CLOVER DISPLAY LTD.

LCD MODULE SPECIFICATION

Model: CV240160D - _ _ - _ _ - _ _ - _

Revision	00
Engineering	Steven Doo
Date	15 March 2021
Our Reference	4940

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MODE OF DISPLAY

Display mode	**Display condition**	**Viewing direction**
STN : ☐ Yellow green	☐ Reflective type	☐ 6 O' clock
☐ Grey	☐ Transflective type	☐ 12 O' clock
☐ Blue (negative)	☐ Transmissive type	☐ 3 O' clock
☐ FSTN positive	☐ Others	☐ 9 O' clock
☐ FSTN negative		

LCD MODULE NUMBER NOTATION:

CV240160D- MY - S F - N 6 – T
(1) (2) (3) (4) (5) (6) (7) (8)

*(1)---Model number of standard LCD Modules
*(2)---Backlight type
N – No backlight
E – EL backlight
L – Side-lited LED backlight
M– Array LED backlight
C – CCFL
*(3)---Backlight color
N – No backlight
A – Amber
B – Blue
O– Orange
W–White
Y – Yellow green
*(4)---Display mode
T – TN
V – TN (Negative)
S – STN Yellow green
G – STN Grey
B – STN Blue (Negative)
F – FSTN
N – FSTN (Negative)
*(5)---Rear polarizer type
R – Reflective
F – Transflective
T – Transmissive
*(6)---Temperature range
N – Normal
W– Extended
*(7)---Viewing direction
6 – 6 O'clock
2 – 12 O'clock
3 – 3 O'clock
9 – 9 O'clock
*(8)---Special code for other requirements
(Can be omitted if not used)
T – Touch panel (Analog)
P – Touch panel (Digital)

GENERAL DESCRIPTION

Display mode : 240 x 160 dots, graphic COF LCD module

Interface : 8 bit parallel

Driving method : 1/160 duty, 1/13 bias

Backlight : Side-lited LED

Controller IC : RAIO RA8806A or equivalent
For the detailed information, please refer to the IC specifications.

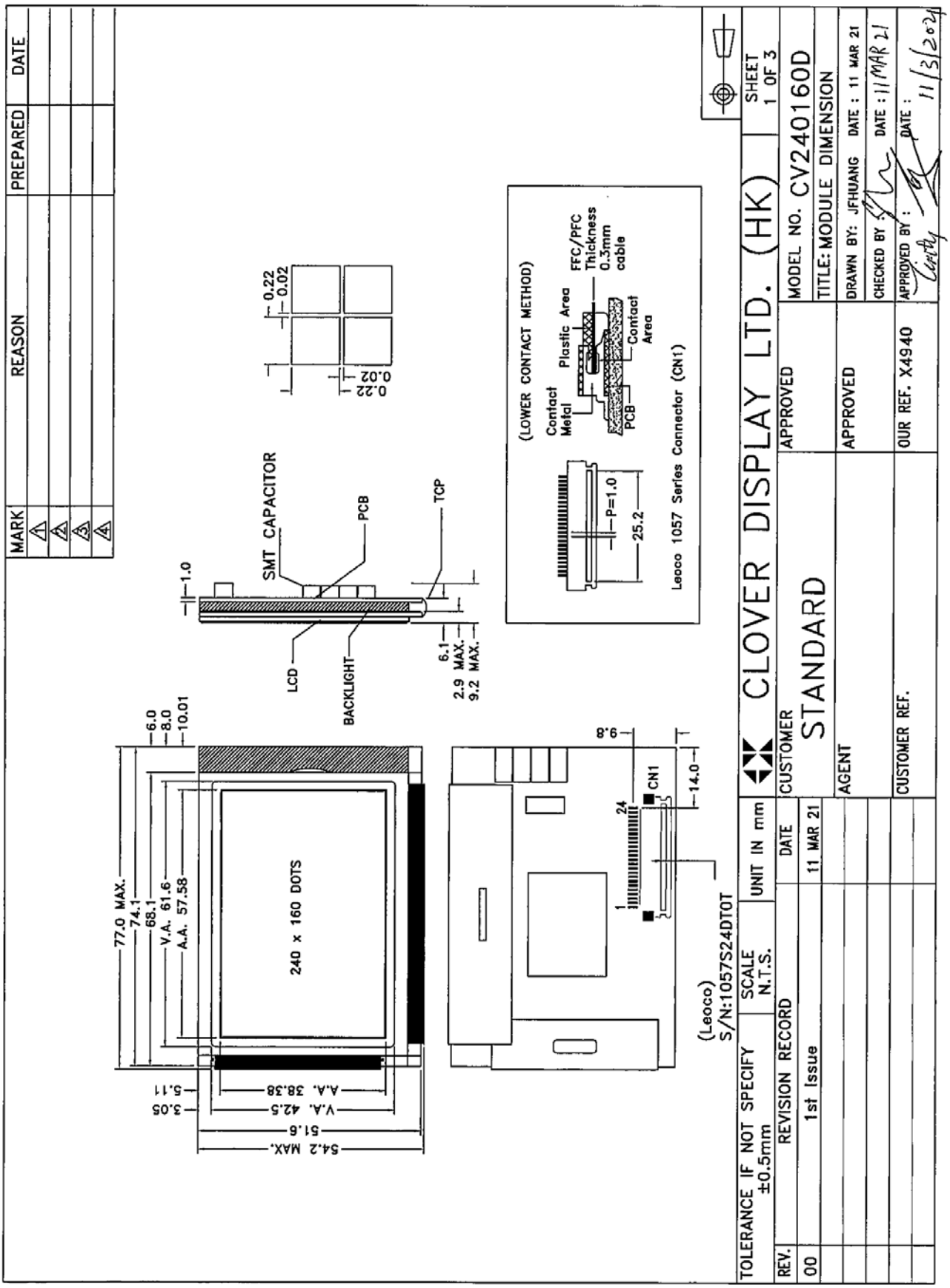
MECHANICAL DIMENSIONS

Item	Dimension	Unit
Outline Dimension	74.1(L) x 51.6(W) x 9.2 MAX.(H)	mm
Viewing Area	61.6(L)x42.5(W)	mm
Active Area	57.58(L)x38.38(W)	mm
Dot Pitch	0.24(L)x0.24(W)	mm
Dot Size	0.22(L)x0.22(W)	mm

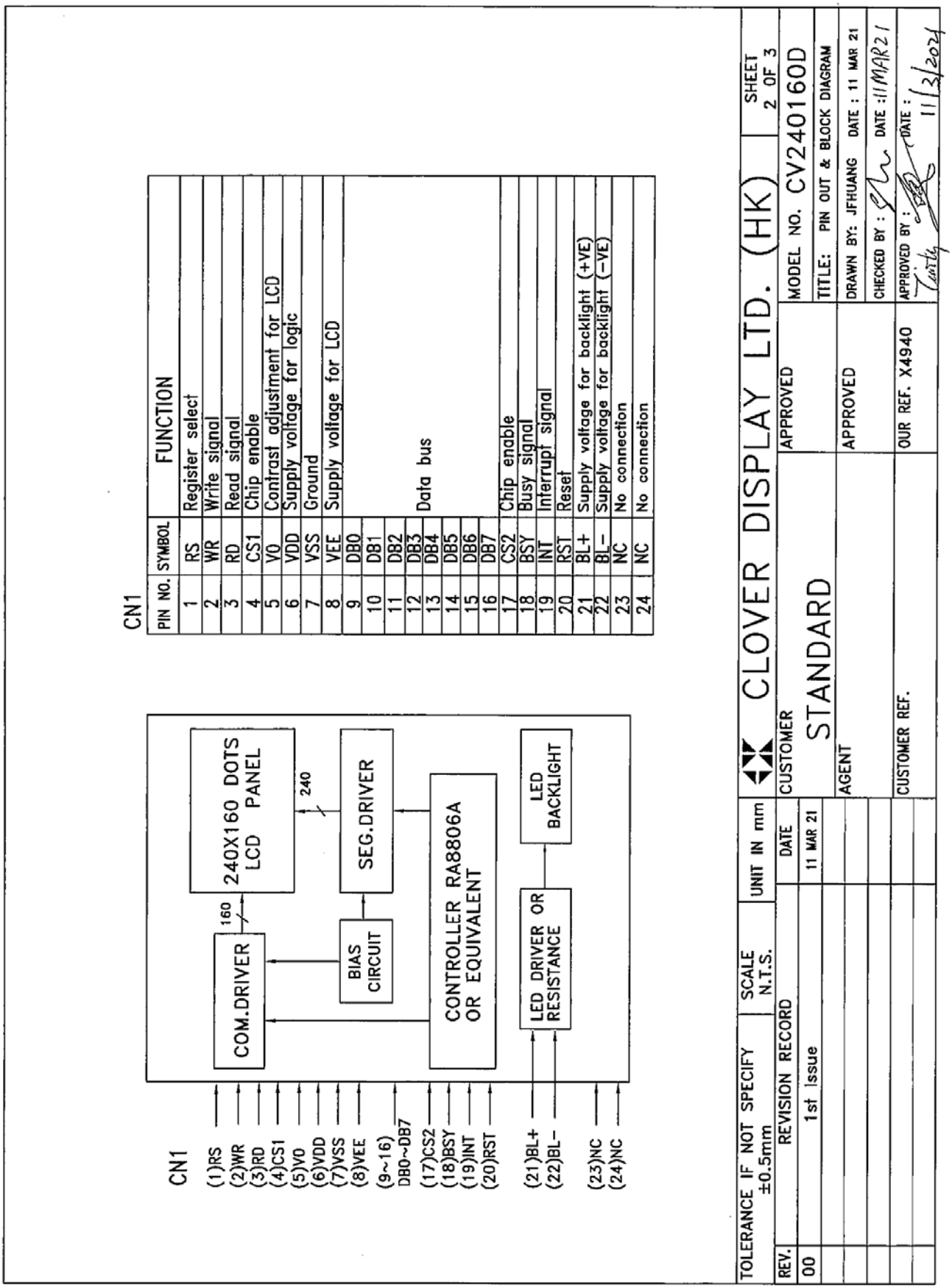
CONNECTOR PIN ASSIGNMENT

Pin No.	Symbol	Function	Pin No.	Symbol	Function
1	RS	Register select	13	DB4	Data bus
2	WR	Write signal	14	DB5	
3	RD	Read signal	15	DB6	
4	CS1	Chip enable	16	DB7	
5	VLCD	Contrast adjustment for LCD	17	CS2	Chip enable
6	VDD	Supply voltage for logic	18	BSY	Busy signal
7	VSS	Ground	19	INT	Interrupt signal
8	VEE	Supply voltage for LCD	20	RST	Reset
9	DB0	Data bus	21	BL+	Supply voltage for backlight
10	DB1		22	BL-	Supply voltage for backlight (-VE)
11	DB2		23	NC	No connection
12	DB3		24	NC	No connection

COUNTER DRAWING OF MODULE DIMENSION



COUNTER DRAWING OF PIN OUT & BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS

Conditions: VSS=0V, Ta=25℃

Item	Symbol	MIN.	TYP.	MAX.	Unit	Item	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage for Logic (5V input)	VDD	4.75	5.0	5.25	V	Power supply for LCD	VEE	21.0	–	25.0	V
Supply Voltage for Logic (3.3V input)	VDD	3.0	3.3	3.6	V	"H"Level Input Voltage	VIH	0.8VDD	–	VDD	V
Supply Current for Logic	IDD	1	5	10	mA	"L"Level Input Voltage	VIL	VSS	–	0.2VDD	V
LCD Contrast Adjustment (*)	VO	17.7	18.6	19.5	V	–	–	–	–	–	–

Note (*): There is tolerance in optimum LCD driving voltage during production and it will be within the specified range.

Side Backlight

Constant current driving:

Item	Symbol	MIN.	TYP.	MAX.	Unit	Condition
Backlight Voltage	V_{BL}	3.8	4.0	4.2	V	I_{BL} = 60mA

ABSOLUTE MAXIMUM RATINGS

Please make sure not to exceed the following maximum rating values under the worst application conditions

Item	Symbol	Rating (for normal temperature)	Unit
Supply Voltage	VDD	-0.3 to 6.5	V
Input Voltage	VIN	-0.3 to V_{DD} +0.3	V
Operating Temperature	Topr	-20 to 70	℃
Storage Temperature	Tstg	-30 to 80	℃

Application note:

FOR RA8806		
	VDD=5V	VDD=3V
L1	OPEN	0.47uH
L2	0.47uH	0.47uH
R12	SHORT	OPEN
R13	SHORT	SHORT
R14	OPEN	OPEN

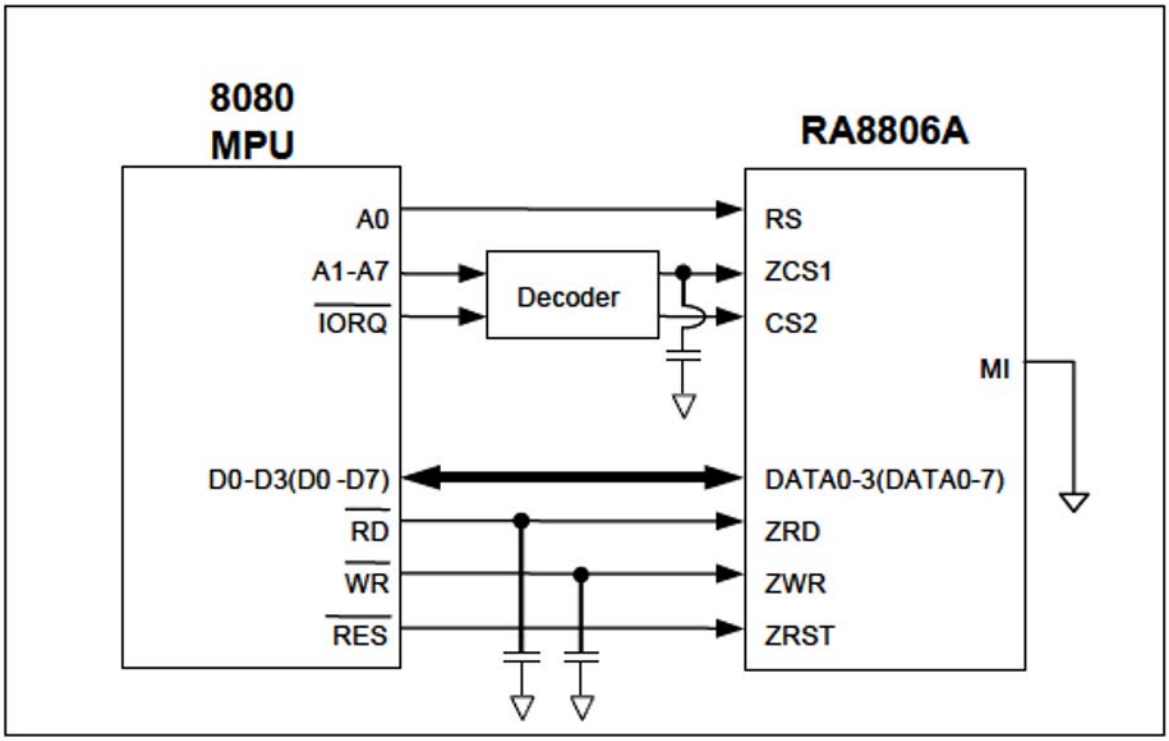


图 6-1 : 8080（4/8-位）MPU 接口

Stabilization enhancing cap: 50pF

CYCLE LIST TABLE

CYC_NAME	RS	ZWR	Description
CMD	1	0	Command write cycle, for writting register number(REG#)
STATUS	1	1	Status read cycle, using to check Interrupt or Sleep status.
DATW	0	0	Data write cycle, using to write register data or memory data.
DATR	0	1	Data read cycle, using to read register data or memory data.

REGISTER LIST TABLE

REG#	Name	D7	D6	D5	D4	D3	D2	D1	D0	初始值
--	**STATUS**	MBUSY	SBUSY	SLEEP			WAKE_STS	KS_STS	TP_STS	--
00h	**WLCR**	PWR	LINEAR	SRST	--	TEXT_MD	ZDOFF	GBLK	GINV	00h
01h	**MISC**	NO_FLICKER	CLKO_SEL	BUSY_LEV	INT_LEV	XCK_SEL1	XCK_SEL0	SDIR	CDIR	04h
03h	**ADSR**	SCR_PEND	--	--	--	BIT_INV	SCR_DIR	SCR_HV	SCR_EN	00h
0Fh	**INTR**	--	WAKI_EN	KEYI_EN	TPI_EN	TP_ACT	WAK_STS	KEY_STS	TP_STS	00h
10h	**WCCR**	CUR_INC	FULL_OFS	BIT_REV	BOLD	T90DEG	CUR_EN	CUR_BLK	---	00h
11h	**CHWI**	CURH3	CURH2	CURH1	CURH0	ROWH3	ROWH 2	ROWH 1	ROWH 0	00h
12h	**MAMR**	CUR_HV	DISPMD2	DISPMD1	DISPMD0	L_MIX1	L_MIX 0	MW_MD1	MW_MD0	11h
20h	**AWRR**	--	--	AWR5	AWR4	AWR3	AWR2	AWR1	AWR0	27h
21h	**DWWR**	--	--	DWW5	DWW 4	DWW 3	DWW 2	DWW 1	DWW 0	27h
30h	**AWBR**	AWB7	AWB6	AWB5	AWB4	AWB3	AWB2	AWB1	AWB0	EFh
31h	**DWHR**	DWH7	DWH6	DWH5	DWH4	DWH3	DWH2	DWH1	DWH0	EFh
40h	**AWLR**	--	--	AWL5	AWL4	AWL3	AWL2	AWL1	AWL0	00h
50h	**AWTR**	AWT7	AWT6	AWT5	AWT4	AWT3	AWT2	AWT1	AWT0	00h
60h	**CURX**	--	--	CURX5	CURX4	CURX3	CURX2	CURX1	CURX0	00h
61h	**BGSG**	--	--	BGSG5	BGSG4	BGSG3	BGSG2	BGSG1	BGSG0	00h
62h	**EDSG**	EDSG7	EDSG6	EDSG5	EDSG4	EDSG3	EDSG2	EDSG1	EDSG0	00h
70h	**CURY**	CURY7	CURY6	CURY5	CURY4	CURY3	CURY2	CURY1	CURY0	00h
71h	**BGCM**	BGCM7	BGCM6	BGCM5	BGCM4	BGCM3	BGCM2	BGCM1	BGCM0	00h
72h	**EDCM**	EDCM7	EDCM6	EDCM5	EDCM4	EDCM3	EDCM2	EDCM1	EDCM0	00h
80h	**BTMR**	BLKT7	BLKT6	BLKT5	BLKT4	BLKT3	BLKT2	BLKT1	BLKT0	00h
90h	**ITCR**	ITC7	ITC6	ITC5	ITC4	ITC3	ITC2	ITC1	ITC0	00h
A0h	**KSCR1**	KEY_EN	KEY4X8	KSAMP1	KSAMP0	LKEY_EN	KF2	KF1	KF0	00h
A1h	**KSCR2**	KWAK_EN	--	--	--	LKEY_T1	LKEY_T0	KEYNO1	KEYNO0	00h
A2h	**KSDR0**	KSD07	KSD06	KSD05	KSD04	KSD03	KSD02	KSD01	KSD00	00h
A3h	**KSDR1**	KSD17	KSD16	KSD15	KSD14	KSD13	KSD12	KSD11	KSD10	00h
A4h	**KSDR2**	KSD27	KSD26	KSD25	KSD24	KSD23	KSD22	KSD21	KSD20	00h
B0h	**MWCR**	MWD7	MWD6	MWD5	MWD4	MWD3	MWD2	MWD1	MWD0	--
B1h	**MRCR**	MRD7	MRD6	MRD5	MRD4	MRD3	MRD2	MRD1	MRD0	--

(Continued)

REG#	Name	D7	D6	D5	D4	D3	D2	D1	D0	初始值
C0h	**TPCR1**	TP_EN	TP_SMP2	TP_SMP1	TP_SMP0	TPWAK_EN	ACLK2	ACLK1	ACLK0	00h
C1h	**TPXR**	TPX9	TPX8	TPX7	TPX6	TPX5	TPX4	TPX3	TPX2	00h
C2h	**TPYR**	TPY9	TPY8	TPY7	TPY6	TPY5	TPY4	TPY3	TPY2	00h
C3h	**TPZR**	TPX1	TPX0	--	--	TPY1	TPY0	--	--	00h
C4h	**TPCR2**	MTP_MD	--	--	--	--	--	MTP_PH1	MTP_PH2	00h
D0h	**PCR**	PWM_EN	PWM_DIS_LEV	--	--	PCLK_R3	PCLK_R2	PCLK_R1	PCLK_R0	00h
D1h	**PDCR**	PDUTY7	PDUTY6	PDUTY5	PDUTY4	PDUTY3	PDUTY2	PDUTY1	PDUTY0	00h
E0h	**PNTR**	PND7	PND6	PND5	PND4	PND3	PND2	PND1	PND0	00h
F0h	**FNCR**	ISO8859_EN	--	--	--	MCLR	ASC	ASC_SEL1	ASC_SEL0	00h
F1h	**FVHT**	FH1	FH0	FV1	FV0	--	--	--	--	00h

A.C. CHARACTERISTICS

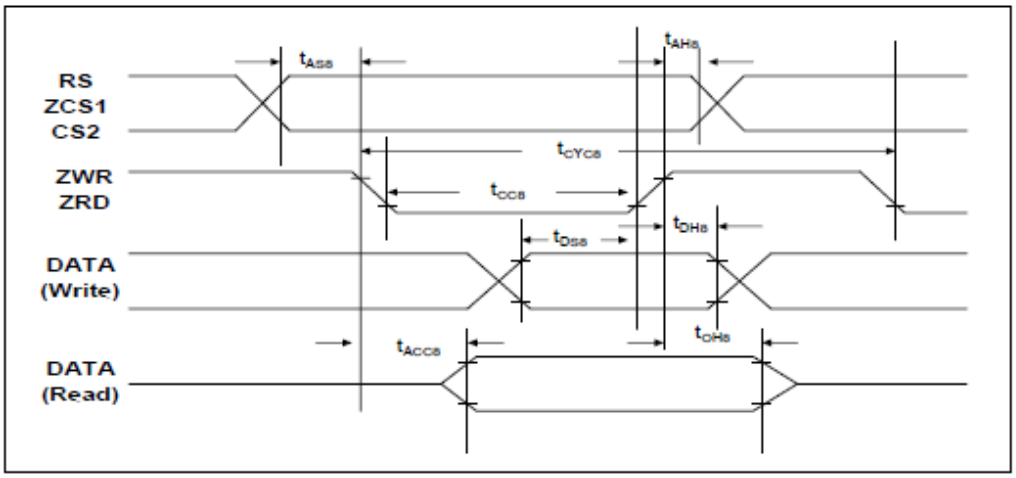


Figure 6-3 : 8080 MPU Interface Waveform

Table 6-1 : 8080 MPU Interface Timing

Symbol	Description	Rating		Unit	Condition
		Min.	Max.		
t_{CYC8}	Cycle time	2*tc	--	ns	tc = one system clock period
t_{CC8}	Strobe Pulse width	50	--	ns	
t_{AS8}	Address setup time	0	--	ns	
t_{AH8}	Address hold time	20	--	ns	
t_{DS8}	Data setup time	30	--	ns	
t_{DH8}	Data hold time	20	--	ns	
t_{ACC8}	Data output access time	0	20	ns	
t_{OH8}	Data output hold time	0	10	ns	

COMMAND WRITE

6-1-2 Command Write

According to the Table 5-1, RA8806 accept 4 cycles through MPU interface. If users want to write command to RA8806, then a Command cycle has to execute first, and then execute a Data Write cycle. The "Command Write" means write function data to register. After these two cycles, the Data will write into the indicative Register. Please see the following Figure 6-5 (1).

In Table 6-1 of Section 6-1-1, each command of RA8806 is take 2 cycles, and the minimum cycle time is 2*tc. So totally the minimum time of command write need 4*tc. See following Table 6-3.

If the secondary cycle is a "Data Read", then user could read the register content. See the following Figure 6-5 (2). Note the Figure 6-5 to Figure 6-7 are use the 8080 MPU interface as examples.

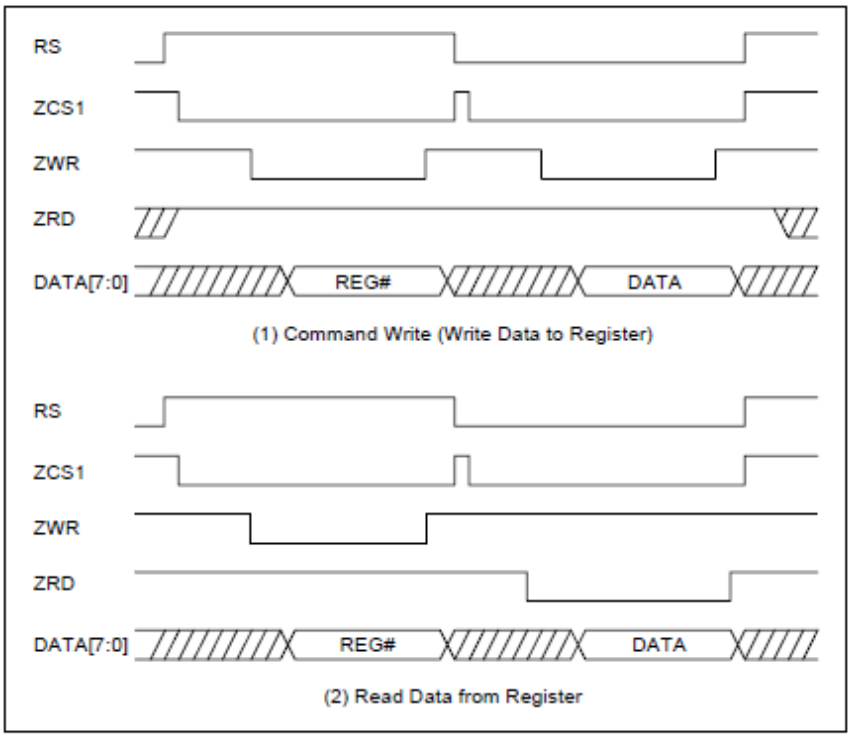


Figure 6-5 : Command Write and Register Read Cycle

Table 6-3 : Command Access Time Table

System Clock	Command Access Time
4MHz	1μs
6 MHz	667ns
8 MHz	500ns
10 MHz	400ns
12 MHz	333ns

Memory Write/Read

6-1-3 Memory Write/Read

When users want to write data to memory – DDRAM or CGRAM, then a special Command cycle has to execute first, the register have to assign to "B0h" on Data Bus. Then the following Data Write cycle will write data into memory. If users want to read data from memory, then the register has to assign to "B1h" on Data Bus in Command Write cycle. Please see the following Figure 6-6 (1) and (2).

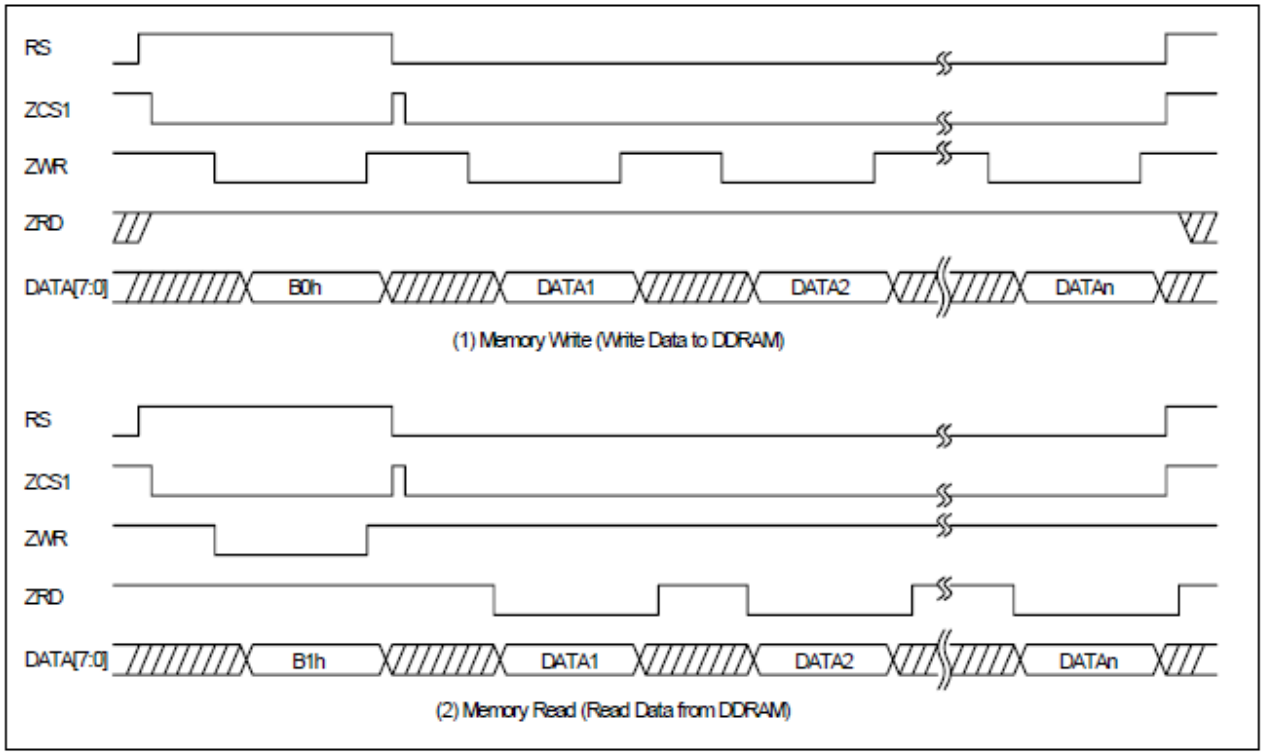


Figure 6-6 : Memory Write/Read Cycle

6-1-4 Status Read

RA8806 provides a dedicate Status Read cycle to help users know the status of RA8806. Please refer to following Figure 6-7 and the beginning of Section 5-2 "Register Description".

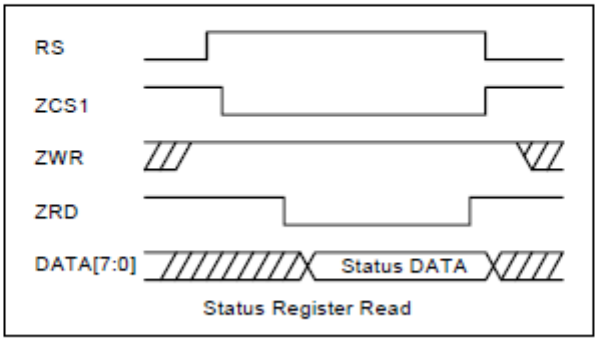


Figure 6-7 : Status Read Cycle

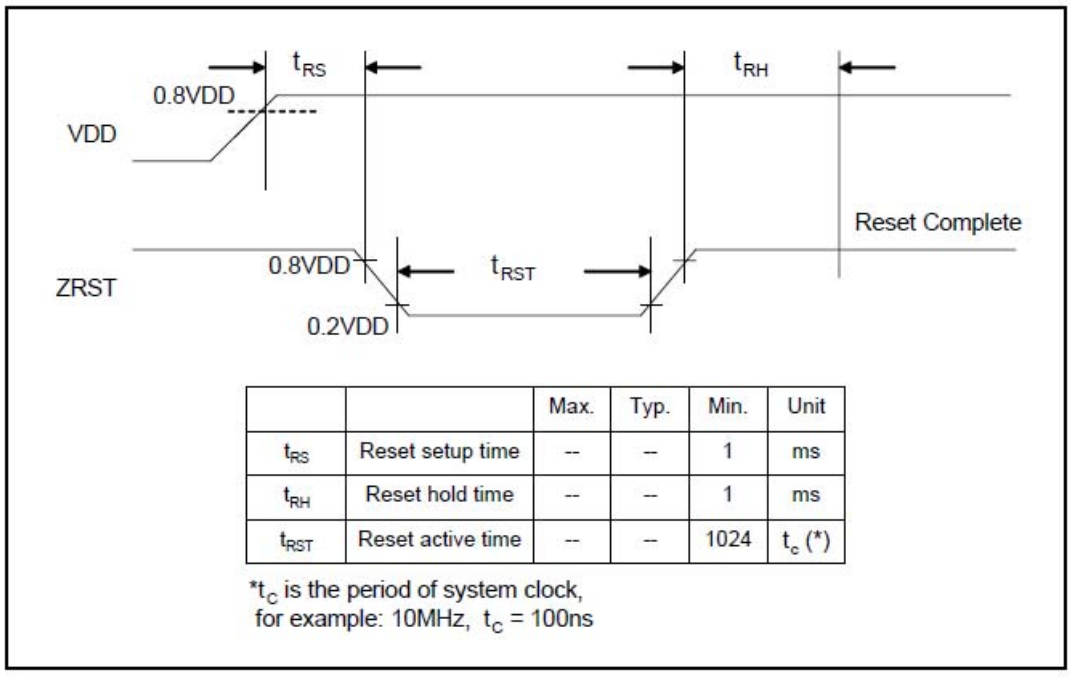
Reset

6-6-3 Reset

The RA8806 requires a reset pulse at least 1024*tc long after power-on in order to re-initialize its internal state. If the oscillator frequency is 6Mhz, then the Reset pulse is at least 170.7μs. For maximum reliability, it is not recommended to apply a DC voltage to the LCD panel while the RA8806 is reset. Turn off the LCD power supplies for at least one frame period after the start of the reset pulse.

Figure 6-27 is an example for ZRST application circuit. It could be controlled by MPU such as (1) of Figure 6-27. Or, generated by a RC circuit such as (2) of Figure 6-27.

The RA8806 cannot receive commands while it is reset. Commands to initialize the internal registers should be issued soon after a reset. During reset, the LCD drive signals XD, LP and FR are halted. A delay of 1ms (minimum) is required following the rising edges of both ZRST and VDD to allow for system stabilization. Please refer to Figure 6-28 for more detail description.



		Max.	Typ.	Min.	Unit
t_{RS}	Reset setup time	--	--	1	ms
t_{RH}	Reset hold time	--	--	1	ms
t_{RST}	Reset active time	--	--	1024	t_c (*)

*t_C is the period of system clock,
for example: 10MHz, t_C = 100ns

Figure 6-28: Reset Timing

Interrupt and Busy:

Refer to controller specification for detail.

DISPLAY DATA RAM

The RA8806 support maximum resolution is 320x240 pixels, therefore it need 9.6Kbyte(320x240/8= 9600)Display Data RAM(DDRAM) to store each pixel data. Figure 6-42 is an example to show the DDRAM data mapping to the LCD panel.

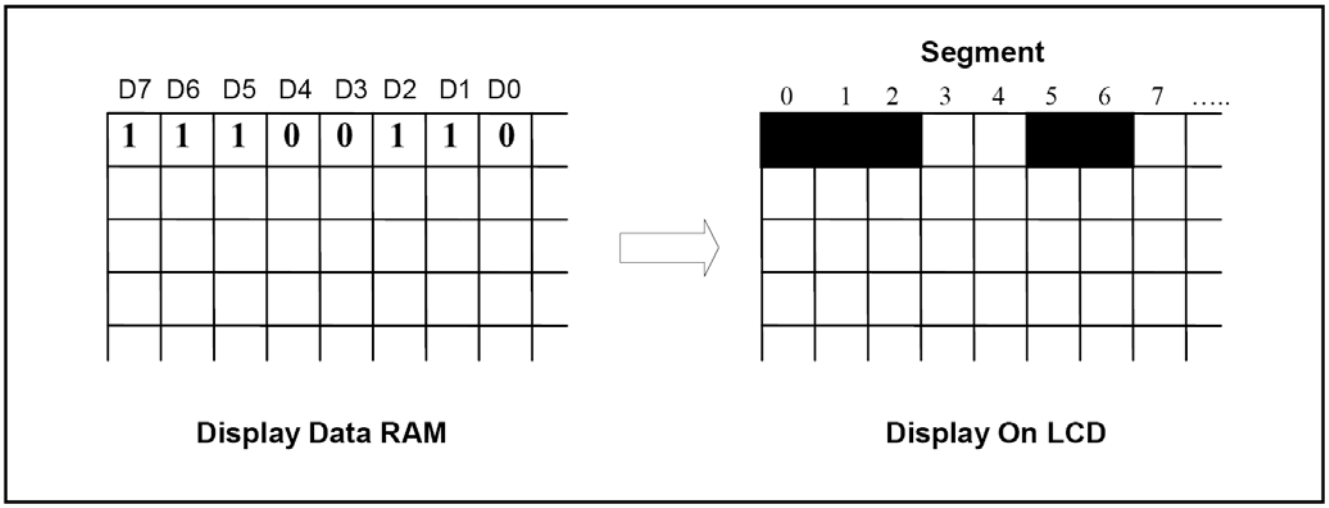


Figure 6-42 : The Mapping of Display Data to LCD Panel

表 6-5：常用 LCD 模块之显示窗口设定

Panel Resolution	Segment	Common	REG[21h] DWWR	REG[31h] DWHR
160*80	160	80	13h	4Fh
160*128	160	128	13h	7Fh
160*160	160	160	13h	9Fh
240*64	240	64	1Dh	3Fh
240*128	240	128	1Dh	7Fh
240*160	240	160	1Dh	9Fh
320*240	320	240	27h	EFh

MEASURING CONDITION :

MEASURING CONDITION: POWER SUPPLY = VOP / 64 Hz
TEMPERATURE = 23 ± 5 °C
RELATIVE HUMIDITY = 60 ± 20 %

ITEM	SYMBOL	UNIT	TYP
RESPONSE TIME	T_{on}	ms	320
	T_{off}	ms	430
CONTRAST RATIO	C_r	-	8
VIEWING ANGLE ($C_r \geq 2$)	$\theta 1_{12:00}$	°	35
	$\theta 2_{6:00}$	°	55
	$\phi 1_{3:00}$	°	40
	$\phi 2_{9:00}$	°	40

THE ELECTRO-OPTICAL CHARACTERISTICS ARE MEASURED VALUE BUT NOT GUARANTEED ONES.

RELIABILITY OF LCD MODULE

ITEM	TEST CONDITION FOR NORMAL TEMPERATURE	TEST CONDITION FOR WIDE TEMPERATURE	TIME
High temperature operating	50°C	70°C	240 hours
Low temperature operating	0°C	-20°C	240 hours
High temperature storage	60°C	80°C	240 hours
Low temperature storage	-10°C	-30°C	240 hours
Temperature-humidity storage	40°C 90% R.H.	60°C 90% R.H.	96 hours
Temperature cycling	-10°C to 60°C 30 Min Dwell	-30°C to 80°C 30 Min Dwell	5 cycle
Vibration Test at LCM Level	Freq 10-55 Hz Sweep rate: 10-55-10 at 1 min Sweep mode Linear Displacement: 2 mm p-p 1 Hour each for X, Y, Z	Freq 10-55 Hz Sweep rate: 10-55-10 at 1 min Sweep mode Linear Displacement: 2 mm p-p 1 Hour each for X, Y, Z	—

SAMPLING METHOD

SAMPLING PLAN : ANSI/ASQ Z1.4
CLASS OF AQL : LEVEL II / SINGLE SAMPLING
MAJOR – 0.65% MINOR – 1.5%

QUALITY STANDARD

DEFECT	CRITERIA	TYPE	FIGURE
SHORT CIRCUIT	-	MAJOR	-
MISSING SEGMENT	-	MAJOR	-
UNEVEN / POOR CONTRAST	-	MAJOR	-
CROSS TALK	-	MAJOR	-
PIN HOLE	MAX(a,b) ≤ 1 / 4 W DOT MATRIX: IF 0.6 ≤ W, MAX(a,b) < 0.3 N.A.** IF 0.4 ≤ W < 0.6, MAX(a,b) < 0.25 N.A** IF W < 0.4, MAX(a,b) < 0.2 N.A**	MINOR	1
EXCESS SEGMENT	MAX(c,d) ≤ 1 / 4 T	MINOR	1
BUBBLES	d* ≥ 0.2 QTY=0	MINOR	2
SPOTS	d ≤ 0.3 N.A.** 0.3<d≤0.4 QTY≤1 0.4<d QTY=0	MINOR	2
LINE SCRATCHES	x≥0.7 y≥0.05 QTY=0	MINOR	3
BLACK LINE	x≥0.7 y≥0.05 QTY=0	MINOR	3

*d = MAX (d_1,d_2) ** N. A . = NOT APPLICABLE DEFECT TABLE : B

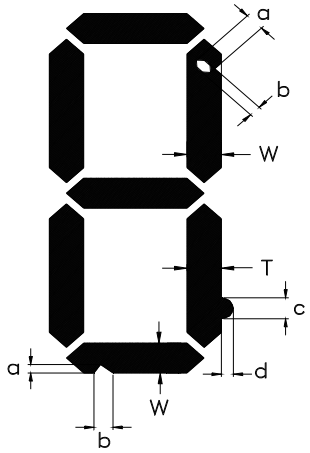
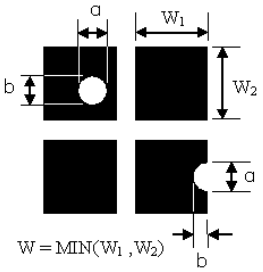
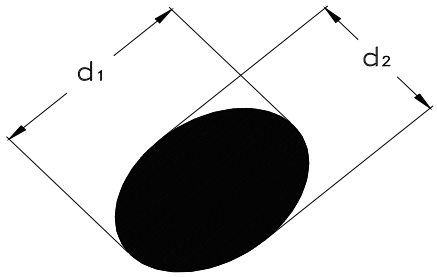
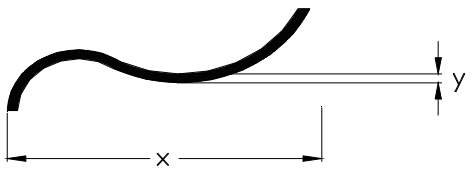


fig . 1





POLARIZER BUBBLES / SPOTS
fig . 2



LINE SCRATCHES / BLACK LINE
fig . 3

QUALITY STANDARD (CONT .)

DEFECT		CRITERIA	TYPE	FIGURE
CHIPS	CONTACT EDGE	e≤1/2T f≤1/3W g≤3.5	MINOR	4
	BOTTOM GLASS	p≤1.0 q≤3.5 r≤1/2T		4
	CORNER	a≤1.5 b≤W		4
	TOP GLASS	a≤3.0 b≤1/2T c≤1/3W		5
GLASS PROTRUSION		a ≤ 1/4 W	MINOR	6
RAINBOW		-	MINOR	-

UNLESS STATE OTHERWISE , ALL UNIT ARE IN MILLIMETER . DEFECT TABLE : B

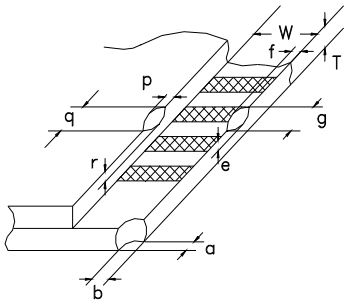


fig . 4

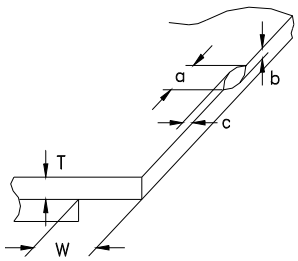


fig . 5

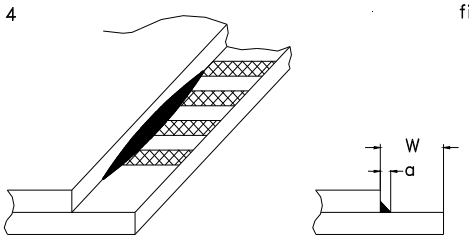


fig . 6

HANDLING PRECAUTIONS

(1) CAUTION OF LCD HANDLING & CLEANING

The polarizing plate on the surface of the panel is made from organic substances. Be very careful for chemicals not to touch the plate or it leads the polarizing plate to deteriorate.

If the use of a chemical is unavoidable, wipe the panel lightly with soft materials, such as gauze and absorbent cotton, soaked in a solvent.

*Usable solvent: Alcohol (ethanol, IPA and the like)
*Appropriate solvent: Ketones, ethyl alcohol

Avoid wiping with a dry cloth, since it could damage the surface of the polarizing plate and others.
Do not expose to direct sunlight or fluorescent light for a long time

(2) CAUTION AGAINST STATIC CHARGE

The LCD modules use CMOS LSI drivers, so customers are recommended that any unused input terminal would be connected to V_{DD} or V_{SS} , do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

(3) ESD PRECAUTION

Inputs and outputs are protected against electrostatic discharge in normal handling. However, to be totally safe, it is recommended to take normal precautions appropriate to handling LCM module. For example: product surface grounding.

Always take ESD precaution when handling the *LCD Module*. Components are exposed for direct finger touches and can be damaged unless ESD precaution is taken.

(4) PACKAGING

Avoid intense shock and falls from a height and do not operate or store them exposed to direct sunshine or high temperature/humidity for long periods.

(5) CAUTION FOR OPERATION

The viewing angle can be adjusted by varying the LCD driving voltage VO.

Driving voltage should be kept within specified range, excess voltage shortens display life.

Response time increases with decrease in temperature.

Display may turn black or dark Blue at temperature above its operational range; this is however not destructive and the display will return to normal once the temperature falls back to range.

Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear “fractured”. They will recover once the display is turned off.

Condensation at terminals will cause malfunction and possible electrochemical reaction. Relative humidity of the environment should therefore be kept below 60%.

(6) SAFETY

Liquid crystal may leak out of a damaged LCD, it is recommended to wash off the liquid crystal by using solvents such as acetone or ethanol and should be burned up later.

If any liquid leak out of a damaged glass cell comes in contact with your hands, wash it off with soap and water immediately.

WARRANTY

CLOVER will replace or repair any of her LCD module in accordance with her LCD specification for a period of one year from date of shipment. The warranty liability of Clover is limited to repair and/or replacement. Clover will not be responsible for any subsequent or consequential event.