晶采光電科技股份有限公司
AMPIRE CO., LTD.

SPECIFICATIONS FOR
LCD MODULE

CUSTOMER	
CUSTOMER PART NO.	
AMPIRE PART NO.	**AM-240320DTMQW01H (TFT 3.2")**
APPROVED BY	
DATE	

APPROVED BY	CHECKED BY	ORGANIZED BY

RECORD OF REVISION

Revision Date	Contents	Editor
2006/3/17	New release	Patrick
2006/3/29	Add the 9H description	Patrick

1 Features

This single-display module is suitable for hand-held application. The LCD adopts one backlight with High brightness 6-lamps white LED.

(1) LCD : 1.1 Amorphous-TFT 3.2 inch display, transmissive, Normally white type.

      1.2 240(RGB)X320 dots Matrix

      1.3 LCD Driver IC: Source: Isron IS2102, Gate: Isron IS2202

      1.4 Full 262,144 colors display.

          Back ground : black (Back-Light, Red, Green, Blue dots are off state)

      1.5   Viewing Direction 9 o'clock

(2) Low cross talk by frame rate modulation

(3) Direct data display with display RAM

(4) Partial display function: You can save power by limiting the display space.

(5) RGB or MPU interface selectable.

(6) Abundant command functions:

      Area scroll function

      Display direction switching function

      Power saving function

(7) Built-in LED driver

(8) Mechanical specifications

    Dimensions and weight

Item		Specifications	Unit
Active Display Size		3.2 inch diagonal(81.28mm)	mm
Main LCD	Outline Dimension	55.64 (H) x 77.3(V)	mm
	Pixel pitch	0.2025 (H) x 0.2025(V)	mm
	Active area	48.6 (H) x 64.8 (V)	mm
	Number of Pixels	240(H)x320(V) pixels	mm

2 Absolute max. ratings and environment

2-1 Absolute max. ratings

Ta=25°C   GND=0V

Item	Symbol	Min.	Max.	Unit	Remarks
Power voltage	VDD – GND	-0.3	+4.0	V	
Power voltage	VBAT	-0.5	+6	V	
Input voltage	VIN	-0.5	VDD+0.5	V	

2-2 Environment

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

Note 1：Ta$\leq$+40°C・・・・Max.85%RH

Ta$>$+40°C・・・・The max. humidity should not exceed the humidity

with 40°C 85%RH.

3 Electrical specifications

3-1 Electrical characteristics of LCM

$(V_{DD}=3.0V, Ta=25\,^{o}C)$

Item	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
IC power voltage	V_{DD}		2.5	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	-	(6)		mA
Consumption current of LED	I_{VBAT}	VBAT=3.0V	-	(180)		mA

3-2 LED back light specification

Item	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	V_f	I_f =15mA	-	(19)	-	V
Forward current	I_f	Vf=19V	-	(15)	(20)	mA
Uniformity (with L/G)	-	I_f=15mA	70%	-	-	
C.I.E.	X		0.265	0.30	0.335	
	Y		0.275	0.31	0.345	
Luminous color	White					
Chip connection	6 chip serial connection					

4 Optical characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast		CR			290			
Response time	Rising	T_R			TBD		msec	
	Falling	T_F						
White luminance (center of screen)		Y_L			160		cd/m²	
Color chromaticity (CIE1931)	Red	Rx	$\Theta=0°$ $\phi=0°$ Normal viewing angle		0.619			
		Ry			0.362			
	Green	Gx			0.326			
		Gy			0.580			
	Blue	Bx			0.145			
		By			0.076			
	White	Wx			0.310			
		Wy			0.328			
Viewing angle	Hor.	Θ_L	CR>10		62.2			
		Θ_R			62.7			
	Ver.	Θ_H			38.7			
		Θ_L			59.2			

NOTE 1: Optical characteristic measurement system

Ring light

LCD module

Brightness gauge
BM-7 (Topcon)

Metal halide lamp

Glass fiber

LED:OFF, LIGHT:ON

LCD

Optical Detector

Brightness gauge
BM-7 (Topcon)

LED

LED:ON, LIGHT:OFF

NOTE 2: Response tome definition

Nonselected
Condition

Selected
Condition

Nonselected
Condition

Brightness

100%

10%

90%

tr

td

Rise Time

Decay Time (fall time tf)
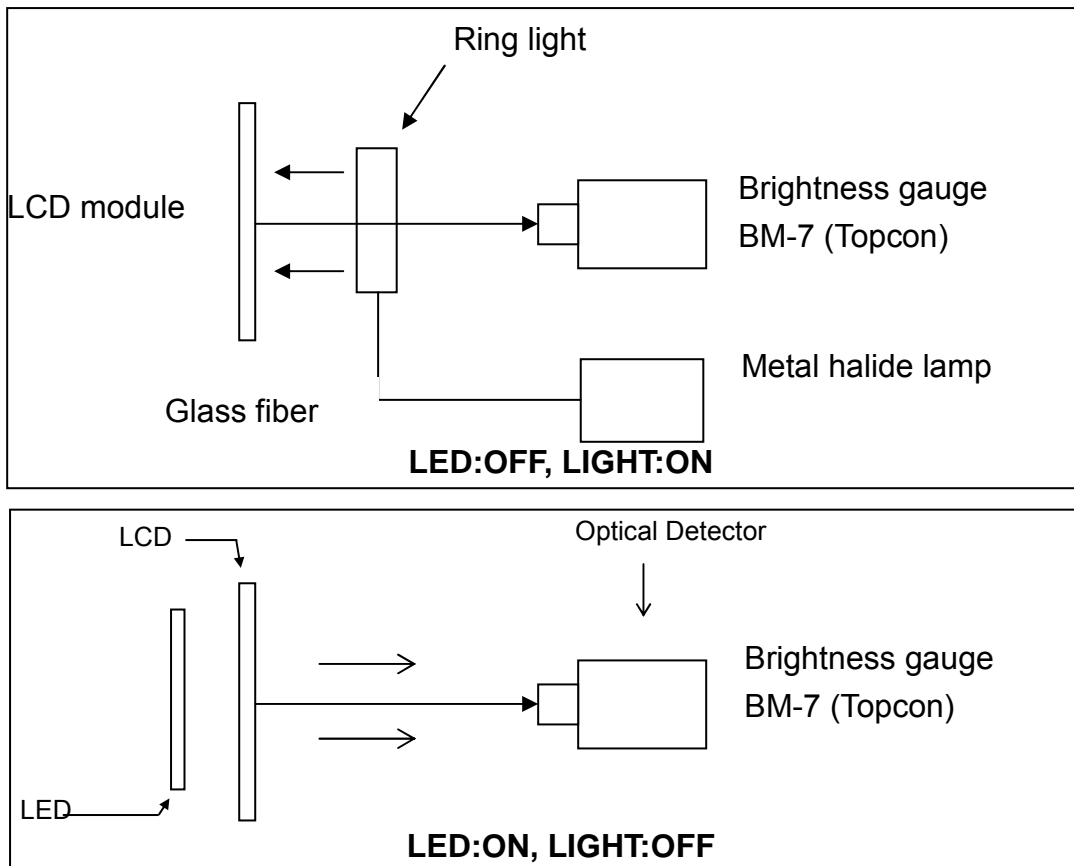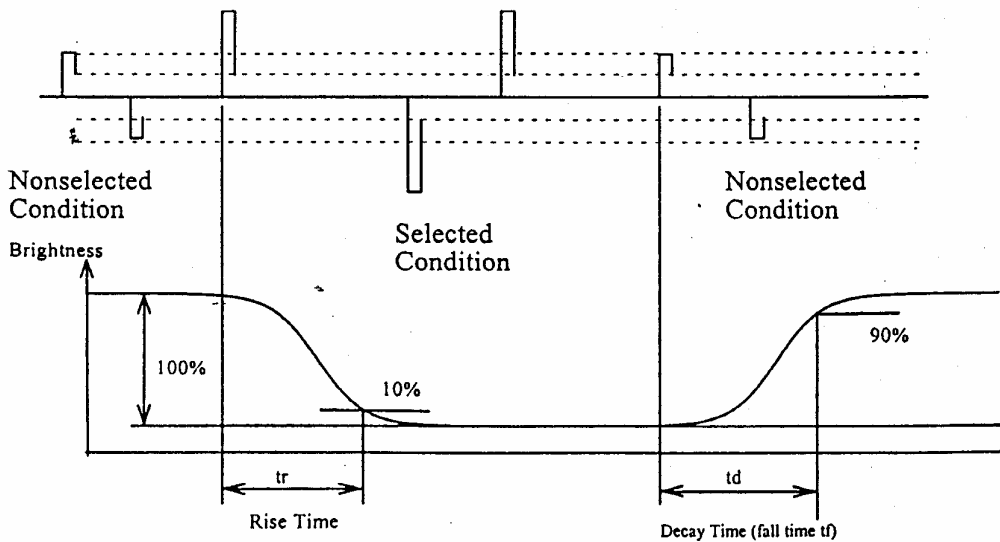
NOTE 3: φ、θ **definition**
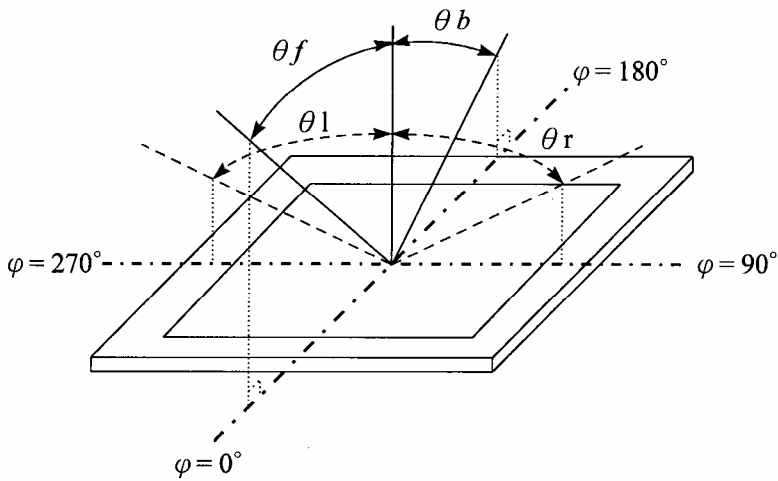
NOTE 4: Contrast definition

CR = Brightness in select (Bs)／Brightness in non-select (Bns)
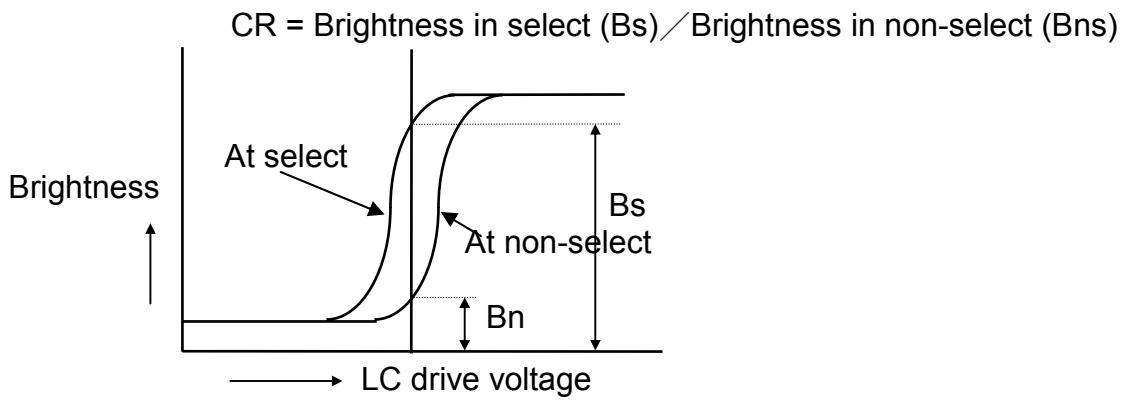
NOTE 5: Visual angle direction priority
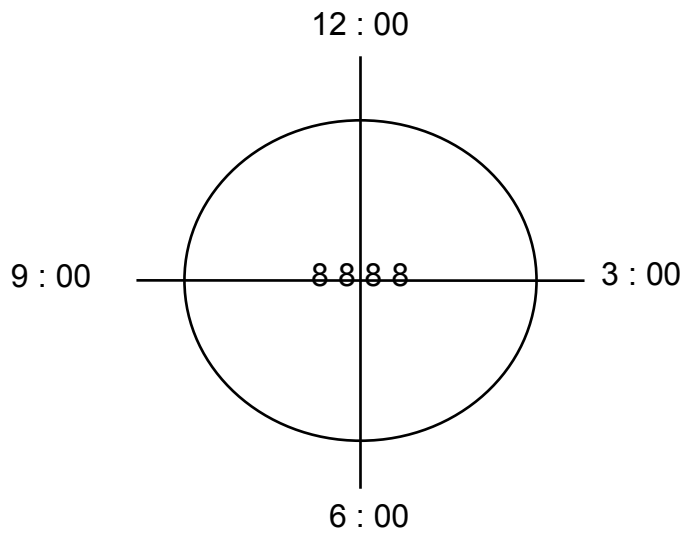
5 Block Diagram

Display format: A-Si TFT transmissive, Normally white type.
Display composition: 240(RGB) x 320 dots
LCD Driver : Source :Isron IS2102, Gate:Isron IS2202
Back light: White LED x 6 (I_{LED}=15mA)

LED B/L

240x320
TFT

1~320

19V

1~720

IS2202

IS2102

LED_Driver

Interface
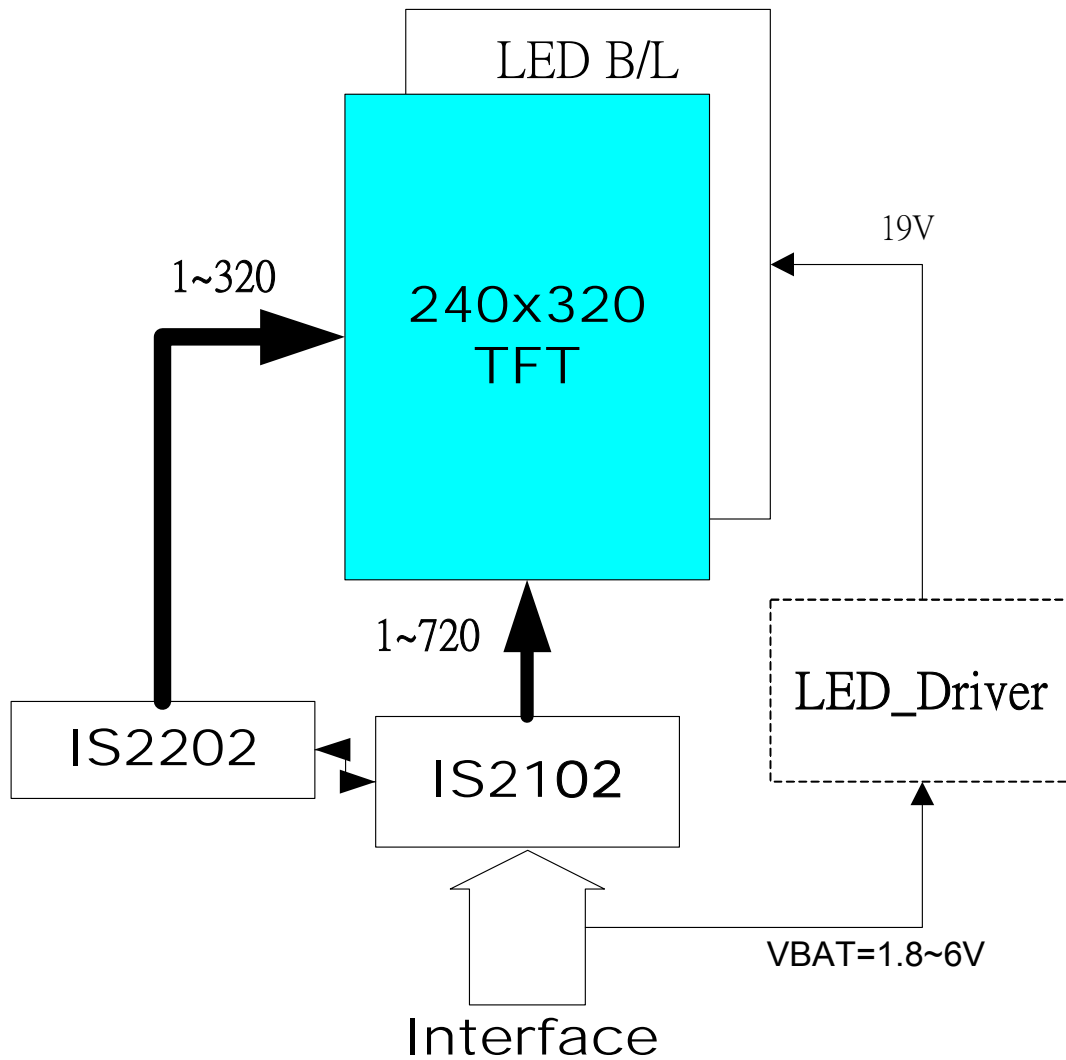
VBAT=1.8~6V

6 Interface specifications

Pin No.	Terminal	Functions
1	VBAT	LED Driver Input 1.8~6V
2	BL-EN	BACKLIGHT ENABLE
3	NC	No Connection
4	VCC	I/O power supply for the system interface (System I/F)
5	VSS	Ground pins
6	ADJ	A pin for external variable resistor to adjust VCOM1 center voltage
7	Dotclk	Dot clock for the RGB interface circuit Connect to VCC1A for VSS when not in use
8	Hsync	Horizontal synchronization signal Connect to VCC1A or VSS when not in use
9	Vsync	Vertical synchronization signal Connect to VCC1A or VSS when not in use
10	RGB/CPU	When IF_SHARE is"H",data pins (D17-D0) "L": Used for the System interface circuit "H":Used for the RGB interface circuit
11	/RD(E)	i80 series:Read enable signal M68 series:"L" Read/Write disable "H" Read/Write enable
12	/WR(R/W)	i80 MPU series:Write enable signal M68 series "L" Write (same for parallel "H" Read and serial interfaces)
13	RS	Selects data or command when transferring parallel/serial data. "L" : Command "H" : Display data
14	/RESET	Switching to "L" initializes internally. Must be reset after the power is supplied.
15	/CS	Chip selection pin. The "L" level enables inputting commands and reading /writing data.
16-33	D0-D17	18-bit bidirectional bus Connect to VSS when the serial interface is selected.
34	IF_SHARE	"L" : Uses data pins(D17-0) only for the system interface circuit. "H": Uses data pins(D17-0)both for the system interface circuit and For RGB interface circuit.
35	BWS2	"L":18 bits "H" : 16 bits
36-37	BWS1/BWS0	System interface selection
38	DTX2	System interface selection
39	DTX1	System interface selection
40	C86	"L" :i80 series MPU "H":M68 series MPU

7 System Interface Circuit

* PSX is fixed to Low in the display

Pin			Interface Circuit		
PSX	IF_SHARE	RGB./CPU	SI, SO, SCLK	D17-0	RGB25-00
L	L	X	–	System interface circuit	RGB interface circuit
L	H	L	–	System interface circuit / RGB interface circuit (*1)	–
L	H	H	–	RGB interface circuit	–

IS2102 HAS 18/16/8-bit parallel bus interfaces for the i80 series MPU, and 18/16/8-bit Parallel bus interfaces and 9/8-bit serial interfaces for the M68 series MPU. It is possible to select the interface by the setting of external pins.

Interface Type	Pin					Interface Mode (Bus width)	Number of data in a dot	Transferring method of one dot data	Transferring method of one-command data
	PSX	BWS1	BWS0	DTX2	DTX1				
MPU1	L	L	L	X	X	18-bit parallel	18 bits	18-bit collective	16-bit collective
MPU2	L	H	L	L	H	16-bit parallel	18 bits	9-bit twice	
MPU3	L	H	L	H	H			16-bit + 2-bit	
MPU4	L	H	L	L	L		16 bits	16-bit collective	
MPU5	L	H	H	L	H	8-bit parallel	18 bits	6-bit 3 times	8-bit twice
MPU6	L	H	H	H	H			8-bit + 8-bit + 2-bit	
MPU7	L	H	H	H	L		16 bits	8-bit twice	
MPU8	H	L	H	X	X	9-bit serial	18 bits	9-bit twice	9-bit twice
MPU9	H	H	H	X	X	8-bit serial	16 bits	8-bit twice	8-bit twice

7.1 ADJ connection

External Adjustment of Vcom Center Voltage

The IS2202 can adjust the VCOM1 center voltage with external resisters. The ADJTP pin is used for this adjustment. The figure below shows an example of this external adjustment connection. The VCOM1 center voltage is adjusted by adjusting internal and external resistances. This function is available only when internal registers R31 and R32 are set as below. With other settings, both VCOM1 center voltage and VCOM1 amplitude vary as VR changes.

R31 = "95"h
R32 = "40"h

When not using this external adjustment function (when ADJTP is OPEN), the VCOM1 center voltage can be set by an internal register (R32).

The VCOM1 amplitude can be changed according to the settings of R31and R32.
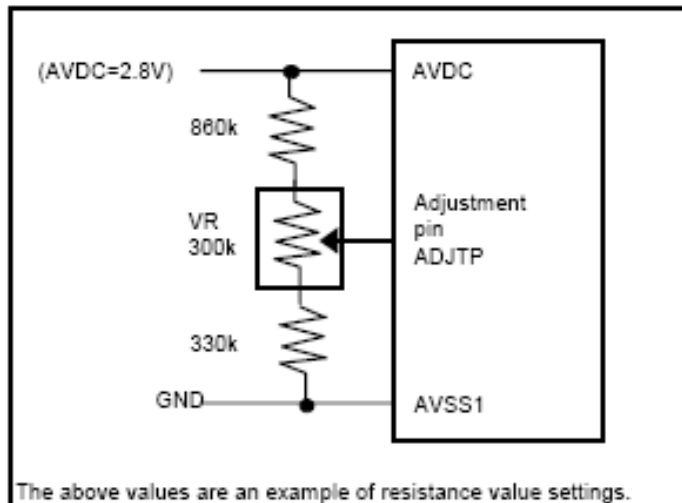
Figure 11-1: Vcom center voltage adjustment

8 AC Characteristics

i80-MPU Connection
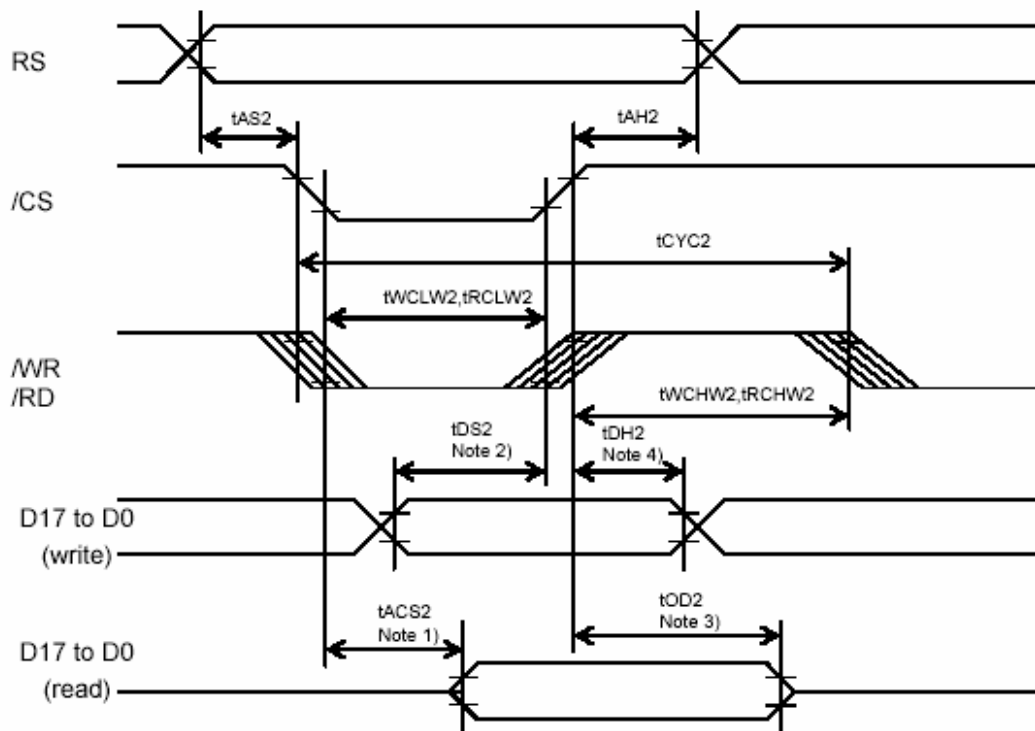
Note 1) . tACS2 is defined by the later timing between "/CS"and "/RD".

Note 2) . tDS2   is defined by the earlier timing between "/CS" and"/RD".

Note 3) . tOD2 is defined by the earlier timing between "/CS"and "/RD".

Note 4) . tDH2 is defined by the later timing between "/CS"and"/RD".

(VCC1A=2.8V,VCC1B=2.8V,V18=1.85V,TA=25 degrees C)

Parameter	Symbol	Min.	Max.	Unit
Address set-up time	tAS2	0		ns
Address hold time	tAH2	0		ns
System cycle time (write)	tCYC2	166		ns
System cycle time (read)	tCYC2	350		ns
WR control H pulse width	tWCHW2	70		ns
WR control L pulse width	tWCLW2	70		ns
RD control H pulse width	tRCHW2	60		ns
RD control L pulse width	tRCLW2	130		ns
Data set-up time	tDS2	20		ns
Data hold time	tDH2	0		ns
Access time (CL=100Pf)	tACS2		110	ns
Invalid output time	tOD2	10	100	ns

Please make sure to set "tr" and "tf" to be less than 15ns.

M68-MPU Connection
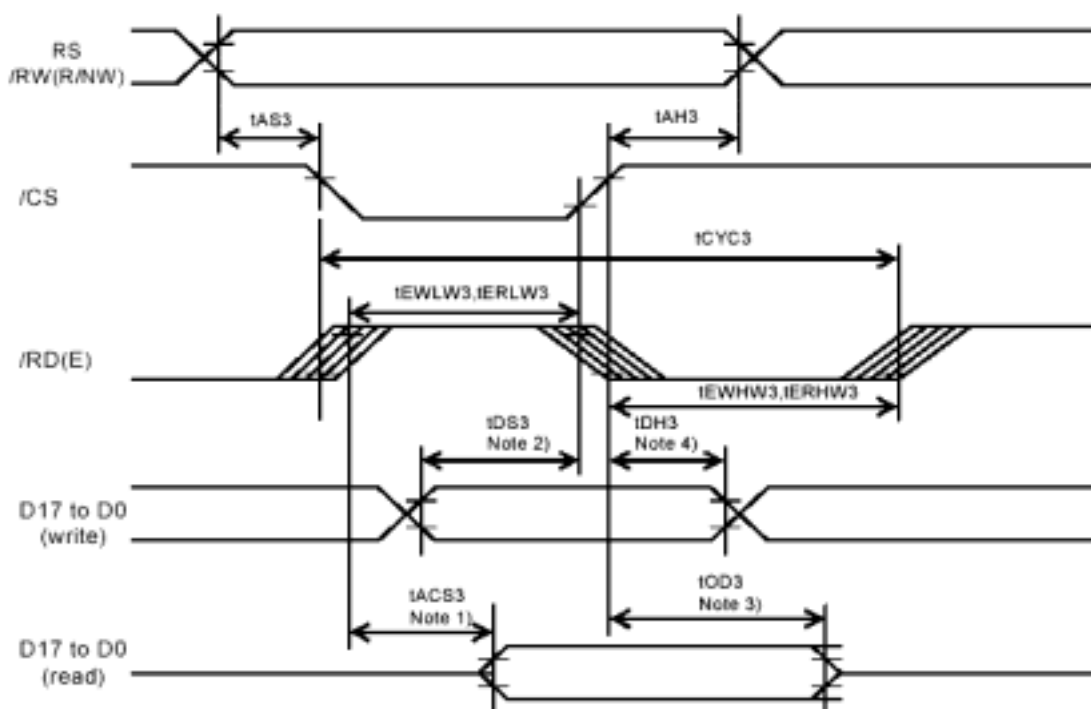
Note 1) . tACS3 is defined by the later timing between "/CS"and "E".

Note 2) . tDS3   is defined by the earlier timing between "/CS" and"E".

Note 3) . tOD3 is defined by the earlier timing between "/CS"and "E".

Note 4) . tDH3 is defined by the later timing between "/CS"and"E".

(VCC1A=2.8V,VCC1B=2.8V,V18=1.85V,TA=25 degrees C)

Parameter	Symbol	Min.	Max.	Unit
Address set-up time	tAS3	0	---	ns
Address hold time	tAH3	0	---	ns
System cycle time (write)	tCYC3	166	---	ns
System cycle time (read)	tCYC3	350	---	ns
Enable H pulse width (write)	tEWHW3	70	---	ns
Enable L pulse width (write)	tEWLW3	70	---	ns
Enable H pulse width (read)	tERHW3	60	---	ns
Enable L pulse width (read)	tERLW3	130	---	ns
Data set-up time	tDS3	20	---	ns
Data hold time	tDH3	0	---	ns
Access time (CL=100Pf)	tACS3		110	ns
Invalid output time	tOD3	10	100	ns

Please make sure to set "tr" and "tf" to be less than 15ns.

9.QUALITY AND RELIABILITY

9.1 TEST CONDITIONS

Tests should be conducted under the following conditions :
Ambient temperature : 25 ± 5°C
Humidity : 60 ± 25% RH.

9.2 SAMPLING PLAN

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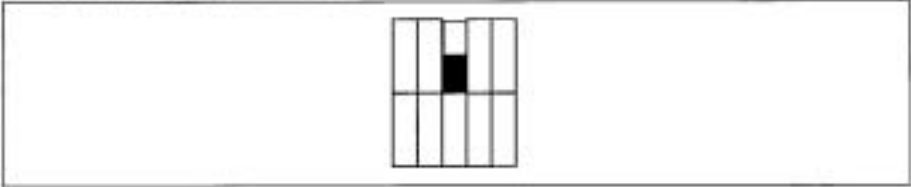
9.3 ACCEPTABLE QUALITY LEVEL

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.
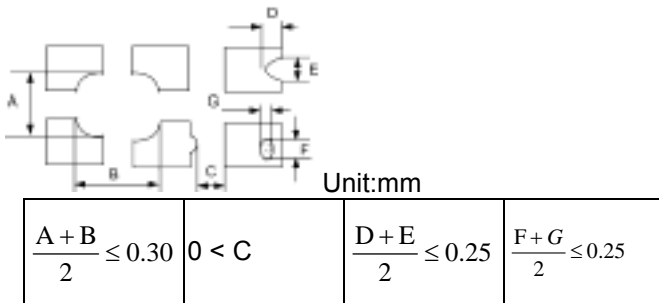
9.4 APPEARANCE

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.

ZONE A active area

ZONE B viewing area
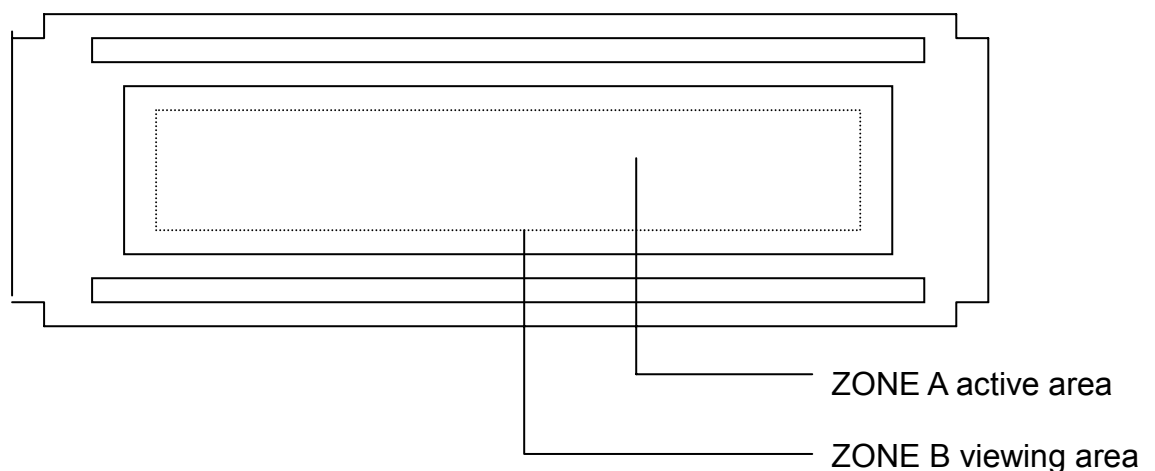
9.5　INSPECTION QUALITY CRITERIA

No.	Item	Criterion for defects			Defect type
1	Non display	No non display is allowed			Major
2	Irregular operation	No irregular operation is allowed			Major
3	Electrical defect	Bright dot	Not allowed		Major
		Dark dot	2		Minor
		Distance between Dark - dark	$\geqq$ 5mm		Minor

Note 1. Bright,Dark dot defect description

-bright area is more than 50% of one dot

- dark area is more than 50% of one dot

No.	Item	Criterion for defects	Defect type
4	Mura	ND 8%	Minor

5	Black/White spot (I)			Minor

Size D (mm)	Acceptable number
D $\leq$ 0.15	Ignore
0.15 < D $\leq$ 0.20	3
0.20 < D $\leq$ 0.30	2
0.30 < D	0

6	Black/White line (I)			Minor

Length(mm)		Acceptable number
10 < L	0.03 < W $\leq$ 0.04	5
5.0 < L $\leq$ 10	0.04 < D $\leq$ 0.06	3
1.0 < L $\leq$ 5.0	0.06 < D $\leq$ 0.07	2
L $\leq$ 1.0	0.07 < D $\leq$ 0.09	1

7	Black/White sport (II)			Minor

Size D (mm)	Acceptable number
D $\leq$ 0.30	Ignore
0.30 < D $\leq$ 0.50	5
0.50 < D $\leq$ 1.20	3
1.20 < D	0

8	Black/White line (II)	Length (mm)	Width (mm)	Acceptable number		Minor
		$20 < L$	$0.05 < W \leq 0.07$	5		
		$10 < L \leq 20$	$0.07 < D \leq 0.09$	3		
		$5.0 < L \leq 10$	$0.09 < D \leq 0.10$	2		
		$L \leq 5.0$	$0.10 < D \leq 0.15$	1		

9	Back Light	1. No Lighting is rejectable 2. Flickering and abnormal lighting are rejectable	Major

10	Display pattern	Unit:mm				Minor

$$\frac{A+B}{2} \leq 0.30 \quad 0 < C \quad \frac{D+E}{2} \leq 0.25 \quad \frac{F+G}{2} \leq 0.25$$

Note: 1. Acceptable up to 3 damages
2. NG if there're to two or more pinholes per dot

11	Blemish & Foreign matters Size: $D = \dfrac{A+B}{2}$	Size D (mm)	Acceptable number	Minor
		$D \leq 0.15$	Ignore	
		$0.15 < D \leq 0.20$	3	
		$0.20 < D \leq 0.30$	2	
		$0.30 < D$	0	

12	Scratch on Polarizer	Width (mm)	Length (mm)	Acceptable number	Minor
		$W \leq 0.03$	Ignore	Ignore	
		$0.03 < W \leq 0.05$	$L \leq 2.0$	Ignore	
			$L > 2.0$	1	
		$0.05 < W \leq 0.08$	$L > 1.0$	1	
			$L \leq 1.0$	Ignore	
		$0.08 < W$	Note (1)	Note(1)	

Note(1) Regard as a blemish

13	Bubble in polarizer	Size D (mm)	Acceptable number	Minor
		$D \leq 0.20$	Ignore	
		$0.20 < D \leq 0.50$	3	
		$0.50 < D \leq 0.80$	2	
		$0.80 < D$	0	

14	Stains on LCD panel surface	Stains that cannot be removed even when wiped lightly with a soft cloth or similar cleaning too are rejectable.	Minor

15	Rust in Bezel	Rust which is visible in the bezel is rejectable.	Minor

16	Defect of land surface contact (poor soldering)	Evident crevices which is visible are rejectable.	Minor
17	Parts mounting	1. Failure to mount parts 2. Parts not in the specifications are mounted 3. Polarity, for example, is reversed	Major Major Major
18	Parts alignment	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.	Minor Minor
19	Conductive foreign matter (Solder ball, Solder chips)	1. $0.45 < \varphi$,$N \geq 1$ 2. $0.30 < \varphi \leq 0.45$,$N \geq 1$ φ :Average diameter of solder ball (unit: mm) 3. $0.50 < L$,$N \geq 1$ L: Average length of solder chip (unit: mm)	Major Minor Minor
20	Faulty PCB correction	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.	Minor Minor

9.6 RELIABILITY

Test Item	Test Conditions	Note
High Temperature Operation	60±3°C , t=96 hrs	
Low Temperature Operation	-10±3°C , t=96 hrs	
High Temperature Storage	70±3°C , t=96 hrs	1,2
Low Temperature Storage	-20±3°C , t=96 hrs	1,2
Humidity Test	40°C , Humidity 90%, 96 hrs	1,2
Thermal Shock Test	-20°C ~ 25°C ~ 70°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

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.

10 Use precautions

10-1 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.

10-2 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.

10-3 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.

10-4 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.

10-5 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.

11 Mechanic Drawing

Back View

Component area
T=2.2Max

20.5±0.3 (20.45)
P0.5x39 0.5
3.5
40
6.806
29.32Max
15.0Max (2.45±0.2)

A Block
0.2025
0.068
R G B
0.2025
3.9±0.2
6.5Max

Contact
Stiffener
Viewing Direction
0.3±0.05

67.0±0.2 (V,A) (7.95)
64.8 (A,A) (9.05)
55.64±0.5
51.0±0.2 (V,A)
48.6 (A,A)
(2.32)
(3.52)
315±0.3
75.19±1.0
27.82±0.3
(5.71(5))
(19.6±0.5)
No coverlay
4.5
20.5±0.3 (20.45)
41.45±0.3
77.3±0.5 (0.5)

AMPIRE
(A)

Note:
1. Unless indicated, Tolerance Grade "B" is adopted.
2. RTV Glue For OLB Protection.
3. Main LCD 240(R,G,B)x320 => 3.2" TFT LCD

1	VBAT	21	D5
2	BL_EN	22	D6
3	NC	23	D7
4	VCC	24	D8
5	VSS	25	D9
6	ADJ	26	D10
7	Dotclk	27	D11
8	Hsync	28	D12
9	Vsync	29	D13
10	R/G	30	D14
11	/RD	31	D15
12	/WR	32	D16
13	RS	33	D17
14	/RES	34	SHARE
15	/CS	35	BWS2
16	D0	36	BWS1
17	D1	37	BWS0
18	D2	38	DTX2
19	D3	39	DTX1
20	D4	40	C86

TOLERANCE GRADE(±)	A	B
~6	0.05	0.1
6~18	0.08	0.18
18~50	0.1	0.25
50~180	0.2	0.4
180~	0.3	0.5

240320D

TITLE: 240320D
DWN: EMILY DATE: 07-04-05
CHK: DATE:
APPD: DATE:
DIM. MM
PARTS NO. LCM 240320D
DWG. NO. *05O7O2MA SHEET 1 OF 1

REV 0 NEW RELEASE
DATE 07-04-05 NAME EMILY