = 0 Ø = 0	
	G	(x,y)	0.28,0.54	0.33,0.59	0.38,0.64			
	B	(x,y)	0.09,0.02	0.14,0.07	0.19,0.12			
	W	(x,y)	0.24,0.24	0.29,0.29	0.34,0.34			
Brightness		L	200	230	-	cd/m2	18mA/LED	
Uniformity			70	-	-			

* Ø = 0˚, Ø = 90˚ means viewing direction.

* B/L is turned on.

* Remark : As for contrast ratio, it is measured in only Panel.

Note 1 . Definition of angle ϴ and Φ

Top
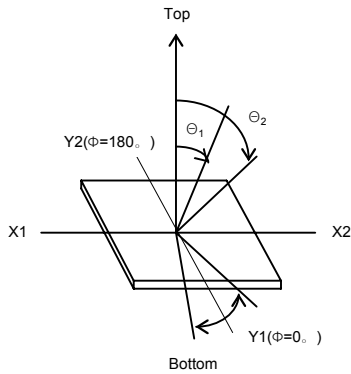
Y2(Φ=180°)

Θ_1 Θ_2

X1 —————————— X2

Y1(Φ=0°)

Bottom

Note 2. Definition of viewing angle ϴ₁ and ϴ₂

Cr

2.0

Θ_1 0° Θ_2
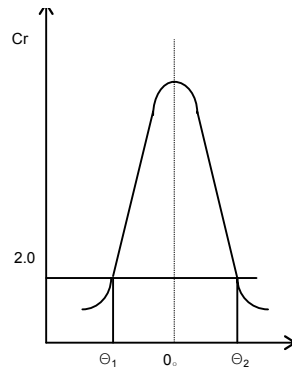
Note 3. Definition of contrast Cr

0%

B

Non - selected
Dots

Brightness

Selected
Dots

A

100%

Voltage
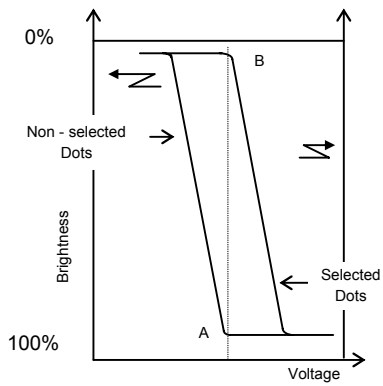
Cr=(A/B)ᴾ   Negative : P= -1   Set
            Positive : P= +1   Point

Lens Ø = 3mm

Note 4. Definition of Optical response

Off   On   Off

Brightness

100%

90%

10%

Time

t_r t_f
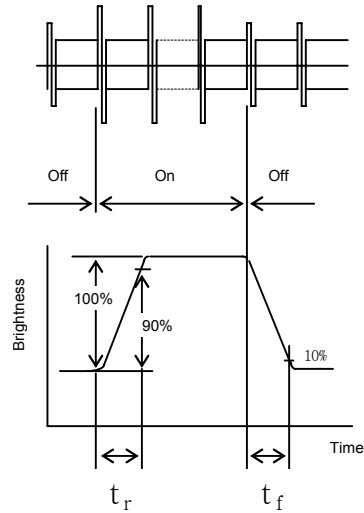
Note 5. Measuring Point(9 POINTS) (WxH)

W/6   W/3   W/3   W/6

H/6

○   ○   ○

H/3

○   ○   ○

H/3

○   ○   ○
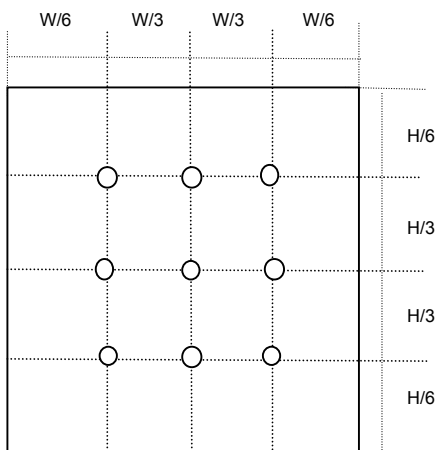
H/6   Rating is defined as the average

brightness inside the viewing area

4. Interface Pins

no	symbol	Description
1	GND	Ground
2	ID	ID bit setting of device ID code
3	RESET	Reset Signal (low active)
4	DB0	Data Bus
5	DB1	Data Bus
6	DB2	Data Bus
7	DB3	Data Bus
8	DB4	Data Bus
9	DB5	Data Bus
10	DB6	Data Bus
11	DB7	Data Bus
12	DB8	Data Bus
13	DB9	Data Bus
14	DB10	Data Bus
15	DB11	Data Bus
16	DB12	Data Bus
17	DB13	Data Bus
18	DB14	Data Bus
19	DB15	Data Bus
20	RD	Read Signal(low active)
21	WR	Write Signal (low active)
22	RS	Command/Data Select
23	CS	Chip select Signal (low active)
24	VCC	Supply Voltage（2.8V）
25	GND	Ground
26	VCCIO	Supply Voltage（1.8V）
27	IM0	CPU Interface Mode Selection
28	XN	Touch Panel Pad
29	YP	Touch Panel Pad
30	XP	Touch Panel Pad
31	YN	Touch Panel Pad
32	GND	Ground
33	LED1+	LED Anode1
34	LED2+	LED Anode2
35	LED3+	LED Anode3
36	NC	No Connection
37	LED-	LED Kathode

5. Backlight Specfication (LED Unit)

Item	Symbol	Spec. Value			Unit	Condition
		Min.	Typ.	Max.		
Input voltage	VBAT(+)	-	3.2	-	V	-
Real Current	I_{LED}	-	18	20	mA	note 1.
Power dissipation	P_D	-	-	250	mW	note 2.
Operation temp.	Topr	-20----70			℃	-
Storage temp.	Tstr	-30----80			℃	-

Note 1. B/L: 3EA LED in parallel， the maximal current is 20mA(FULL BRIGHTNESS)

Note2. Total power consumpation(max) depends on LED current/ LED driver efficiency, etc.

The above data only describes maximum power consumption of LCM's LED Chips.

(LED Max. Vf=3.4V, LED Max. Current=20mA)

6. Recommended Software Setting Values (Initial code)

LDI : LGPD4524

instruction	data
hard reset	
delay 10ms	
0007	0000
0012	0000
0013	0000
0014	0331
delay 15ms	
0012	0009
0011	0000
0010	0104
0013	0C31
0010	0144
0011	0200
0012	0019
delay 20ms	
0013	2C31
0010	0140
delay 20ms	
0060	2000
0060	0000
0061	0002
0001	011B
0002	0700
0003	1030
0008	0304
0009	0000
000B	5D2C
0021	0000
0030	0101
0031	0604
0032	0007
0033	0403
0034	0007
0035	0402
0036	0606
0037	0304
0038	070E
0039	070E
003A	0101
003B	0101
003C	0101
003D	0101
003E	0101
003F	0101
0042	DB00
0044	AF00
0045	DB00
0071	0040
0072	0002

instruction	data
delay 10ms	
0010	3250
0007	0001
delay 30ms	
0007	0021
0007	0023
delay 30ms	
0007	0037
0022	

standby in	
0007	0036
delay 20ms	
0007	0026
delay 20ms	
0007	0000
delay 10ms	
0010	0004
0012	0000
0013	0000
delay 10ms	
0010	0008
standby out	
0000	0001
delay 10ms	
0010	0000
0014	0331
delay 15ms	
0012	0009
0011	0000
0010	0104
0013	0C31
0010	0144
0011	0200
0012	0019
delay 20ms	
0013	2C31
0010	0140
delay 20ms	
0010	3250
0007	0001
delay 30ms	
0007	0021
0007	0023
delay 30ms	
0007	0037

NOTE: HYES requires the customer to follow the above instructions strictly. If customer would like to change
the above instructions, the customer should inform HYES and get re-check from HYES,
or the customer will be responsible for any unexpected result because of the change.

7. Power Supply Sequence

7.1 Power ON Sequence
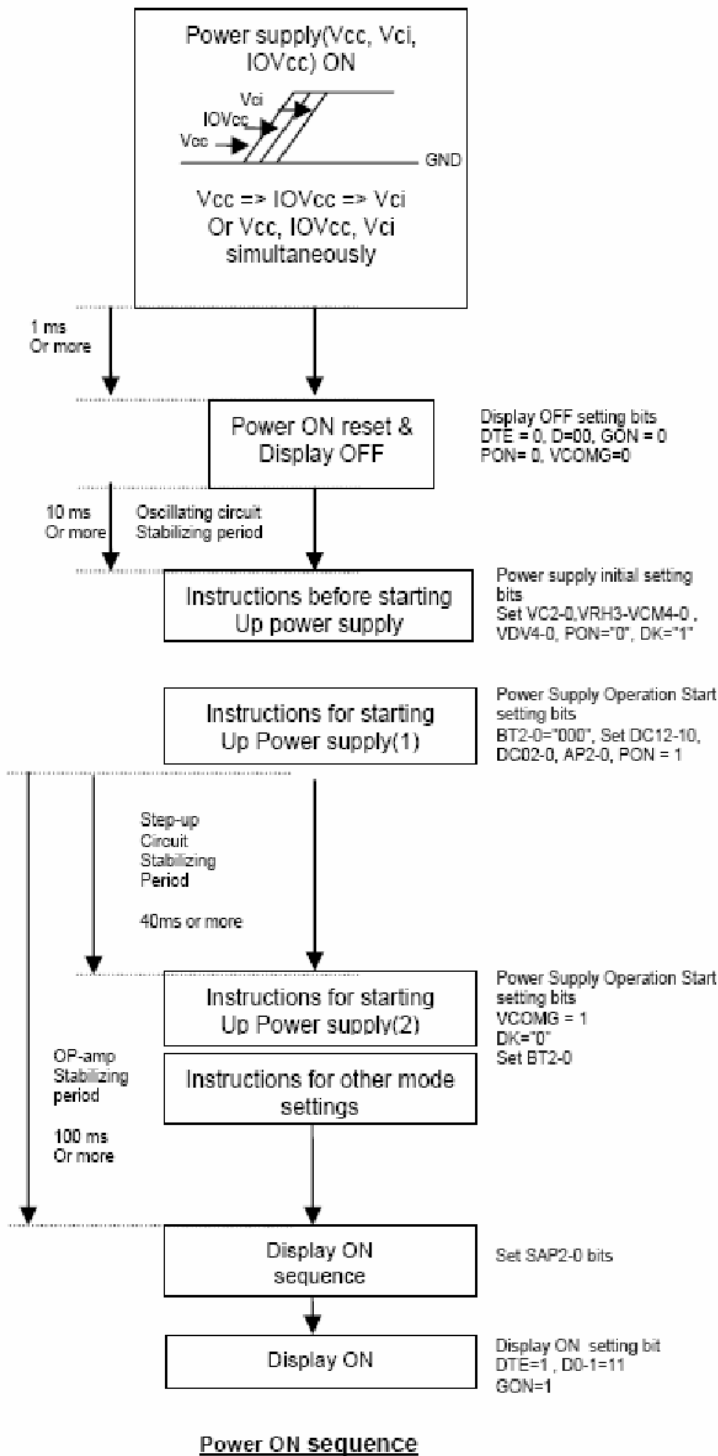
Power ON sequence

7.2 Power OFF Sequence

Power OFF sequence
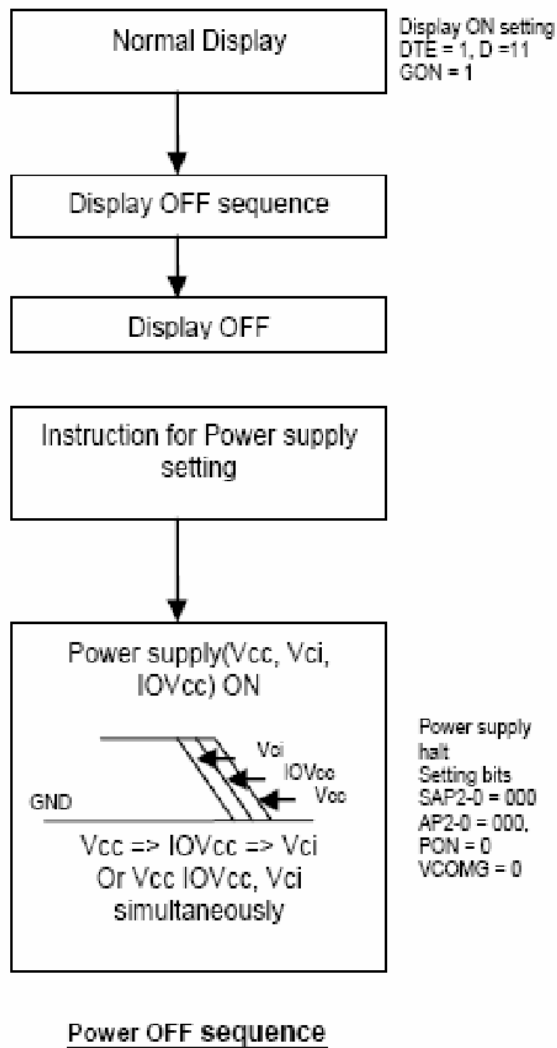
8. Read/Write Timing characteristics (80 series MPU)

1）Read/Write Timing

Timing Characteristics Diagram

Note 1) PWLW and PWLR are defined by the overlap period when CS* is "Low" and WR* or RD* is "Low".
Note 2) Unused DB pins must be fixed at "Vcc" or "GND".
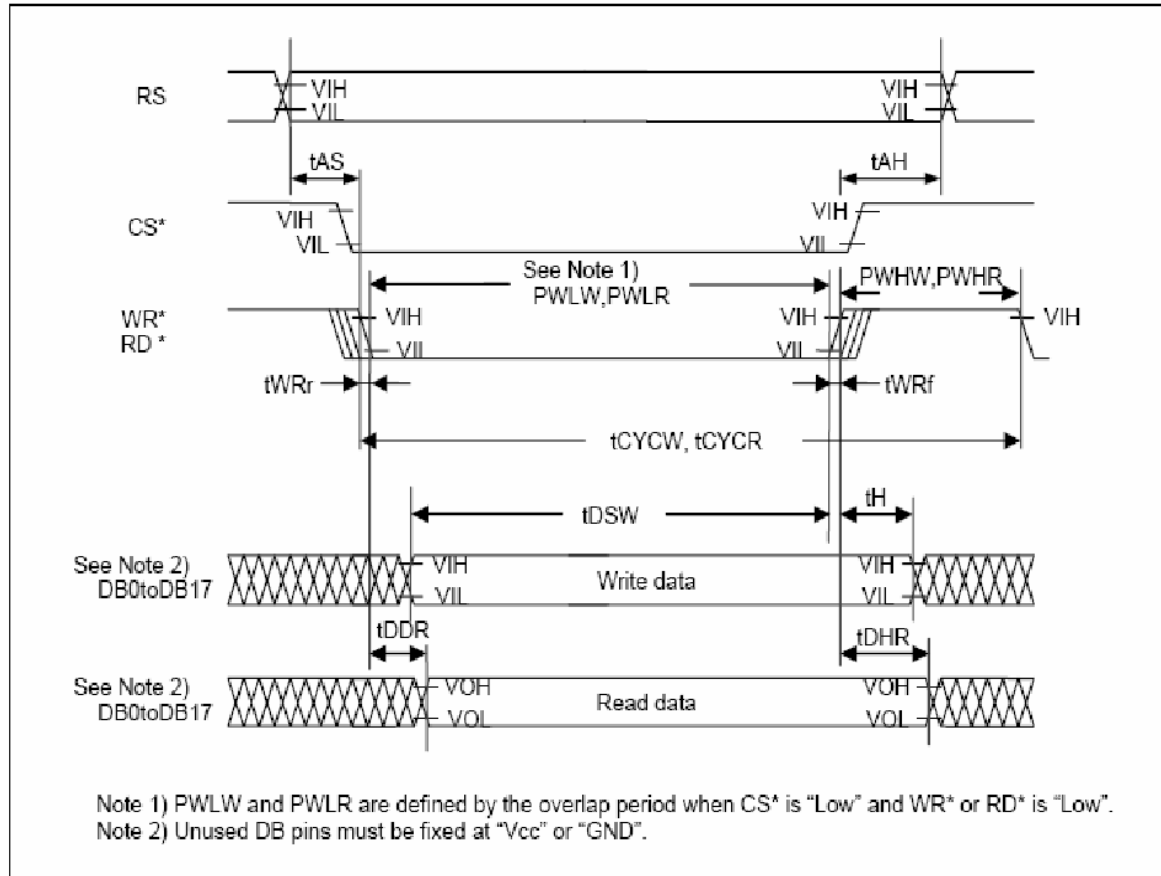
80-System Bus Interface Timing Characteristics

Table 75 (Condition: IOVcc = 1.65 to 3.30V, Vcc = 2.50 to 3.30V, VDD = 1.7 to 1.9V)

Item		Symbol	Unit	Min	Typ	Max
Bus cycle time	Write	t_{CYCW}	ns	100	-	-
	Read	t_{CYCR}		250	-	-
Write "Low" level pulse width	Write	PW_{LW}	ns	40	-	-
Read "Low" level pulse width	Read	PW_{LR}		150	-	-
Write "High" level pulse width	Write	PW_{HW}	ns	30	-	-
Read "High" level pulse width	Read	PW_{HR}		100	-	-
Write/Read rise/fall time		t_{WRr}, t_{WRf}	ns	-	-	25
Setup time	Write (RS to CS*/WR*)	t_{AS}	ns	0	-	-
	Read (RS to CS*/RD*)			10	-	-
Address hold time		t_{AH}	ns	2	-	-
Write data setup time		t_{DSW}	ns	25	-	-
Write data hold time		t_{H}	ns	2	-	-
Read data delay time		t_{DDR}	ns	-	-	100
Read data hold time		t_{DHR}	ns	5	-	-

Reset Timing characteristics
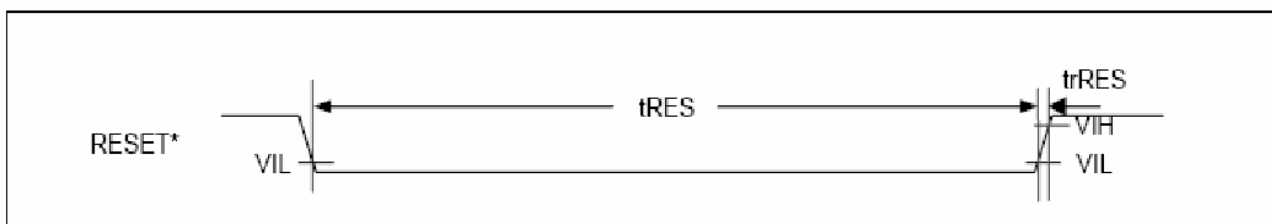
Reset Timing Characteristics

Table 78 (Condition: IOVcc = 1.65 to 3.30V, Vcc = 2.50 to 3.30V, VDD = 1.7 to 1.9V)

Item	Symbol	Unit	Min	Typ	Max
Reset "Low" level width	t_{RES}	ms	1	-	-
Reset rise time	t_{rRES}	us	-	-	10

9. LCD Module Out-Going Quality Level

(1.0) Purpose

The LCD specification provides outgoing provision and its expected quality level

based on our outgoing inspection of LCD.

(2.0) Applicable Scope

The LCD specification is applicable to the arrangement in regard to outgoing

Inspection and quality assurance after it.

(3.0) Quality Specification

(3.1) Quality Level

The quality level of HYES are based on GB/T2828.1, Apply Level II,

normal inspection by single sampling.

Rank	Item	AQL	Note
Major(MA)	Segment Short, Missing	0.65	
	Solder Bridging, Cold Solder		
	Outside Dimension		
Minor (MI)	Black Spots, White Spots, Foreign Substance, Pinhole, Segment Deformation, Scratchs(Glass & Pol.) Air Bubbles between Glass & Polarizer, Color Variation, Solder Ball, Misalignment	1.0	

Note) AQL- Acceptable Quality Level

(3.2) Appearance Standards

1) Inspection Conditions

The LCD shall be inspected under 20W white fluorescent lamp light.

The distance between the eyes and the sample shall be 30cm.

All directions for inspecting the sample should be within 30º to perpendicular line.

2) Definition of the Area

A Area : Active Area
B Area : Viewing Area
C Area : Out of Viewing Area

C Area
B Area
A Area
Bonding Area

(3.3) Apperance Spec

No	Item	Criteria	Rank	Remark
1	Segment Short Segment Missing	Not allowed	MA	
2	Solder Bridging	Any bridging between components, except common circuit, is not allowed.	MA	
3	Outside Dimension	Drawing & specification must be within permitable tolerance.	MA	
4	Cold Solder	Cold solder is not allowed.	MA	
5	Black(White) Spots, Foreign Substances	1) Round Type 2) Liner Type At (1) & (2) total defect q'ty is must not exceed 5 pieces.	MI	Y ↕ X ** : Mean Diameter (X + Y)/2
6	OC Spot		MI	
7	Air Bubles Between Glass & Polarizer (Polarizer Defects)		MI	

Item 5 — 1) Round Type

Area Dimension**	Acceptable Q'ty		Remark
	A Area	B Area	
≤ 0.1	Ignore		
≤ 0.2	2	Ignore	
≤ 0.3	1	Ignore	
0.3 <	0	Ignore	

Item 5 — 2) Liner Type

Dimension		Acceptable Q'ty		Remark
Length	Width	A Area	B Area	
-	≤ 0.025	Ignore		
≤ 2.5	≤ 0.05	3	Ignore	
≤ 1.5	≤ 0.075	2	Ignore	
	0.075 <	Follow round type		

Item 6 — OC Spot

Area Dimension**	Acceptable Q'ty		Remark
	A Area	B Area	
≤ 0.2	Ignore		
≤ 0.8	3	Ignore	
≤ 1.0	1	Ignore	

Item 7 — Air Bubles

Area Dimension**	Acceptable Q'ty		Remark
	A Area	B Area	
≤ 0.15	Ignore		
≤ 0.3	3	Ignore	
≤ 0.5	2	Ignore	
≤ 0.7	1	Ignore	
Total	5	Ignore	
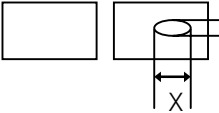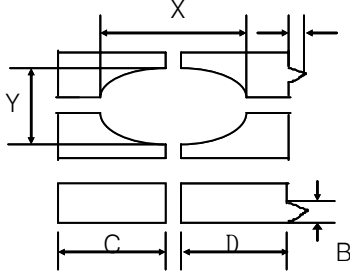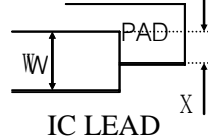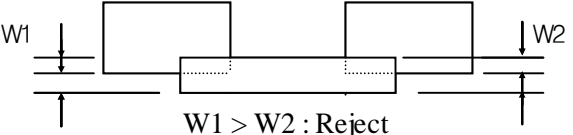
(3.3) Appearance Spec					
No	Item	Criteria		Rank	Remark
8	Pin hole (On Segment)	$(X+Y)/2 \leq 0.2$mm Within 1 per one segment (Less than 0.1mm is not counted) Total defects q'ty is must not exceed 5 pieces.		MI	
9	Segment Deformation	$(X+Y)/2 \leq 0.2$mm $A \leq 0.2$mm $B \leq 0.2$mm $(C-D) \leq 0.2$mm Acceptable Q'ty table: Dot, Segment = 1; LCD = 5; ≤ 0.1 = Ignore all defect Each visible dot must be more than half effective dot area		MI	$(X+Y)/2$ ≤ 0.2mm
10	Color Variation	Within the three colors, except LCD Standard color is acceptable.		MI	
11	Glass & Polarizer Scratch	Follow NO.5(2) condition		MI	
12	Solder Ball	1)Acceptable if the size of void is less than 0.18mm 2)Acceptable if a solder ball is not movable 3)Rejectable if the solder ball exceed 5EA in 2.54×2.54mm area.		MI	
13	Miss Alignment	1)Acceptable if it dose not exceed 50% of the lead width IC. $X \leq W/2$: Accept $X > W/2$: Reject IC LEAD 2)Rejectable, provided that it does exceed 50% of the component termination width. $W1 > W2$: Reject			

Note : A limitation sample is given top priority

(4.0) Reliability Condition

Item	Content
Room Temperature Operation	50,000 hrs

(4.1) Reliability Test

No.	Item	Condition	Test Time	Sample Numbers	Creteria (Acc/Rej)	Note
1	High Temp Operation	70 ± 2℃	120 hrs	3	0/1	
2	Low Temp Operation	-20 ± 2℃	120 hrs	3	0/1	
3	High Humidity Storage	60℃ 90%rh	120 hrs	3	0/1	
4	Thermal Shock	30mn stage -20℃ ↔70℃	100 cycles /6days	3	0/1	

(4.2) Criteria

a. No changes for indication and appearance.
b. Leave the all samples under roon temperature 4 hours after reliability test ends.

10. LCD Module Operation Instruction

Part I. How to use the LCD Module

1. Don't hit the LCD Panel in any way because the LCD is made of glass.

2. Don't clean the surface of LCD with hard things. Please clean LCD with Air-gun or very soft cloth when necessary. The protective film on the POL can be removed just before assembly, otherwise,dust, spit or other foreign matter may attached on the LCD under the protective film. After the protective film is removed, only air-gun can be used to remove any dust or foreign matter. Fingure or cloth MUST NOT be used in such cases.

3. No chemical liquid is allowed to clean the LCD, such as alcohol, acetone and IPA. All of these candamage the LCD. Water on the LCD must be cleaned as soon as possible, for it will cause POL color change or other defect.

4. Please move and assemble LCD very carefully during assembly, and don't push or twist it.

5. Don't damage the FPC of LCD module. It will cause permanent defect.

6. Don't disassemble LCD module. It will cause permanent defect.

7. Don't expose LCD module under sunshine, strong fluorescence or ultraviolet radiation.

8. Please make sure that operators wear static-protective bands effectively and working tables are effectively earthing during operation.

9. Please place LCD module on the tray provided by HYES while moving it, in order to avoid mechanical damage. Hold the module's side frames to avoide damage during moving.

10. Don't twist, disassemble, squeeze or hit the PCB. It will damage the circuit or component on PCB and cause functional defect.

11. Please use the connector according to the instruction provided by HYES.

12. Please place dual module with the sub-panel upward. Trays should be placed in contrary direction.An empty tray should be placed on the top.

13. Sealing operation on PCB must be very careful to avoid short or cut the original circuit on PCB.Otherwise, it will cause permenant damage to the LCD.

14. Don't add direct DC or high voltage to LCD panel. It will cause functional damage to the LCD or shorten the life of LCD product.

15. LCD may respond slowly or display abnormally in extrem temperature (lower than -20℃ or higher than 50℃). But this doesn't mean LCD functional defect. LCD will display normally in regular temperature. Therefore, don't use LCD product in extrem temperature.

16. Don't push the display area of LCD panel, it will cause abnormal display. This doesn't mean LCD functional defect, neither. LCD will display normally in regular temperature.

17. Electrical test of LCD product is made by using mobile phone provided by Customer. We can use special test equipment to do the test, also.

18. The black band on IC on LCD product is used to protect the IC from light. Please do NOT remove it.

19. Please take great care to use connector. Customer should be responsible for connector defect caused by operation on Customer side.

Part II Storage

1. Physical status of liquid crystal will change in extrem temperature, and it can not be resumed whenthe temperature returns to be normal. So LCD module should be stored in required temperature.

2. LCD module should be stored in required humidity. Low hymidity may add static, while high humidity may corrode the ITO circuit of LCD product. The suitable storage environment is: temperature:22±5℃, humidity: 55%±10%.

3. Don't expose LCD module under sunshine, strong fluorescence or ultraviolet radiation for a long time.It should be stored in dark area.

4. LCD should be stored in static-protective polythene bag. Don't expose it in the air for a long time.