A Brighter Solution

AMP DISPLAY INC.

SPECIFICATIONS

2.0-in COLOR TFT MODULE

CUSTOMER:	
CUSTOMER PART NO.	
AMP DISPLAY PART NO.	A M 1 7 6 2 2 0 N 1 T N Q W - 0 0 H
APPROVED BY:	
DATE:	

☐ APPROVED FOR SPECIFICATIONS

☐ APPROVED FOR SPECIFICATION AND PROTOTYPES

AMP DISPLAY INC

9856 SIXTH STREET RANCHO CUCAMONGA CA 91730

TEL: 909-980-13410 FAX: 909-980-1419

WWW.AMPDISPLAY.COM

RECORD OF REVISION

Revision Date	Page	Contents	Editor
2006/10/18	-	New Release	Alen
2006/11/17	-	Issue official specifications Rename TF176220-83-0 to AM176220N1TNQW-00H	Alen

1 Features

This single-display module is suitable for cell phone application. The Main-LCD adopts one backlight with High brightness 3-lamps white LED.

(1) Construction: 2.0” a-Si color TFT-LCD, White LED Backlight, and FPCB.

(2) Main LCD : 2.1 Amorphous-TFT 2.0 inch display, transmissive, Normally white type, 12 o’clock.
2.2 176(RGB)X220 dots Matrix,1/220 Duty.
2.3 Narrow-contact ledge technique.
2.4 Main LCD Driver IC: ILI9221
2.5 Real 262K colors display:
262K: Red-6bit, Green-6bit, Blue-6bit (9/18-bit interface)
Dithering 262K: Red-5bit, Green-6bit, Blue-5bit (8/16-bit interface)

(3) Low cross talk by frame rate modulation
(4) Direct data display with display RAM
(5) Partial display function: You can save power by limiting the display space.
(6) MPU interface: 8/9/16/18-bit 80-Series, parallel interface.
(7) Abundant command functions:
Area scroll function
Display direction switching function
Power saving function
Electric volume control function: you are able to program the temperature compensation function.

2 Mechanical specifications

Dimensions and weight

Item		Specifications	Unit
External shape dimensions		*37.68(W) x 69.84(H) x 3.44 (D) Max.	mm
Main LCD	Pixel size	0.18 (W) x 0.18 (H)	mm
	Active area	31.68 (W) x 39.6 (H)	mm
	View area	35.48 (W) x 43.4 (H)	mm
Weight		9.75	g

*1. This specification is about External shape on shipment from AMPIRE.

3 Absolute max. ratings and environment

3-1 Absolute max. ratings

Ta=25°C GND=0V

Item	Symbol	Min.	Max.	Unit	Remarks
Power voltage	VDD – GND	-0.3	+3.3	V	
Power voltage	LED A – LED K	-0.5	+4.0	V	Parallel
Input voltage	VIN	-0.5	VDD	V	

3-2 Environment

Item	Specifications	Remarks
Storage temperature	Max. +70°C Min. -20°C	Note 1: Non-condensing
Operating temperature	Max. +60°C Min. -10°C	Note 1: Non-condensing

Note 1：Ta≦+40°C・・・・Max.85%RH

Ta＞+40°C・・・・The max. humidity should not exceed the humidity with 40°C 85%RH.

4 Electrical specifications

4-1 Electrical characteristics of LCM

(V_{DD}=3.0V, Ta=25 °C)

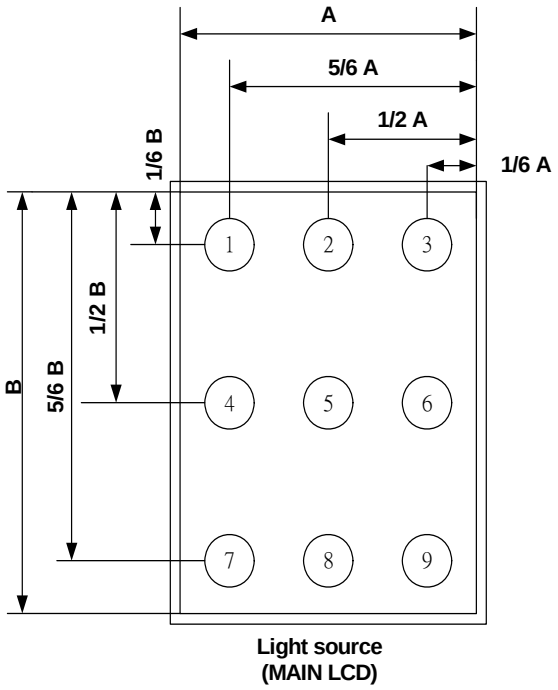
Item	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
IC power voltage	V_{DD}		2.4	3.0	3.3	V
High-level input voltage	V_{IHC}		0.8V_{DD}		V_{DD}	V
Low-level input voltage	V_{ILC}		0		0.2V_{DD}	V
Consumption current of VDD	I_{DD}	LED OFF	4	5.2	6	mA
Consumption current of LED	I_{LED_ON}	V_{LED_ON}=3.3V	-	45	55	mA

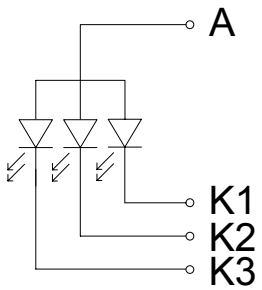
※ 1. 1/220 duty.

4-2 LED back light specification

Item	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	V_f	I_f =45mA	3.2	3.3	4	V
Reverse voltage	V_r		-	-	12	V
Forward current	I_f	3-chip Parallel	40	45	55	mA
Power Consumption	P_{BL}	I_f =45mA	-	162	-	mW
Uniformity (with L/G)	-	I_f=45mA	80%*1	-	-	
Bare LED Luminous intensity	V_f I_f	3.3V 45mA	2400	-	-	cd/m^2
Luminous color	White					
Chip connection	3 chip parallel connection					

Bare LED measure position:





*1 Uniformity (LT): $\frac{Min(P1 \sim P9)}{Max(P1 \sim P9)} \times 100 \geq 80\%$

5 Optical characteristics

Main LCD

5.1 Optical characteristics

(1/220 Duty in case except as specified elsewhere Ta = 25°C)

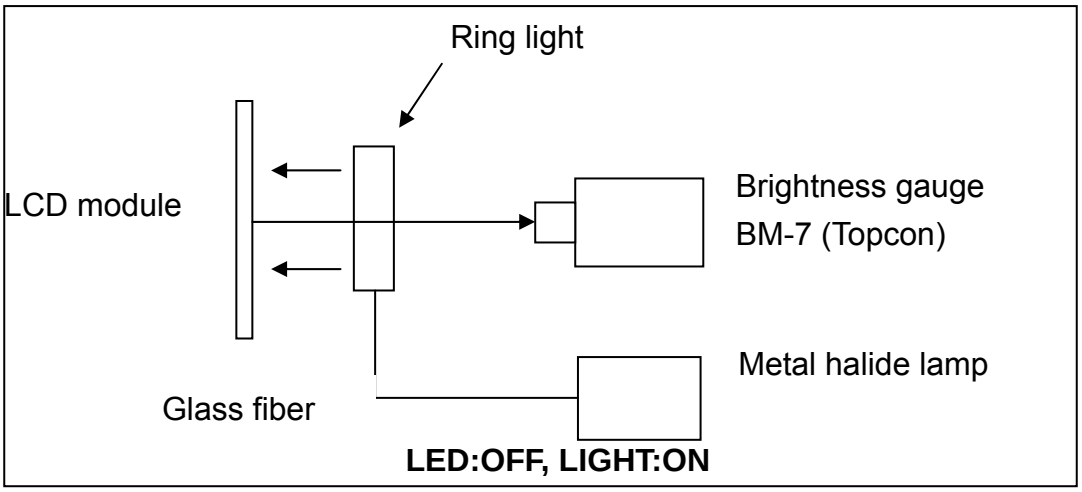
LED backlight transmissive module:

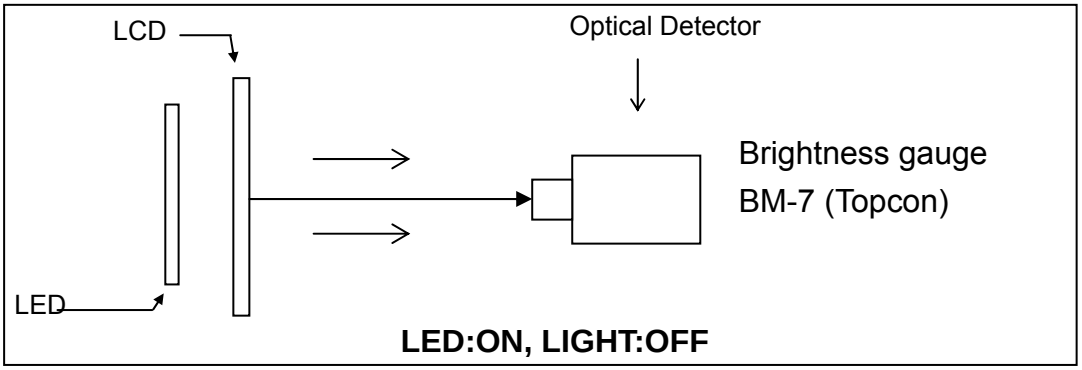
Item	Symbol	Temp.	Min.	Std.	Max.	Unit	Conditions
Response time	Tr	25°C	-	12		ms	θ=0°, φ=0° (Note 2)
	Tf	25°C	-	18			
Contrast ratio	CR	25°C		300	-	-	θ=0°, φ=0° LED:ON, LIGHT:OFF (Note 4)
Transmittance	T	25°C	-	6.6	-	%	
Visual angle range front and rear	θ	25°C	(θf) 20 (θb) 40			De-gree	φ = 0°, CR≧10 LED:ON LIGHT:OFF (Note 3)
Visual angle range left and right	θ	25°C	(θl) 45 (θr) 45			De-gree	φ=90°, CR≧10 LED:ON LIGHT:OFF (Note 3)
Visual angle direction priority			12:00				(Note 5)
Brightness			150			Cd/m2	V_{LED}=10V, 15mA Full White pattern

5.2 CIE (x, y) chromaticity (1/220 Duty Ta = 25°C)

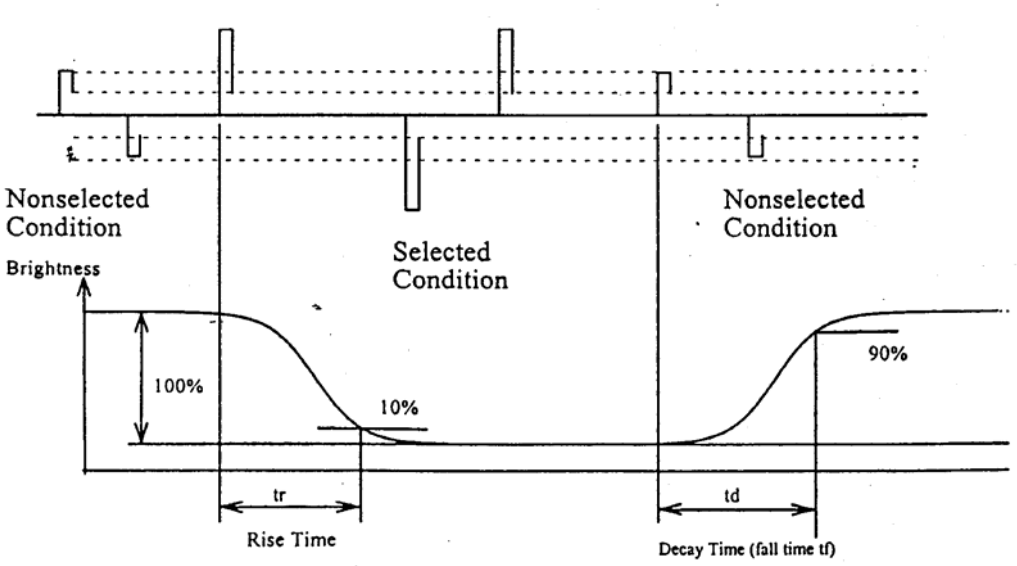
Item	Symbol	Transmissive			Conditions
		Min.	Typ.	Max.	
Red	X	0.600	0.630	0.660	θ=0°, φ=0°
	Y	0.313	0.343	0.373	
Green	X	0.317	0.347	0.377	θ=0°, φ=0°
	Y	0.545	0.575	0.605	
Blue	X	0.105	0.135	0.165	θ=0°, φ=0°
	Y	0.070	0.100	0.130	
White	X	0.263	0.293	0.323	θ=0°, φ=0°
	Y	0.288	0.318	0.348	

NOTE 1: Optical characteristic measurement system

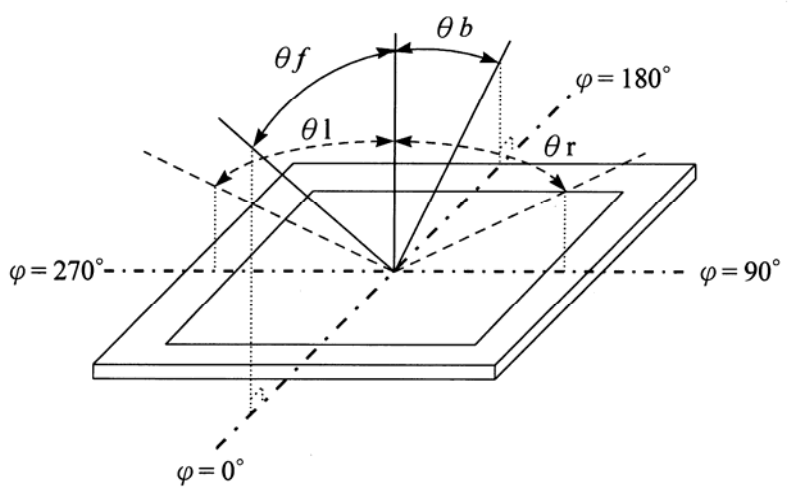




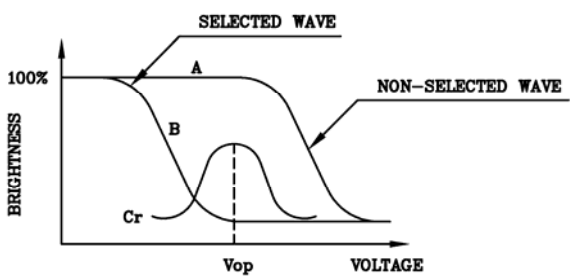
NOTE 2: Response tome definition



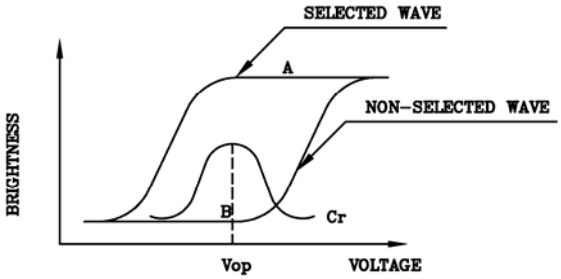
NOTE 3: φ 、θ definition



NOTE 4: Contrast definition



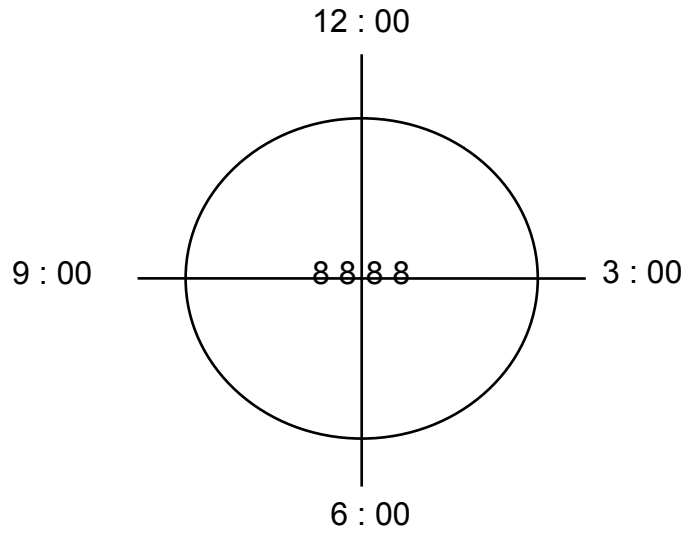
(positive type)



(negative type)

Contrast Ratio : Cr=A/B

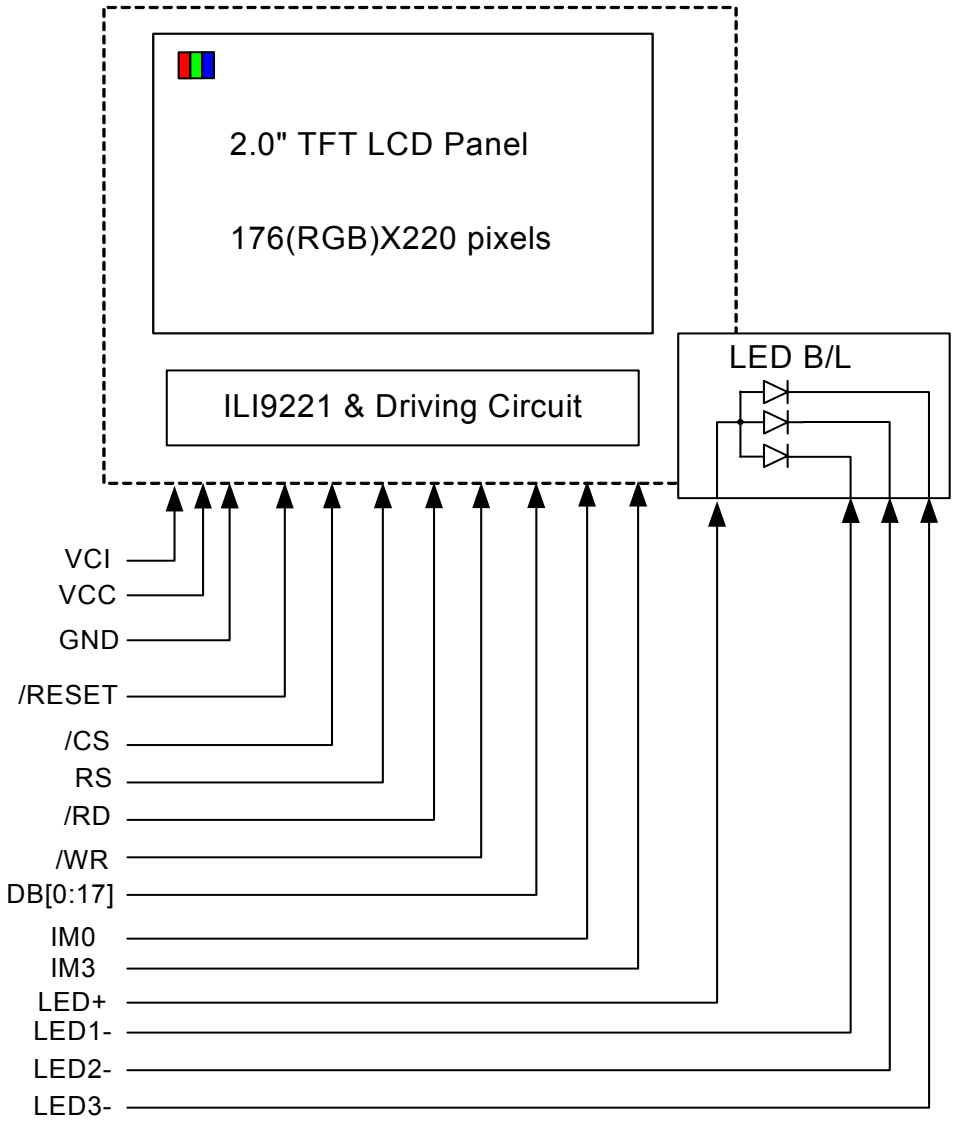
NOTE 5: Visual angle direction priority



6 Block Diagram

Block diagram (Main LCD)

Display format: A-Si TFT transmissive, Normally white type, 12 o'clock.
Display composition: 176 x RGB x 220 dots
LCD Driver : ILI9221
Back light: White LED x 3 (I_{LED}=45mA)



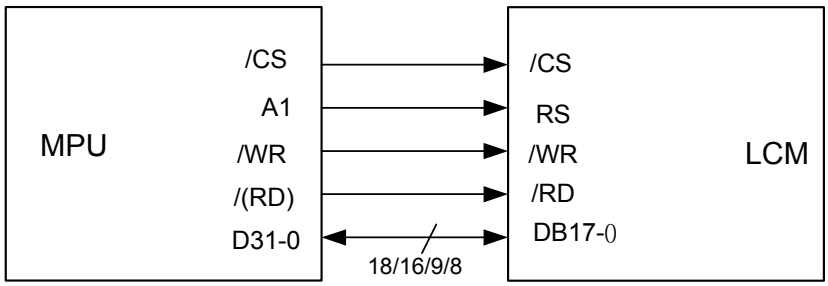
7 Interface specifications

Pin No.	Terminal	Functions
1	DUMMY1	DUMMY PIN
2	GND1	GND-terminal for analog circuit.
3	VCC1	Power supply for the internal logic circuit. (VCC=2.2~3.3V)
4	/CS	Chip select signal. Low: chip can be accessed; High: chip cannot be accessed.
5	RS	The signal for register index or register command select . Low: Register index or internal status (in read operation); High: Register command.
6	/WR	Write clock terminal, active “L” (80 series interface).
7	/RD	Read clock terminal, active “L” (80 series interface).
8	IM0	Select MPU Interface type (8/9/16 bits) by IM0 and IM3.
9	DB0	MPU interface for 80-system input. 18-bits: Connection DB17-0 16-bits: Connection DB17-10 and DB8-1 pins. Unused pins must be fixed to VDD or GND level.
10	DB1	
11	DB2	
12	DB3	
13	DB4	
14	DB5	
15	DB6	
16	DB7	
17	DB8	
18	IM3	Select MPU Interface type (8/9/16 bits) by IM0 and IM3.
19	DB9	MPU interface for 80-system input. 18-bits: Connection DB17-0 16-bits: Connection DB17-10 and DB8-1 pins. 9-bits: Connection DB17-9 pins. 8-bits: Connection DB17-10 pins. Unused pins must be fixed to VDD or GND level.
20	DB10	
21	DB11	
22	DB12	
23	DB13	
24	DB14	
25	DB15	
26	DB16	
27	DB17	
28	/RESET	LCD Reset terminal, active “L”.
29	VC1	Power supply for Step-up circuit. (VCi=2.5~3.3V)
30	VCC2	Power supply for the internal logic circuit. (VCC=2.2~3.3V)
31	GND2	GND-terminal for analog circuit.
32	DUMMY2	DUMMY PIN

7.1 System interface

IM bits setting and the type of system interface for LCD

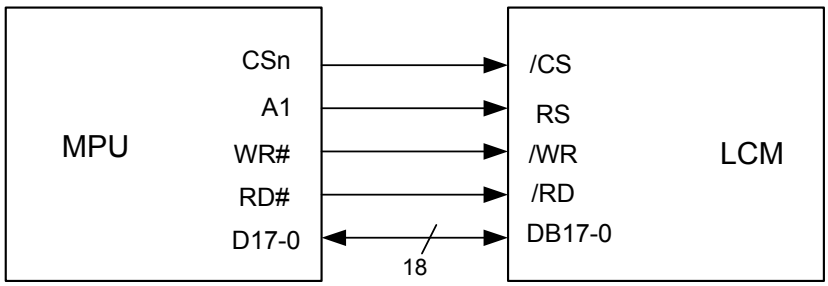
IM0	IM3	MPU interface mode	DB pins
0	0	16-bit bus interface, 80-system	DB17-10, 8-1
0	1	18-bit bus interface, 80-system	DB17-0
1	0	8-bit bus interface, 80-system	DB17-10
1	1	9-bit bus interface, 80-system	DB17-9



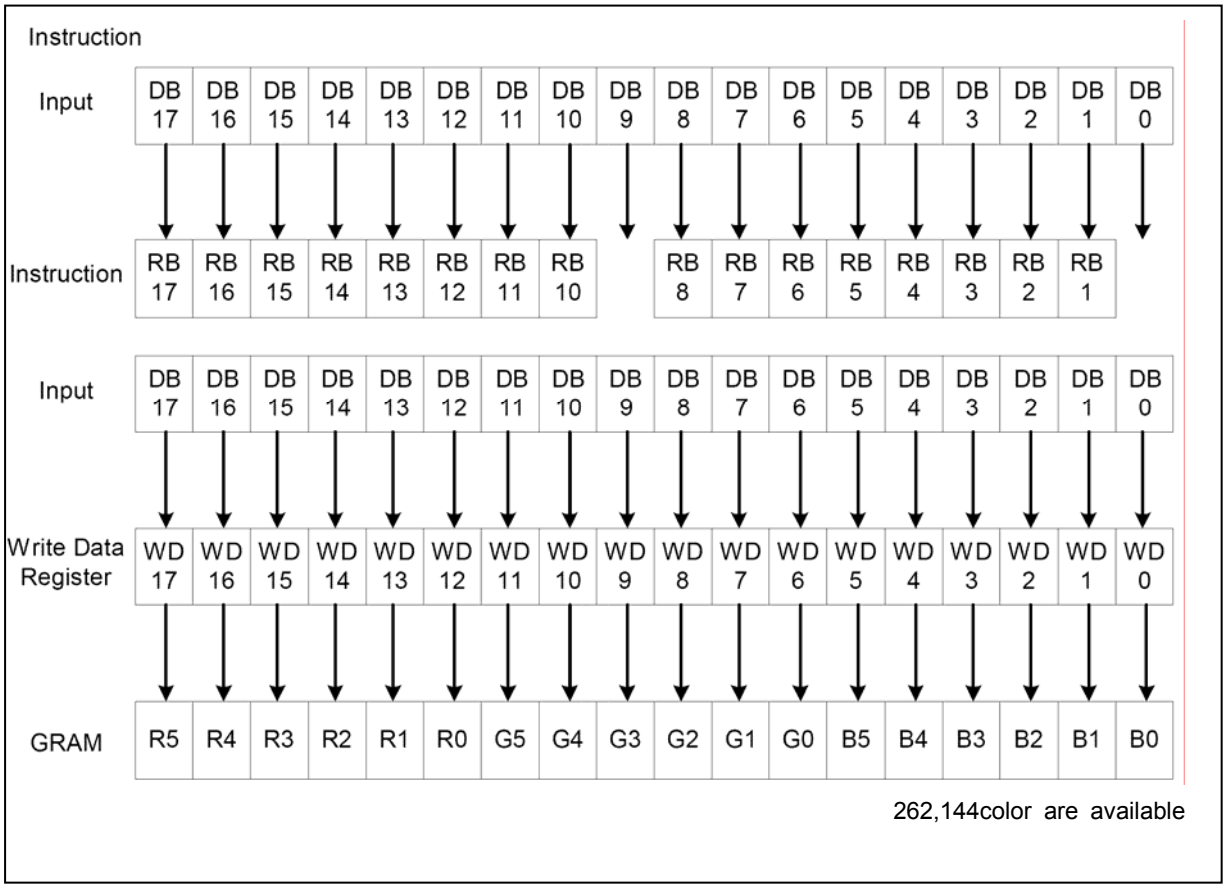
System Interface

7.2 80-system 18-bit interface

The 80-system 18-bit parallel data transfer can be used bye setting IM3 & IM0 pins to “10”. The below picture is the example of interface with i80Microcomputer and data format of 18-bit system interface.

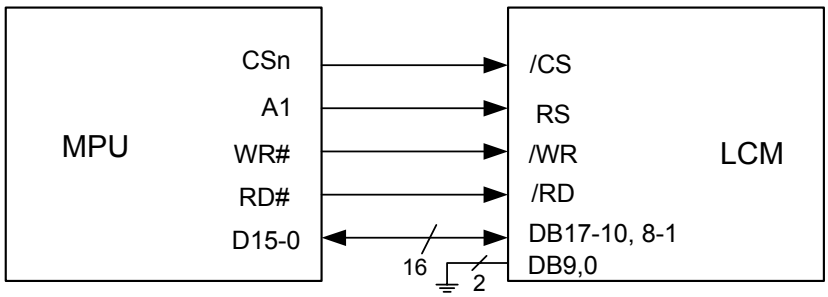


Data format for 18-bit interface

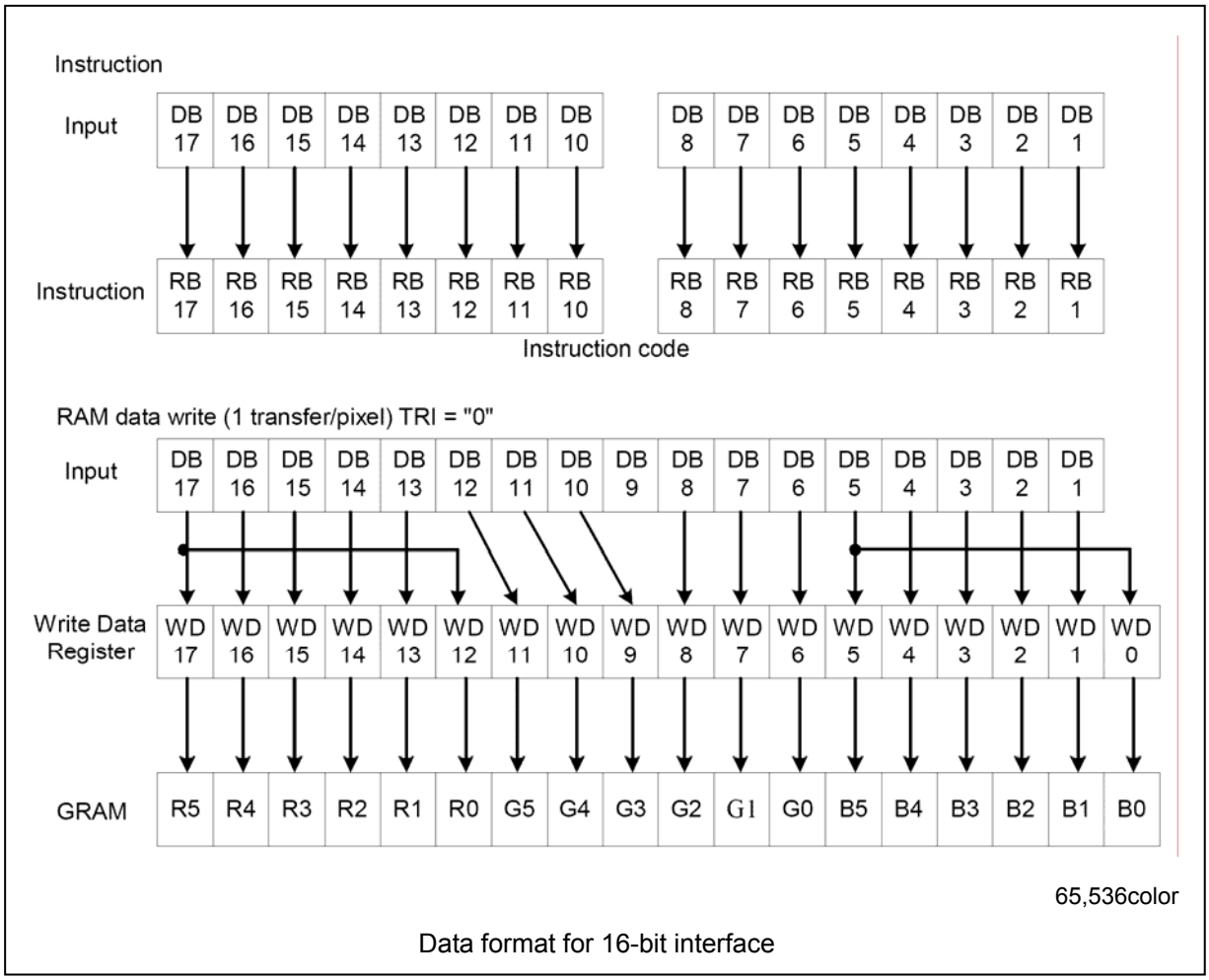


7.3 80-system 16-bit interface

The 80-system 16-bit bus parallel data transfer can be used bye setting IM3 & IM0 pins to “00”. The data written to GRAM is expended to 18-bit bys data automatically in the LSI. Unused pin(DB9,DB0) must be fixed to the VDD or GND level.



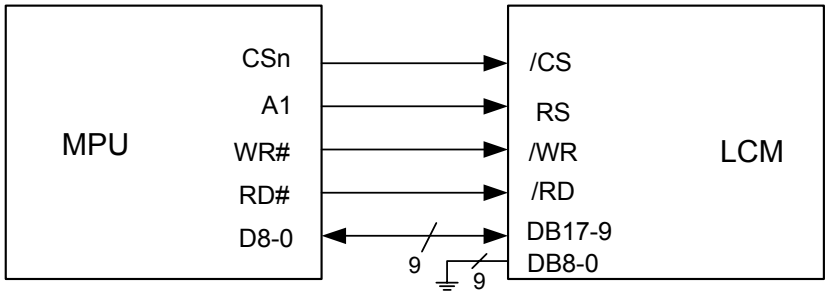
Data format for 16-bit interface



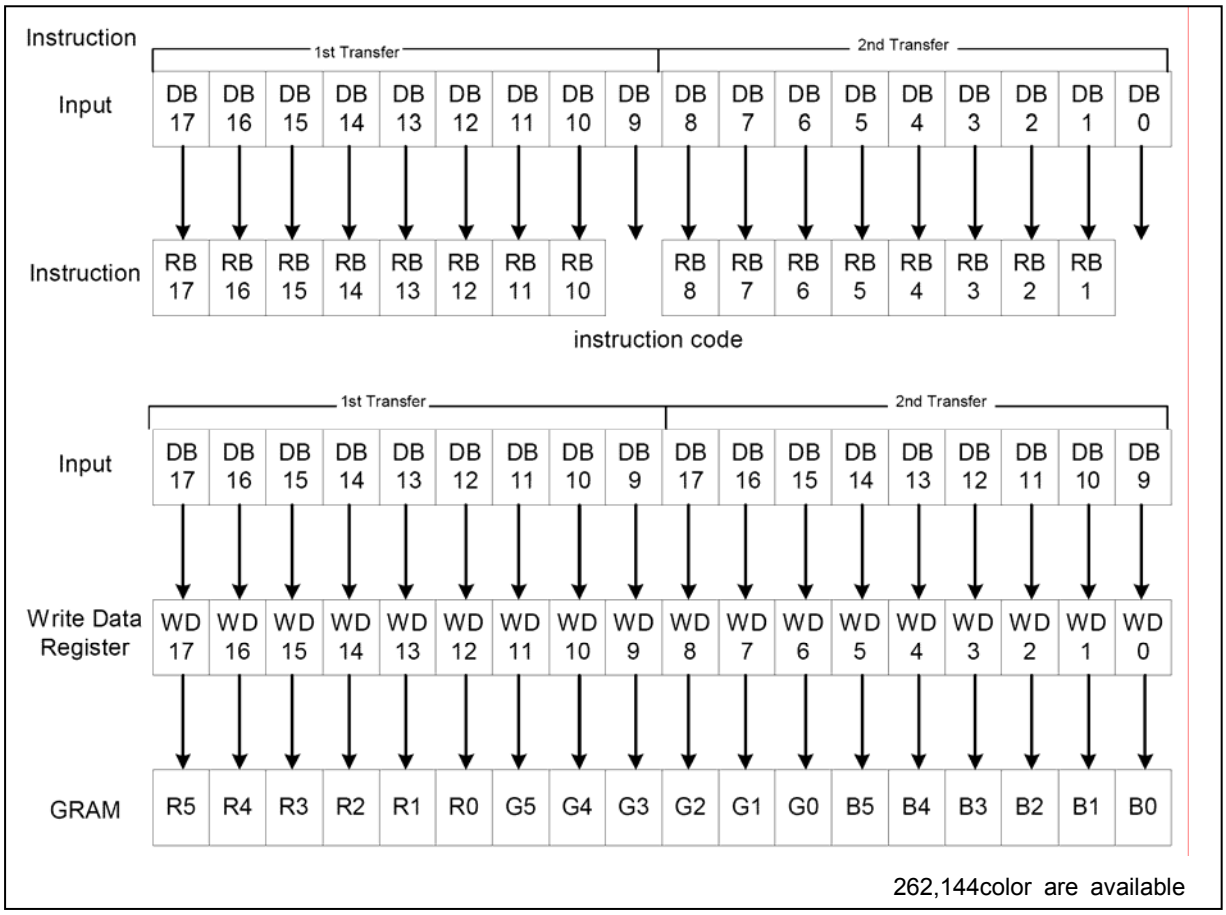
Data format for 16-bit interface

7.4 80-system 9-bit interface

The 80-system 9-bit bus parallel data transfer can be used bye setting IM3 & IM0 pins to “11”. In 80-system 9-bit bus parallel data transfer mode, the 16-bit bus instruction and GRAM write data are divided into lower and upper nine bits, and then the upper nine bits are transferred first. Unused pin(DB8-0) must be fixed to the VDD or GND level. Ensure that upper bytes have to be written when writing the index register.

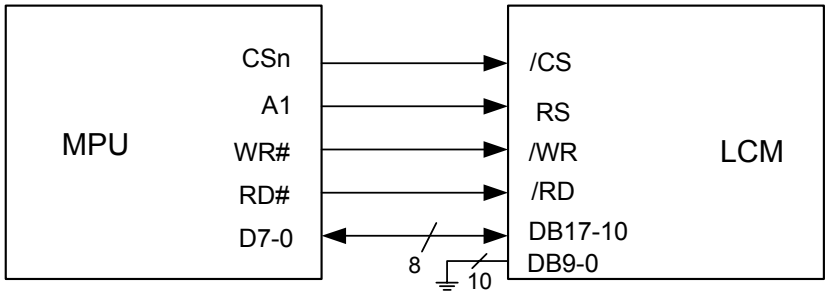


Data format for 9-bit interface

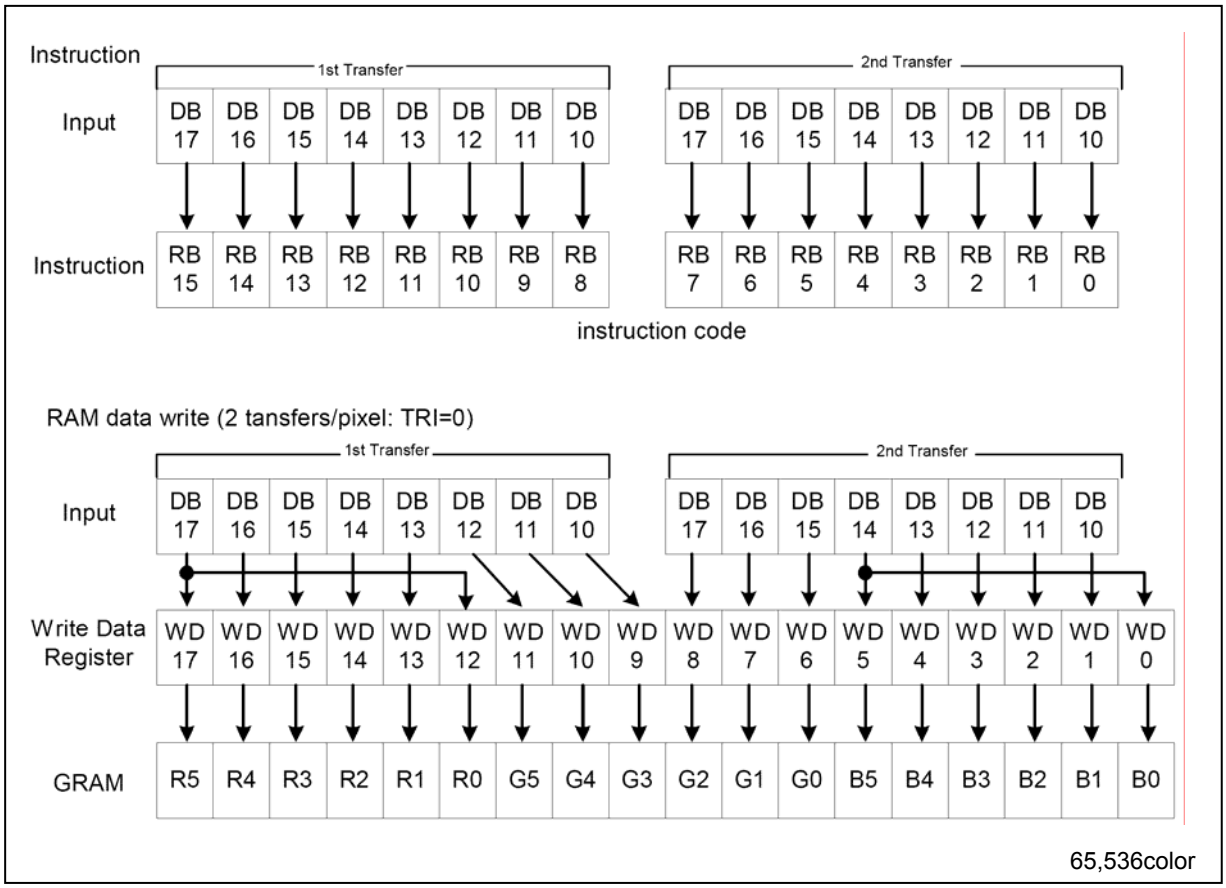


7.5 80-system 8-bit interface

The 80-system 8-bit bus parallel data transfer can be used bye setting IM3 & IM0 pins to “01”. In 80-system 8-bit bus parallen data transfer mode, the 16-bit bus instruction and GRAM write data are divided into lower and upper eight bits, and then the upper eight bits are transferred first. Furthermore, the GRAM write data can be expended into 16-bit bus automatically in internal process. Unused pin(DB9-0) must be fixed to the VDD or GND level.



Data format for 16-bit interface



7.6 Instruction List

Reg. No.	Register	R/W	RS	Upper Code								Lower Code							
				RB 15	RB 14	RB 13	RB 12	RB 11	RB 10	RB9	RB8	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0
IR	Index	W	0	*	*	*	*	*	*	*	*	*	ID6	ID5	ID4	ID3	ID2	ID1	ID0
SR	Status read	R	0	L7	L6	L5	L4	L3	L2	L1	L0	0	0	0	0	0	0	0	0
R00h	Oscillation Start	W	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	OSC
	Device code read	R	1	1	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0
R01h	Driver output control	W	1	0	VSPL	HSPL	DPL	EPL	SM	GS	SS	0	0	0	NL4	NL3	NL2	NL1	NL0
R02h	LCD AC driving Control	W	1	0	0	0	0	FLD1	FLD0	B/C	EOR	0	0	NW5	NW4	NW3	NW2	NW1	NW1
R03h	Entry Mode	W	1	TRI	DFM1	DFM0	BGR	0	0	0	0	0	0	I/D1	I/D0	AM	LG2	LG1	LG0
R04H	Compare Register (1)	W	1	0	0	CP11	CP10	CP9	CP8	CP7	CP6	0	0	CP5	CP4	CP3	CP2	CP1	CP0
R05h	Compare Register (2)	W	1	0	0	0	0	0	0	0	0	0	0	CP17	CP16	CP15	CP14	CP13	CP12
R07h	Display Control(1)	W	1	0	0	0	PT1	PT0	VLE2	VLE1	SPT	0	0	GON	DTE	CL	REV	D1	D0
R08h	Display Control(2)	W	1	0	0	0	0	FP3	FP2	FP1	FP0	0	0	0	0	BP3	BP2	BP1	BP0
R09h	Display Control(3)	W	1	0	0	0	0	0	0	0	0	0	0	PTG1	PTG0	ISC3	ISC2	ISC1	ISC0
R0Bh	Frame cycle control Adjustment Control	W	1	GD1	GD0	SDT1	SDT0	CE1	CE0	DIV1	DIV0	0	0	0	0	RTN3	RTN2	RTN1	RTN0
R0Ch	External Display Interface Control	W	1	0	0	0	0	0	0	0	RM	0	0	DM1	DM0	0	0	RIM1	RIM0
R10h	Power Control(1)	W	1	0	SAP2	SAP1	SAP0	0	BT2	BT1	BT0	0	AP2	AP1	AP0	0	DK	SLP	STB
R11h	Power Control(2)	W	1	0	0	0	0	0	DC12	DC11	DC10	0	DC02	DC01	DC00	0	VC2	VC1	VC0
R12h	Power Control(3)	W	1	0	0	0	0	0	0	0	0	0	0	0	PON	VRH3	VRH2	VRH1	VRH0
R13h	Power Control(4)	W	1	0	0	VCOMG	VDV4	VDV3	VDV2	VDV1	VDV0	0	0	0	VCM4	VCM3	VCM2	VCM1	VCM0
R21H	RAM Address Set	W	1	AD15	AD14	AD13	AD12	AD11	AD10	AD9	AD8	AD7	AD6	AD5	AD4	AD3	AD2	AD1	AD0
R22H	Write data to GRAM	W	1	Write Data (Upper)								Write Data (Lower)							
R23H	18-bit RAM Write Data Mask (1)	W	1	0	0	WM11	WM10	WM9	WM8	WM7	WM6	0	0	WM5	WM4	WM3	WM2	WM1	WM0
R24H	18-bit RAM Write Data Mask (2)	W	1	0	0	0	0	0	0	0	0	0	0	WM17	WM16	WM15	WM14	WM13	WM12

: Means the initial value is"1" : Means the initial value is"0"

Main LCD Driver IC:ILI9221

Reg. No.	Register	R/W	RS	Upper Code								Lower Code							
				RB 15	RB 14	RB 13	RB 12	RB 11	RB 10	RB9	RB8	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0
R30h	r Control (1)	W	1	0	0	0	0	0	MP12	MP11	MP10	0	0	0	0	0	MP02	MP01	MP00
R31h	r Control (2)	W	1	0	0	0	0	0	MP32	MP31	MP30	0	0	0	0	0	MP22	MP21	MP20
R32h	r Control (3)	W	1	0	0	0	0	0	MP52	MP51	MP50	0	0	0	0	0	MP42	MP41	MP40
R33h	r Control (4)	W	1	0	0	0	0	0	CP12	CP11	CP10	0	0	0	0	0	CP02	CP01	CP00
R34h	r Control (5)	W	1	0	0	0	0	0	MN12	MN11	MN10	0	0	0	0	0	MN02	MN01	MN00
R35h	r Control (6)	W	1	0	0	0	0	0	MN32	MN31	MN30	0	0	0	0	0	MN22	MN21	MN20
R36h	r Control (7)	W	1	0	0	0	0	0	MN52	MN51	MN50	0	0	0	0	0	MN42	MN41	MN40
R37h	r Control (8)	W	1	0	0	0	0	0	CN12	CN11	CN10	0	0	0	0	0	CN02	CN01	CN00
R38h	r Control (9)	W	1	0	0	0	OP14	OP13	OP12	OP11	OP10	0	0	0	0	OP03	OP02	OP01	OP00
R39h	r Control (10)	W	1	0	0	0	ON14	ON13	ON12	ON11	ON10	0	0	0	0	ON03	ON02	ON01	ON00
R40H	Gate Scan Control	W	1	0	0	0	0	0	0	0	0	0	0	0	SCN4	SCN3	SCN2	SCN1	SCN0
R41H	Vertical Scroll Control	W	1	0	0	0	0	0	0	0	0	VL7	VL6	VL5	VL4	VL3	VL2	VL1	VL0
R42H	First Screen Driving Position	W	1	SE17	SE16	SE15	SE14	SE13	SE12	SE11	SE10	SS17	SS16	SS15	SS14	SS13	SS12	SS11	SS10
R43H	Second Screen Driving Position	W	1	SE27	SE26	SE25	SE24	SE23	SE22	SE21	SE20	SS27	SS26	SS25	SS24	SS23	SS22	SS21	SS20
R44H	Horizontal RAM Address Position	W	1	HEA7	HEA6	HEA5	HEA4	HEA3	HEA2	HEA1	HEA0	HSA7	HSA6	HSA5	HSA4	HSA3	HSA2	HSA1	HSA0
R45H	Vertical RAM Address Position	W	1	VEA7	VEA6	VEA5	VEA4	VEA3	VEA2	VEA1	VEA0	VSA7	VSA6	VSA5	VSA4	VSA3	VSA2	VSA1	VSA0

: Means the initial value is"1" : Means the initial value is"0"

8 Timing Characteristics

8.1Timing Characteristics

Read / Write Characteristics (8080-series MPU)

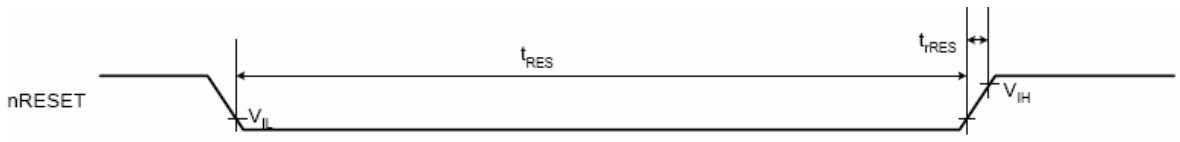
80-system Bus Timing Characteristics

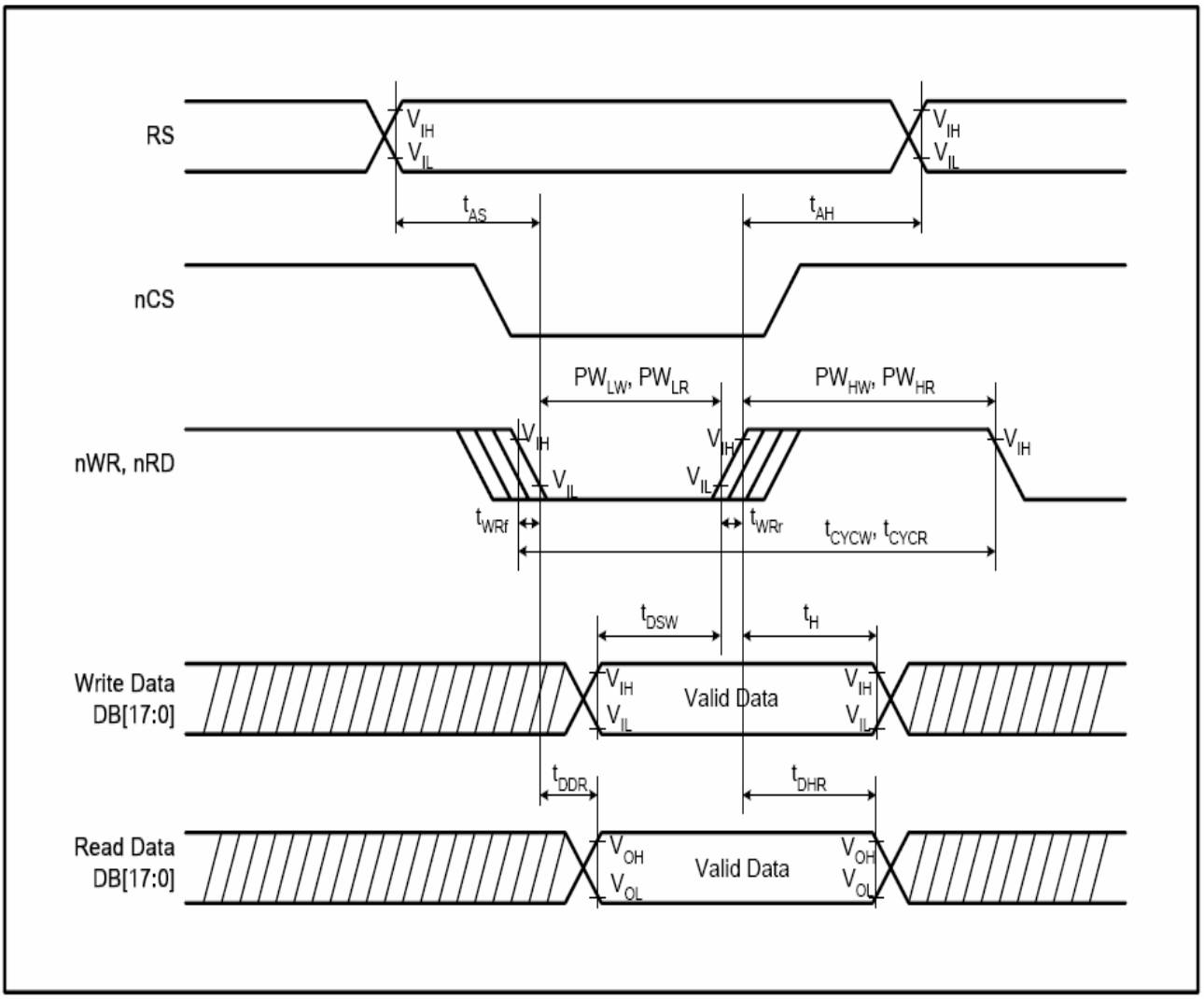
<<Normal Write Mode(HWM=0),IoVcc=1.65V~3.3V , VCC=2.4~3.3V >>

Item		Symbol	Unit	Min	Typ	Max
Bus cycle time	Write	tCYCW	ns	100	-	-
	Read	tCYCR	ns	300	-	-
Write low-level pulse width		PWLW	ns	50	-	500
Read low-level pulse width		PWLR	ns	150	-	-
Write high-level pulse width		PWHW	ns	50	-	-
Read high-level pulse width		PWHR	ns	150	-	-
Write/Read rise/fall time		tWRr,WRf	ns	-	-	25
Set up time	(RS to NCS,E_NWR)	tAS	ns	10	-	T.B.D
	(RS toNCS,RE_NRD)		ns	5	-	-
Address hold time		tAH	ns	5	-	-
Write data set up time		tDSW	ns	10	-	-
Write data hold time		tH	ns	15	-	-
Read data delay time		tDDR	ns	-	-	100
Read data hold time		tDHR	ns	5	-	-

Reset Timing Characteristics (VCC=1.8~3.3V, IOVCC=1.65~3.3V)

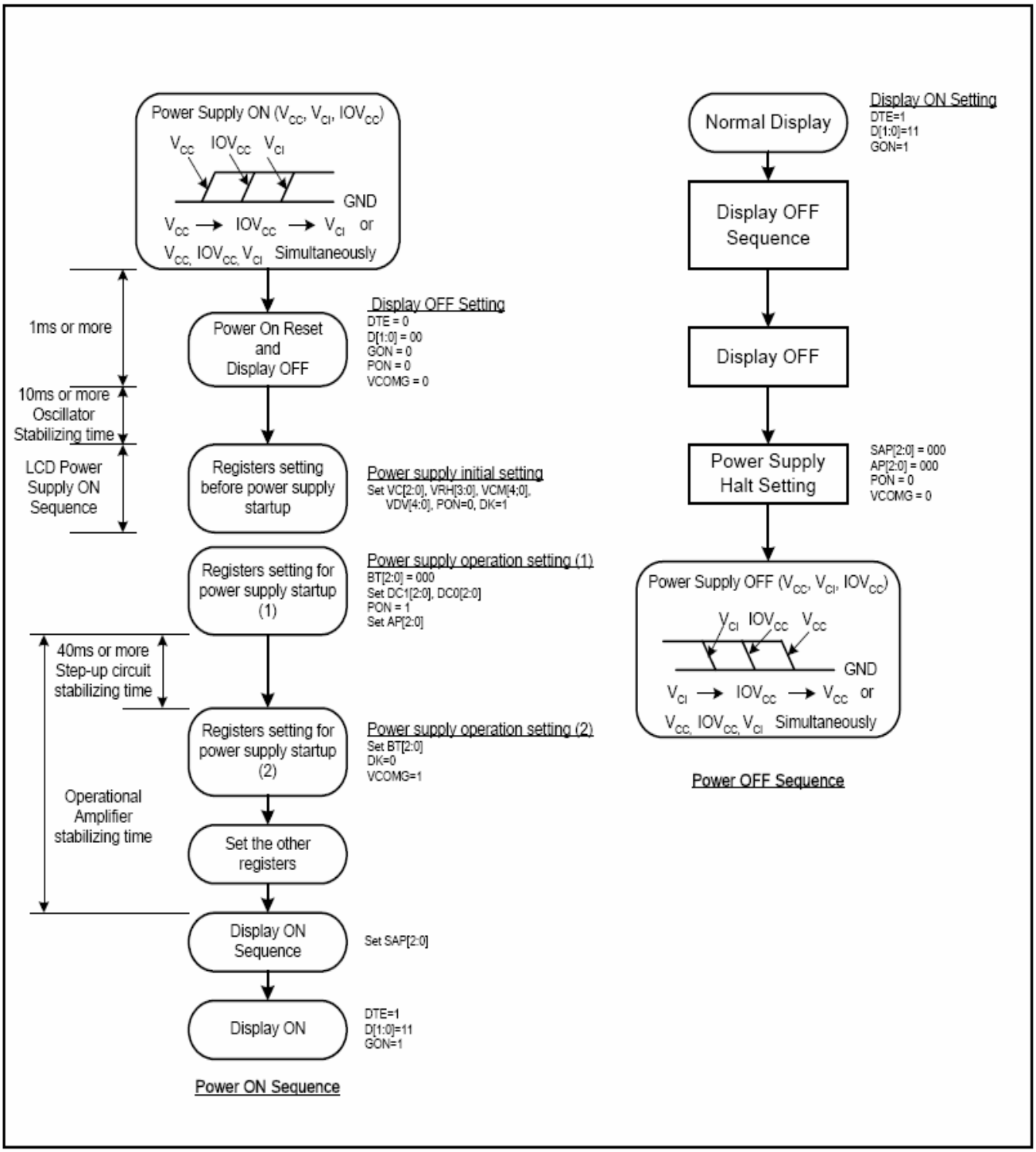
Item	Symbol	Unit	Min	Typ	Max
Reset"low"level width	tRES	ms	1	-	-
Reset rise time	trRES	us	-	-	10





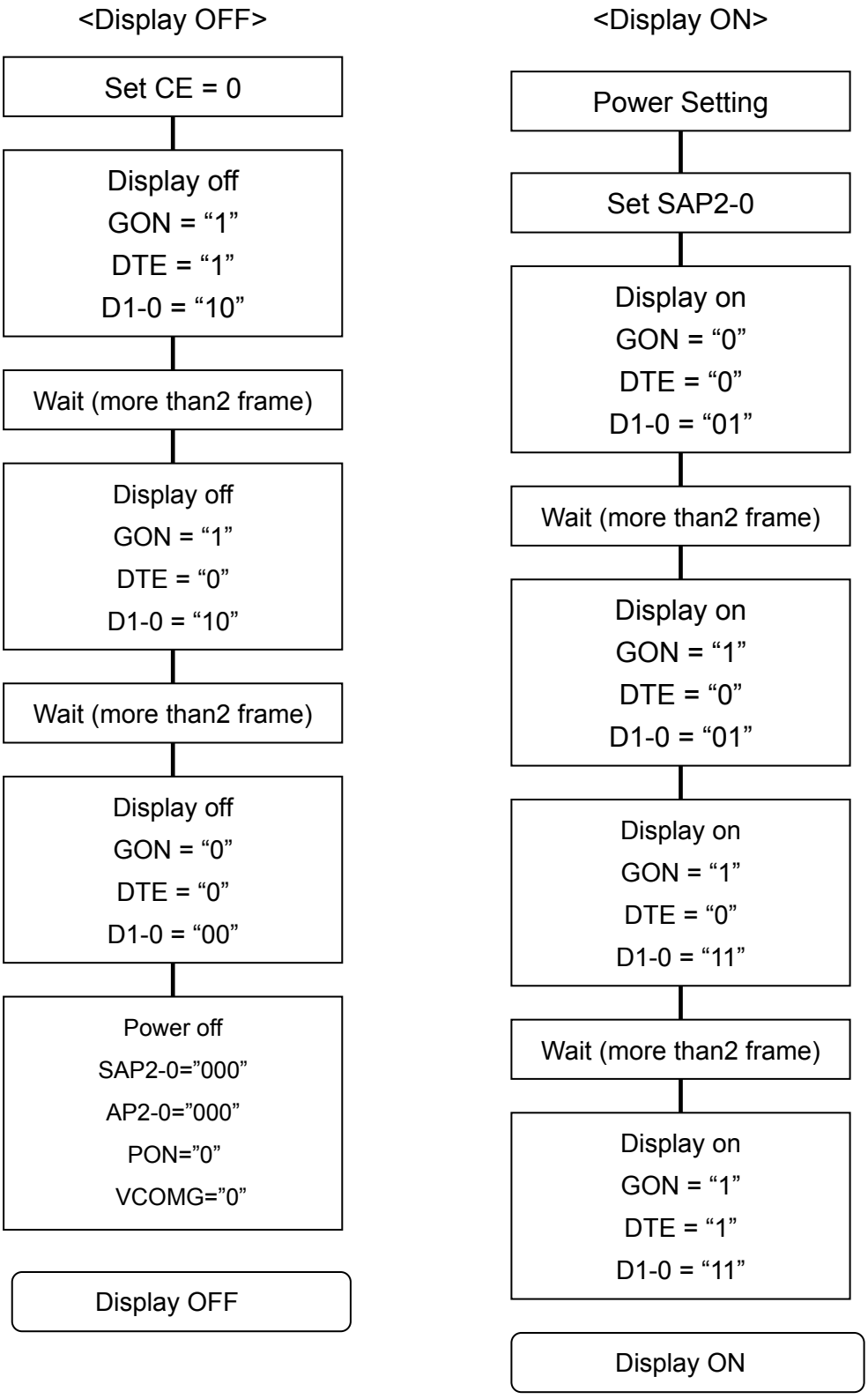
80-System Bus Timing

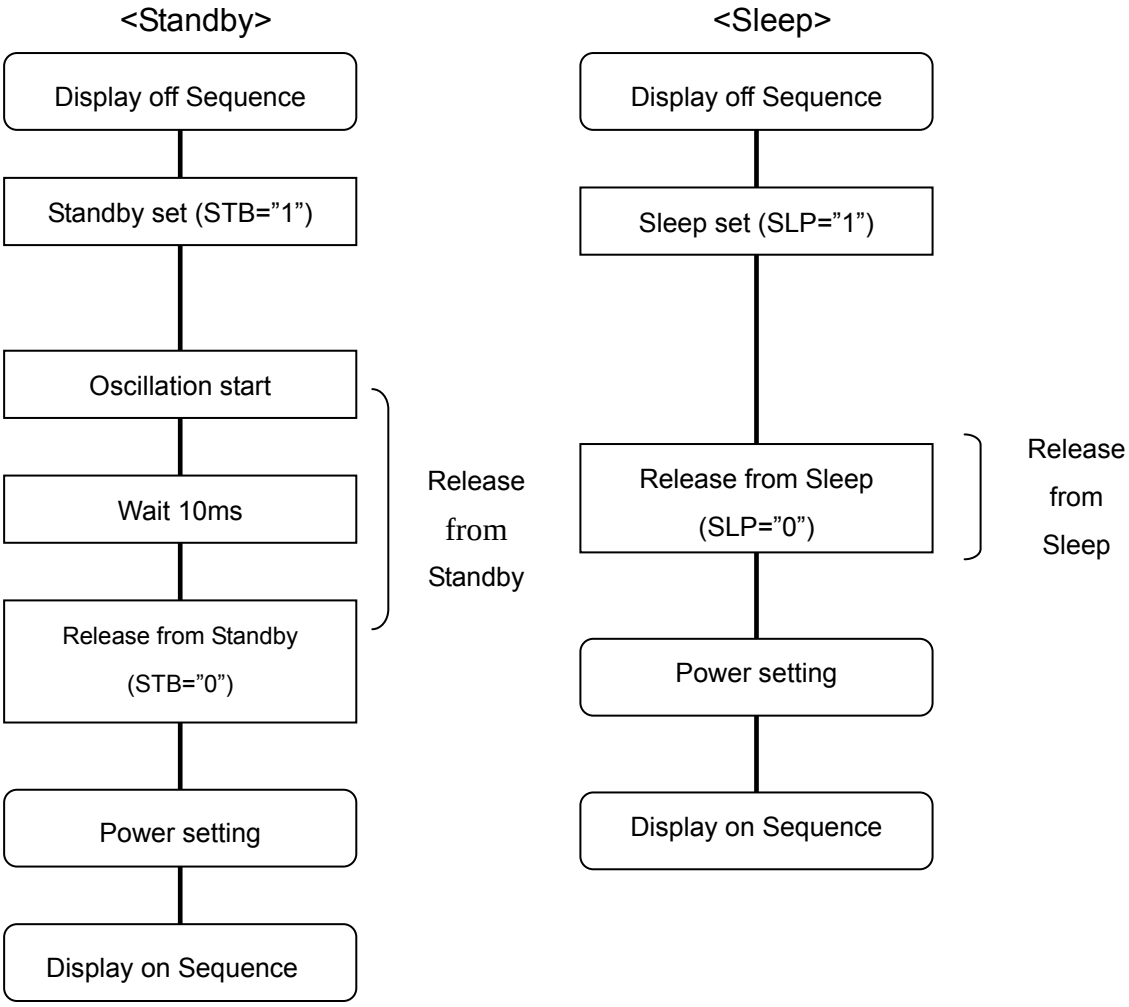
9 SETUP FLOW OF POWER SUPPLY



Power Supply ON/OFF Sequence

10 INSTRUCTION SETUP FLOW




<Standby>
Display off Sequence
Standby set (STB="1")
Oscillation start
Wait 10ms
Release from Standby
(STB="0")
Power setting
Display on Sequence
Release
from
Standby
<Sleep>
Display off Sequence
Sleep set (SLP="1")
Release from Sleep
(SLP="0")
Power setting
Display on Sequence
Release
from
Sleep

11 QUALITY AND RELIABILITY

11.1 TEST CONDITIONS

Tests should be conducted under the following conditions :

Ambient temperature : 25 ± 5°C

Humidity : 60 ± 25% RH.

11.2 SAMPLING PLAN

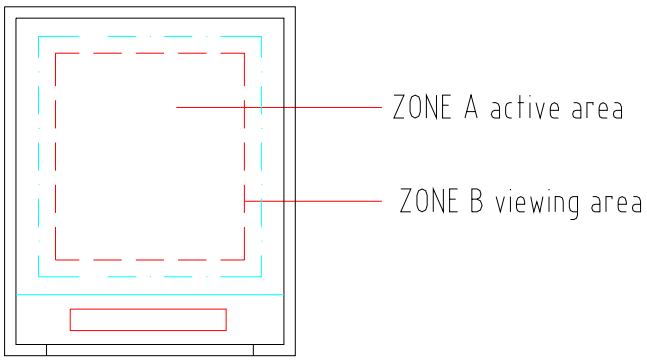
Sampling method shall be in accordance with MIL-STD-105E , level II, normal single sampling plan .

11.3 ACCEPTABLE QUALITY LEVEL

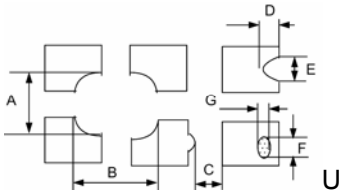
A major defect is defined as one that could cause failure to or materially reduce the usability of the unit for its intended purpose. A minor defect is one that does not materially reduce the usability of the unit for its intended purpose or is an infringement from established standards and has no significant bearing on its effective use or operation.

11.4 APPEARANCE

An appearance test should be conducted by human sight at approximately 30 cm distance from the LCD module under flourescent light. The inspection area of LCD panel shall be within the range of following limits.



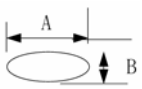
11.5 INSPECTION QUALITY CRITERIA

<table>
<tr><th>No.</th><th>Item</th><th>Criterion for defects</th><th>Defect type</th></tr>
<tr><td>1</td><td>Non display</td><td>No non display is allowed</td><td>Major</td></tr>
<tr><td>2</td><td>Irregular operation</td><td>No irregular operation is allowed</td><td>Major</td></tr>
<tr><td>3</td><td>Short</td><td>No short are allowed</td><td>Major</td></tr>
<tr><td>4</td><td>Open</td><td>Any segments or common patterns that don’t activate are rejectable.</td><td>Major</td></tr>
<tr><td>5</td><td>Black/White spot (I)</td><td>
<table>
<tr><th>Size D (mm)</th><th>Acceptable number</th></tr>
<tr><td>D ≤ 0.15</td><td>Ignore</td></tr>
<tr><td>0.15 < D ≤ 0.20</td><td>3</td></tr>
<tr><td>0.20 < D ≤ 0.30</td><td>2</td></tr>
<tr><td>0.30 < D</td><td>0</td></tr>
</table>
</td><td>Minor</td></tr>
<tr><td>6</td><td>Black/White line (I)</td><td>
<table>
<tr><th>Length(mm)</th><th>Width (mm)</th><th>Acceptable number</th></tr>
<tr><td>10 < L</td><td>0.03 < W ≤ 0.04</td><td>5</td></tr>
<tr><td>5.0 < L ≤10</td><td>0.04 < W ≤ 0.06</td><td>3</td></tr>
<tr><td>1.0 < L ≤ 5.0</td><td>0.06 < W ≤ 0.07</td><td>2</td></tr>
<tr><td>L ≤ 1.0</td><td>0.07 < W ≤ 0.09</td><td>1</td></tr>
</table>
</td><td>Minor</td></tr>
<tr><td rowspan="4">7</td><td rowspan="4">Dot Defect</td><td>Bright dot</td><td>$N \leqq 1$</td><td rowspan="4">Minor</td></tr>
<tr><td>Dark dot</td><td>$N \leqq 3$</td></tr>
<tr><td>Total dot defect
(Bright dot + Dark dot)</td><td>$N \leqq 3$</td></tr>
<tr><td>Minimum distance between dark dot and dark dot</td><td>$0.1 < D \leqq 0.3\text{mm}, N \leqq 2$</td></tr>
<tr><td>8</td><td>Back Light</td><td>1. No Lighting is rejectable
2. Flickering and abnormal lighting are rejectable</td><td>Major</td></tr>
<tr><td>9</td><td>Display pattern</td><td>


Unit:mm
<table>
<tr><td>$\frac{A+B}{2} \leq 0.30$</td><td>0 < C</td><td>$\frac{D+E}{2} \leq 0.25$</td><td>$\frac{F+G}{2} \leq 0.25$</td></tr>
</table>
Note: 1. Acceptable up to 3 damages
2. NG if there’re to two or more pinholes per dot
</td><td>Minor</td></tr>
</table>

<table>
<tr><td>10</td><td>Blemish & Foreign matters

Size:
$D = \frac{A+B}{2}$</td><td><table><tr><th>Size D (mm)</th><th>Acceptable number</th></tr><tr><td>D ≤ 0.15</td><td>Ignore</td></tr><tr><td>0.15 < D ≤ 0.20</td><td>3</td></tr><tr><td>0.20 < D ≤ 0.30</td><td>2</td></tr><tr><td>0.30 < D</td><td>0</td></tr></table></td><td>Minor</td></tr>
<tr><td>11</td><td>Scratch on Polarizer

  </td><td><table><tr><th>Width (mm)</th><th>Length (mm)</th><th>Acceptable number</th></tr><tr><td>W≤0.03</td><td>Ignore</td><td>Ignore</td></tr><tr><td>0.03<W≤0.05</td><td>L ≤ 2.0</td><td>Ignore</td></tr><tr><td></td><td>L > 2.0</td><td>1</td></tr><tr><td>0.05<W≤0.08</td><td>L > 1.0</td><td>1</td></tr><tr><td></td><td>L ≤ 1.0</td><td>Ignore</td></tr><tr><td>0.08<W</td><td>Note (1)</td><td>Note(1)</td></tr></table>Note(1) Regard as a blemish</td><td>Minor</td></tr>
<tr><td>12</td><td>Bubble in polarizer</td><td><table><tr><th>Size D (mm)</th><th>Acceptable number</th></tr><tr><td>D ≤ 0.20</td><td>Ignore</td></tr><tr><td>0.20 < D ≤ 0.50</td><td>3</td></tr><tr><td>0.50 < D ≤ 0.80</td><td>2</td></tr><tr><td>0.80 < D</td><td>0</td></tr></table></td><td>Minor</td></tr>
<tr><td>13</td><td>Stains on LCD panel surface</td><td>Stains that cannot be removed even when wiped lightly with a soft cloth or similar cleaning too are rejectable.</td><td>Minor</td></tr>
<tr><td>14</td><td>Rust in Bezel</td><td>Rust which is visible in the bezel is rejectable.</td><td>Minor</td></tr>
<tr><td>15</td><td>Defect of land surface contact (poor soldering)</td><td>Evident crevices which is visible are rejectable.</td><td>Minor</td></tr>
<tr><td>16</td><td>Parts mounting</td><td>1. Failure to mount parts
2. Parts not in the specifications are mounted
3. Polarity, for example, is reversed</td><td>Major
Major
Major</td></tr>
<tr><td>17</td><td>Parts alignment</td><td>1. LSI, IC lead width is more than 50% beyond pad outline.
2. Chip component is off center and more than 50% of the leads is off the pad outline.</td><td>Minor

Minor</td></tr>
<tr><td>18</td><td>Conductive foreign matter (Solder ball, Solder chips)</td><td>1. 0.45< φ ,N≧1
2. 0.30< φ ≤0.45 ,N≧1
φ :Average diameter of solder ball (unit: mm)
3. 0.50<L ,N≧1
L: Average length of solder chip (unit: mm)</td><td>Major
Minor

Minor</td></tr>
<tr><td>19</td><td>Faulty PCB correction</td><td>1. Due to PCB copper foil pattern burnout, the pattern is connected, using a jumper wire for repair; 2 or more places are corrected per PCB.
2. Short circuited part is cut, and no resist coating has been performed.</td><td>Minor

Minor</td></tr>
</table>

11.6 RELIABILITY

Test Item	Test Conditions	Note
High Temperature Operation	70±3°C , t=96 hrs	
Low Temperature Operation	-20±3°C , t=96 hrs	
High Temperature Storage	80±3°C , t=96 hrs	1,2
Low Temperature Storage	-30±3°C , t=96 hrs	1,2
Humidity Test	40°C , Humidity 90%, 96 hrs	1,2
Thermal Shock Test	-30°C ~ 25°C ~ 80°C 30 min. 5 min. 30 min. (1 cycle) Total 5 cycle	1,2
Vibration Test (Packing)	Sweep frequency：10~55~10 Hz/1min Amplitude : 0.75mm Test direction : X.Y.Z/3 axis Duration : 30min/each axis	2
Static Electricity	150pF 330 ohm ±8kV, 10times air discharge	

Note 1 : Condensation of water is not permitted on the module.

Note 2 : The module should be inspected after 1 hour storage in normal conditions

(15-35°C , 45-65%RH).

Definitions of life end point :

- Current drain should be smaller than the specific value.
- Function of the module should be maintained.
- Appearance and display quality should not have degraded noticeably.
- Contrast ratio should be greater than 50% of the initial value.

12 USE PRECAUTIONS

12.1 Handling precautions

1) The polarizing plate may break easily so be careful when handling it. Do not touch, press or rub it with a hard-material tool like tweezers.
2) Do not touch the polarizing plate surface with bare hands so as not to make it dirty. If the surface or other related part of the polarizing plate is dirty, soak a soft cotton cloth or chamois leather in benzine and wipe off with it. Do not use chemical liquids such as acetone, toluene and isopropyl alcohol. Failure to do so may bring chemical reaction phenomena and deteriorations.
3) Remove any spit or water immediately. If it is left for hours, the suffered part may deform or decolorize.
4) If the LCD element breaks and any LC stuff leaks, do not suck or lick it. Also if LC stuff is stuck on your skin or clothing, wash thoroughly with soap and water immediately.

12.2 Installing precautions

1) The PCB has many ICs that may be damaged easily by static electricity. To prevent breaking by static electricity from the human body and clothing, earth the human body properly using the high resistance and discharge static electricity during the operation. In this case, however, the resistance value should be approx. 1MΩ and the resistance should be placed near the human body rather than the ground surface. When the indoor space is dry, static electricity may occur easily so be careful. We recommend the indoor space should be kept with humidity of 60% or more. When a soldering iron or other similar tool is used for assembly, be sure to earth it.
2) When installing the module and ICs, do not bend or twist them. Failure to do so may crack LC element and cause circuit failure.
3) To protect LC element, especially polarizing plate, use a transparent protective plate (e.g., acrylic plate, glass etc) for the product case.
4) Do not use an adhesive like a both-side adhesive tape to make LCD surface (polarizing plate) and product case stick together. Failure to do so may cause the polarizing plate to peel off.

12.3 Storage precautions

1) Avoid a high temperature and humidity area. Keep the temperature between 0°C and 35°C and also the humidity under 60%.
2) Choose the dark spaces where the product is not exposed to direct sunlight or fluorescent light.
3) Store the products as they are put in the boxes provided from us or in the same conditions as we recommend.

12.4 Operating precautions

1) Do not boost the applied drive voltage abnormally. Failure to do so may break ICs. When applying power voltage, check the electrical features beforehand and be careful. Always turn off the power to the LC module controller before removing or inserting the LC module input connector. If the input connector is removed or inserted while the power is turned on, the LC module internal circuit may break.
2) The display response may be late if the operating temperature is under the normal standard, and the display may be out of order if it is above the normal standard. But this is not a failure; this will be restored if it is within the normal standard.
3) The LCD contrast varies depending on the visual angle, ambient temperature, power voltage etc. Obtain the optimum contrast by adjusting the LC dive voltage.
4) When carrying out the test, do not take the module out of the low-temperature space suddenly. Failure to do so will cause the module condensing, leading to malfunctions.
5) Make certain that each signal noise level is within the standard (L level: 0.2Vdd or less and H level: 0.8Vdd or more) even if the module has functioned properly. If it is beyond the standard, the module may often malfunction. In addition, always connect the module when making noise level measurements.
6) The CMOS ICs are incorporated in the module and the pull-up and pull-down function is not adopted for the input so avoid putting the input signal open while the power is ON.
7) The characteristic of the semiconductor element changes when it is exposed to light emissions, therefore ICs on the LCD may malfunction if they receive light emissions. To prevent these malfunctions, design and assemble ICs so that

they are shielded from light emissions.

8) Crosstalk occurs because of characteristics of the LCD. In general, crosstalk occurs when the regularized display is maintained. Also, crosstalk is affected by the LC drive voltage. Design the contents of the display, considering crosstalk.

12.5 Other

1) Do not disassemble or take the LC module into pieces. The LC modules once disassembled or taken into pieces are not the guarantee articles.
2) The residual image may exist if the same display pattern is shown for hours. This residual image, however, disappears when another display pattern is shown or the drive is interrupted and left for a while. But this is not a problem on reliability.

13 MECHANIC DRAWING