MULTI-INNO TECHNOLOGY CO., LTD.

LCD MODULE SPECIFICATION

Model : MI1602K2

Revision	1.1
Engineering	
Date	
Our Reference	

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RECORDS OF REVISION

Date	Rev.	Description	Note	Page
2007/3/15	1.0	New Sample		
2009/10/15	1.1	Update Timing Characteristics and Display Command		13,14

Contents

Note：For detailed information please refer to IC data sheet：ST7066U,ST7065C

1. SPECIFICATIONS

1.1 Features

Item	Standard Value
Display Type	16 ＊ 2 Characters
LCD Type	STN，Gray，Transflective，Positive , Normal Temp.
Driver Condition	1/16 Duty，1/5 Bias
Viewing Direction	6 O'clock
Backlight	Yellow-Green LED B/L
Weight	11.0g
Interface	—
Other	—

1.2 Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	53.0 (L) * 20.0 (w) * 8.6 (H)(Max)	mm
Viewing Area	36.0 (L) * 10.0 (w)	mm
Active Area	34.1 (L) * 7.4 (w)	mm
Dot Size	0.35 (L) * 0.33 (w)	mm
Dot Pitch	0.40 (L) * 0.38 (w)	mm

Note：For detailed information please refer to LCM drawing

1.3 Absolute Maximum Ratings

Item	Symbol	Condition	Min.	Max.	Unit
Power Supply Voltage	V_{DD}	—	-0.3	7.0	V
LCD Driver Supply Voltage	V_{LCD}	—	V_{DD}-10.0	V_{DD}+0.3	V
Input Voltage	V_{IN}	—	-0.3	V_{DD}+0.3	V
Operating Temperature	T_{OP}	Excluded B/L	0	50	℃
Storage Temperature	T_{ST}	Excluded B/L	-20	70	℃
Storage Humidity	H_D	Ta＜40 ℃	-	90	%RH

1.4 DC Electrical Characteristics

V_{DD} = 5.0 V ± 10%，V_{SS} = 0V，Ta = 25℃

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Logic Supply Voltage	V_{DD}	—	4.5	5.0	5.5	V
“H” Input Voltage	V_{IH}	—	0.7 V_{DD}	-	V_{DD}	V
“L” Input Voltage	V_{IL}	—	-0.3	-	0.6	V
“H” Output Voltage	V_{OH}	I_{OH}=-0.1mA	3.9	-	V_{DD}	V
“L” Output Voltage	V_{OL}	I_{OL}=0.1mA	-	-	0.4	V
Supply Current	I_{DD}	V_{DD} = 5.0 V	1.2	1.5	3.0	mA
	I_{EE}	—	-	-	-	
LCM Driver Voltage	V_{OP}	0℃	-	-	-	V
		25℃*1	4.2	4.4	4.7	
		50℃	-	-	-	

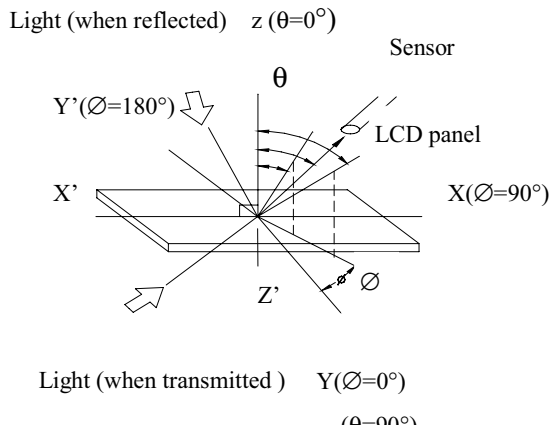
Note: *1. THE V_{OP} TEST POINT IS V_{DD} - V_O.

1.5 Optical Characteristics

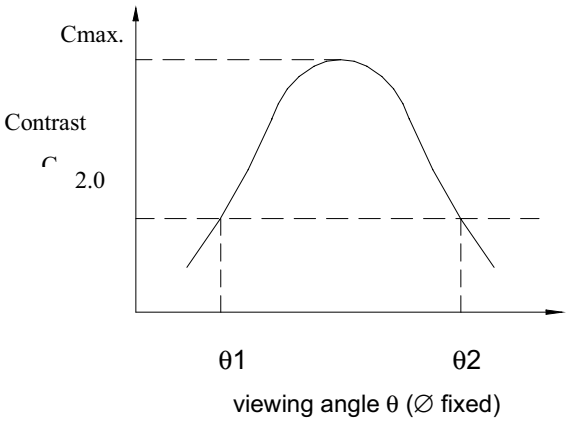
LCD Panel：1/16 Duty，1/5 Bias，V_{LCD} = 4.67 V，Ta = 25℃

Item	Symbol	Conditions	Min.	Typ.	Max.	Reference
View Angle	θ	C≥2.0, ∅ = 0°	40°	-	-	Notes 1 & 2
Contrast Ratio	C	θ = 5°, ∅ = 0°	5	7	-	Note 3
Response Time(rise)	tr	θ = 5°, ∅ = 0°	-	150 ms	-	Note 4
Response Time(fall)	tf	θ = 5°, ∅ = 0°	-	300 ms	-	Note 4

Note 1: Definition of angles θ and ∅



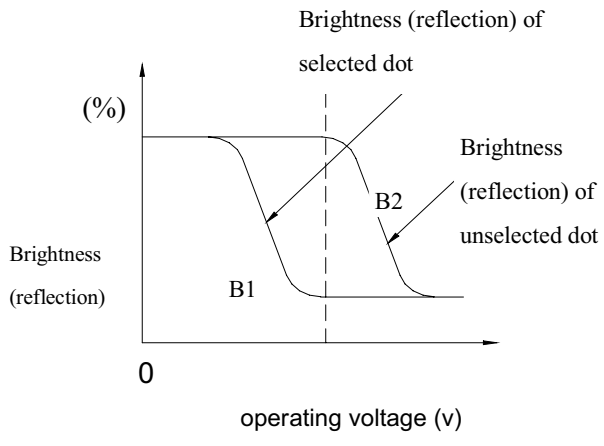
Note 2: Definition of viewing angles θ1 and θ2



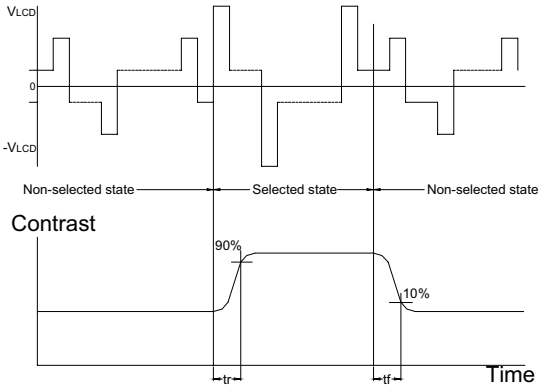
Note : Optimum viewing angle with the naked eye and viewing angle θ at Cmax. Above are not always the same

Note 3: Definition of contrast C

$$C = \frac{\text{Brightness (reflection) of unselected dot (B2)}}{\text{Brightness (reflection) of selected dot (B1)}}$$



Note 4: Definition of response time



Note:Measured with a transmissive LCD panel which is displayed 1 cm^2

V_{LCD} : Operating voltage f_{FRM} : Frame frequency

t_r : Response time (rise) t_f : Response time (fall)

1.6 Backlight Characteristics

LCD Module with LED Backlight

Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Forward Current	IF	Ta =25℃	-	40	mA
Reverse Voltage	VR	Ta =25℃	-	8	V
Power Dissipation	PO	Ta =25℃	-	0.19	W
Operating Temperature	T_{OP}	-	-20	70	℃
Storage Temperature	T_{ST}	-	-30	80	℃
Solder Temp. for 3 Second	-	-	-	260	℃

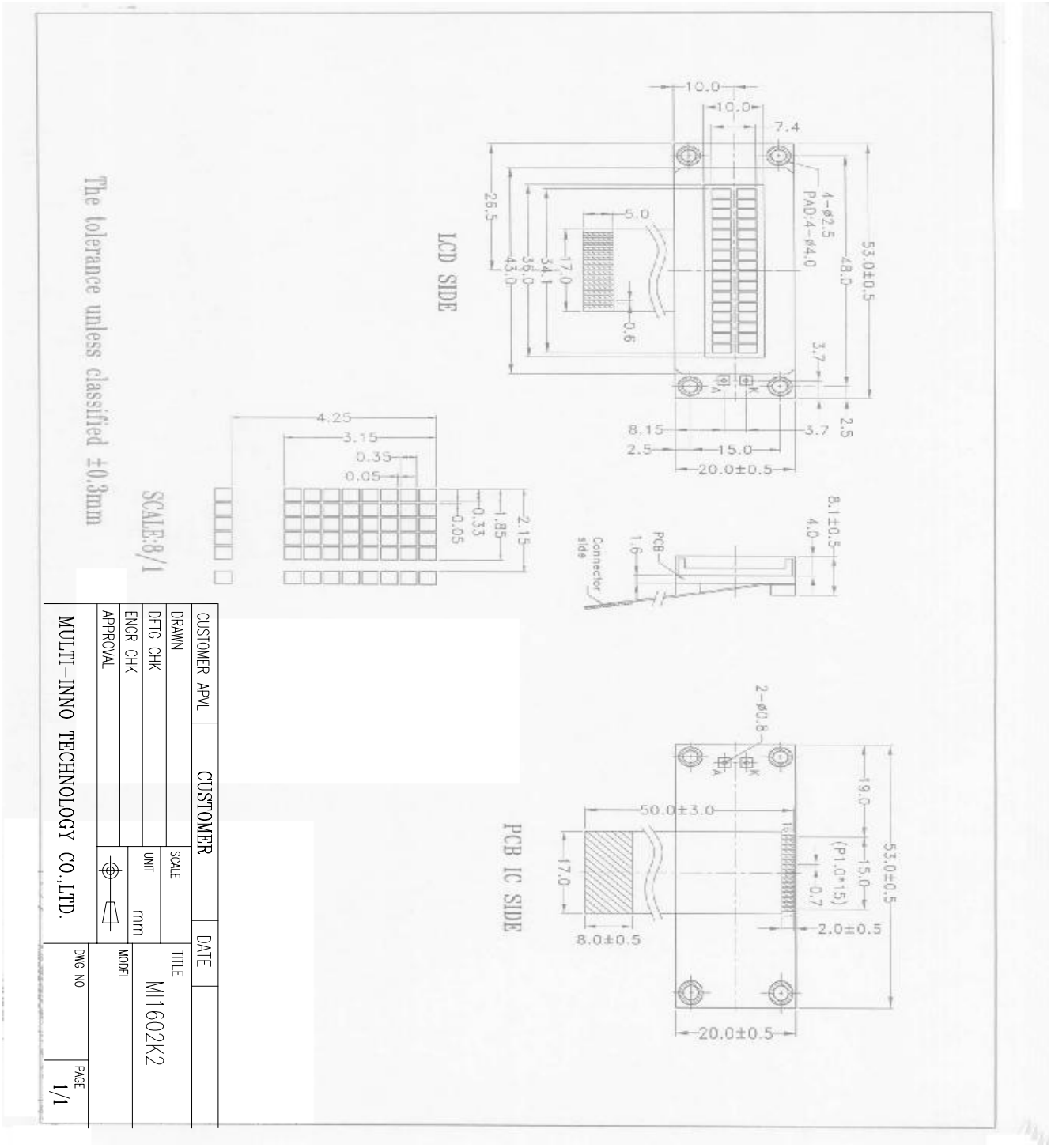
Electrical / Optical Characteristics

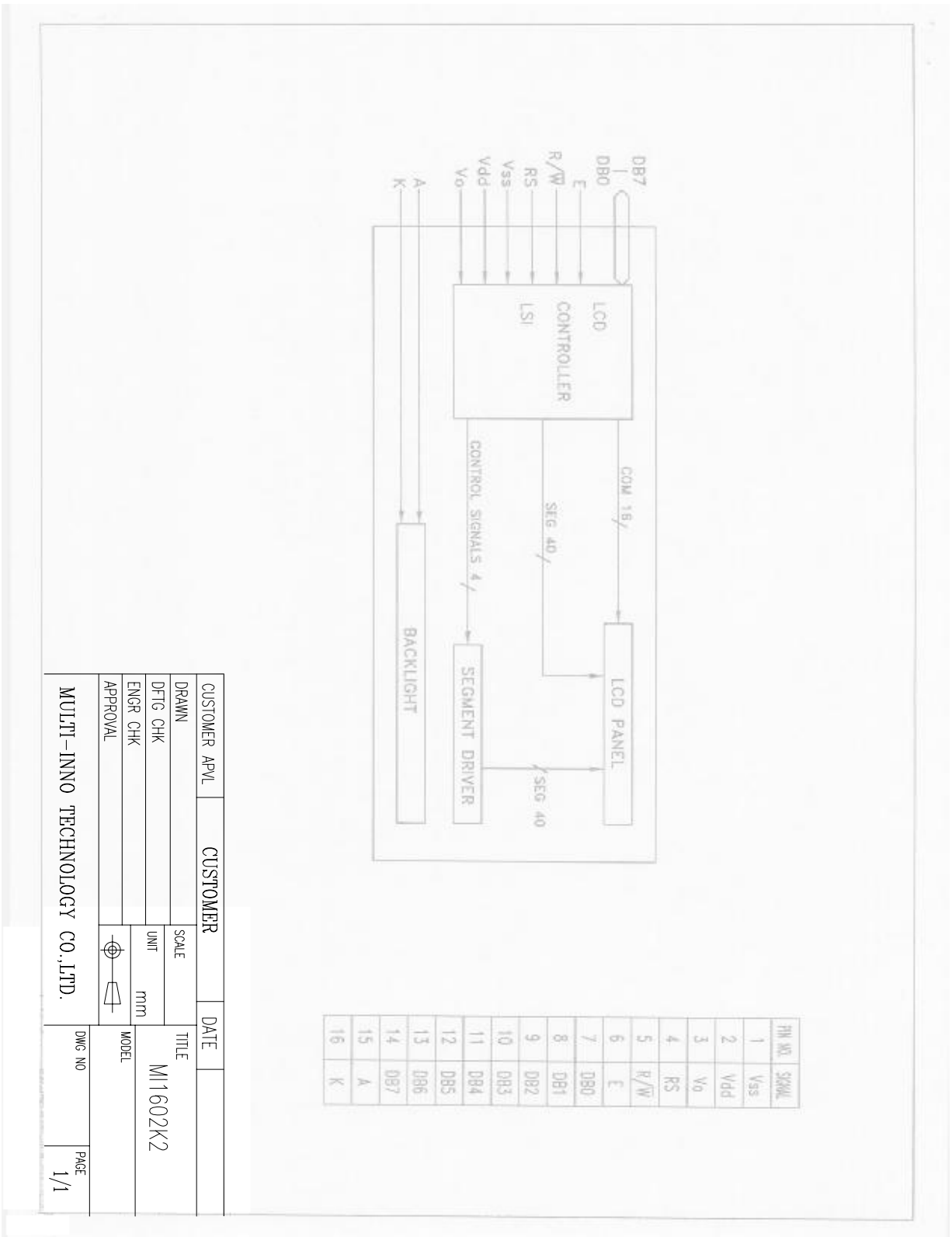
Ta =25℃

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Forward Voltage	VF	IF= 28mA	-	4.2	4.8	V
Reverse Current	IR	VR= 8 V	-	-	0.2	mA
Average Brightness (with LCD)	IV	IF= 28mA	4	5	-	cd/m^2
Wavelength	λ p	IF= 28 mA	-	570	-	nm
Color	Yellow-Green					

2. MODULE STRUCTURE

2.1 Counter Drawing

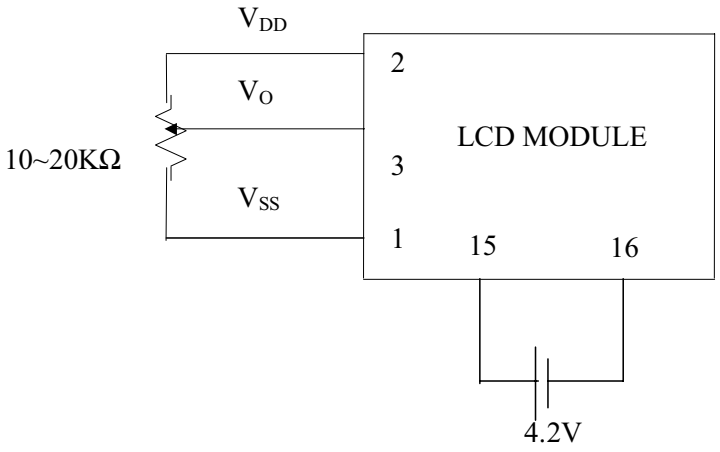



DB7
DB0
E
R/W
RS
Vss
Vdd
Vo
A
K
LCD CONTROLLER
LSI
CONTROL SIGNALS 4
COM 16
SEG 40
SEG 40
LCD PANEL
SEGMENT DRIVER
BACKLIGHT
PIN NO. SIGNAL
1 Vss
2 Vdd
3 Vo
4 RS
5 R/W
6 E
7 DB0
8 DB1
9 DB2
10 DB3
11 DB4
12 DB5
13 DB6
14 DB7
15 A
16 K
CUSTOMER APVL
CUSTOMER
DRAWN
DFTG CHK
ENGR CHK
APPROVAL
SCALE
UNIT
mm
DATE
TITLE
MODEL
M1602K2
MULTI-INNO TECHNOLOGY CO.,LTD.
DWG NO
PAGE
1/1

2.2 Interface Pin Description

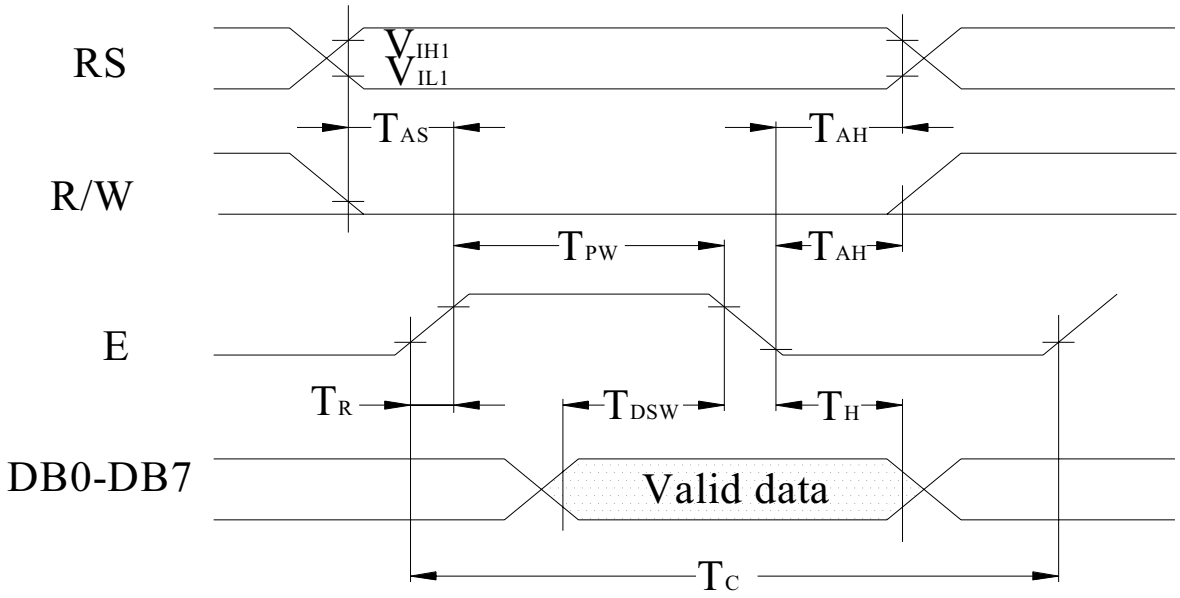
Pin No.	Symbol	Function
1	Vss	Signal ground (GND)
2	VDD	Power Supply for logic (VDD> Vss)
3	VO	Operating Voltage for LCD (variable)
4	RS	Register selection input High = Data register Low = Instruction register (for write) Busy flag address counter (for read)
5	R/W	Read/Write signal input is used to select the read/write mode. High = Read mode, Low = Write mode
6	E	Start enable signal to read or write the data
7-10	DB0 ~ DB3	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCD module. These four are not used during 4-bit operation.
11~14	DB4~DB7	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCD module. DB7 can be used as a busy flag.
15	A	Power supply for LED backlight (+)
16	K	Power supply for LED backlight (-)

Contrast Adjust

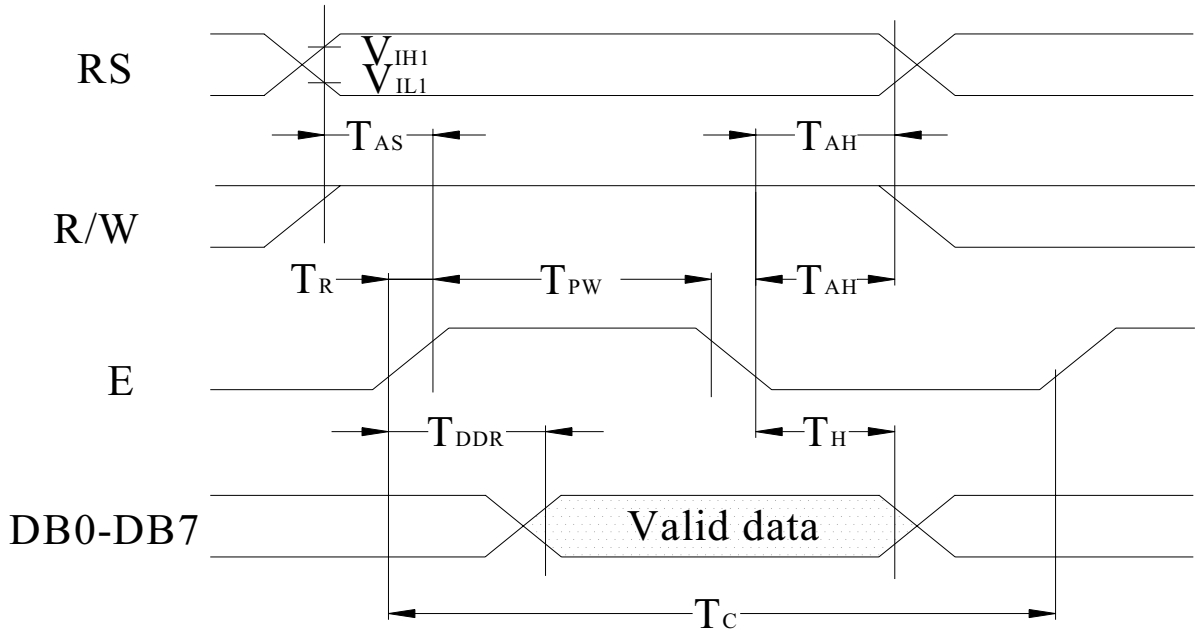


2.3 Timing Characteristics

- Writing data from MPU to ST7066U



- Reading data from ST7066U to MPU



• Write Mode (Writing data from MPU to ST7066U)

(V_{DD}= +5V±10%,Ta=25°C)

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
T_C	Enable Cycle Time	Pin E	1200	-	-	ns
T_{PW}	Enable Pulse Width	Pin E	140	-	-	ns
T_R , T_F	Enable Rise / Fall Time	Pin E	-	-	25	ns
T_{AS}	Address Setup Time	Pins: RS , RW,E	0	-	-	ns
T_{AH}	Address Hold Time	Pins :RS,RW,E	10	-	-	ns
T_{DSW}	Data Setup Time	Pins:DB0~DB7	40	-	-	ns
T_H	Data Hold Time	Pins:DB0~DB7	10	-	-	ns

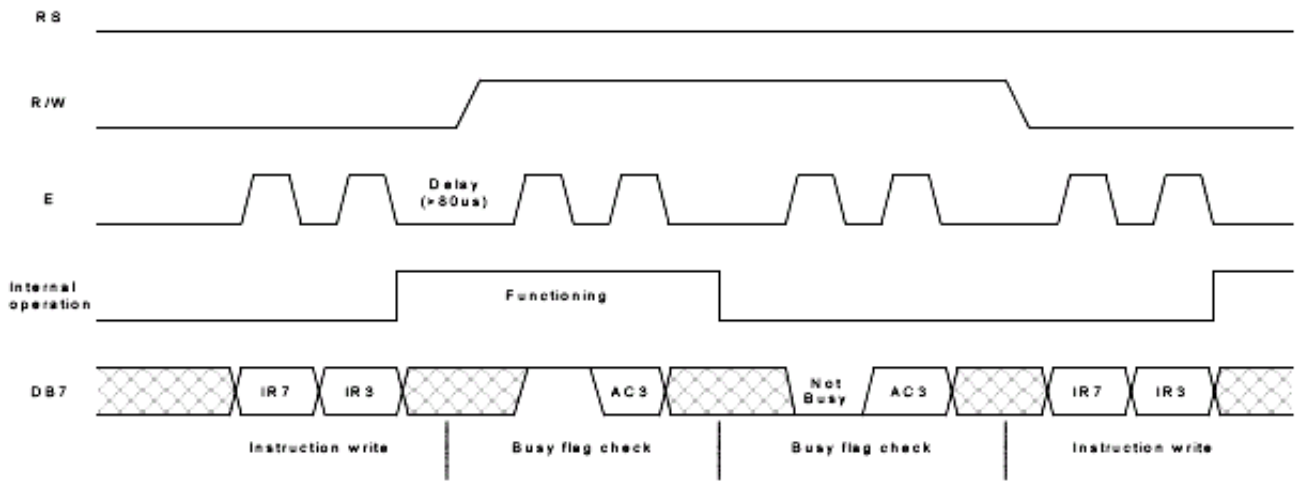
• Read Mode (Reading data from ST7066U to MPU)

(V_{DD}= +5V±10%,Ta=25°C)

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
T_C	Enable Cycle Time	Pin E	1200	-	-	ns
T_{PW}	Enable Pulse Width	Pin E	140	-	-	ns
T_R , T_F	Enable Rise / Fall Time	Pin E	-	-	25	ns
T_{AS}	Address Setup Time	Pins: RS , RW,E	0	-	-	ns
T_{AH}	Address Hold Time	Pins :RS,RW,E	10	-	-	ns
T_{DDR}	Data Setup Time	Pins:DB0~DB7	-	-	100	ns
T_H	Data Hold Time	Pins:DB0~DB7	10	-	-	ns

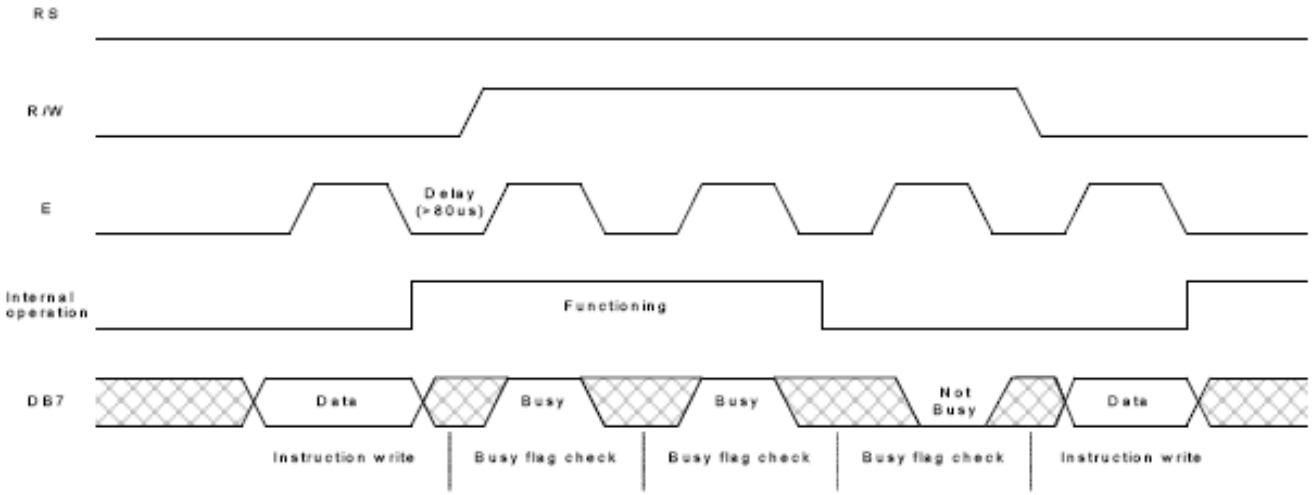
For 4-bit interface date, only four bus lines (DB4 to DB7) are used for transfer.

Example of busy flag check timing sequence



For 8-bit interface date, all eight bus lines (DB0 to DB7) are used .

Example of busy flag check timing sequence



2.4 Display Command

Instructions	Instruction Code										Description	Description Time (270KHz)
	RS	R/W	DB 7	DB 6	DB 5	DB 4	DB 3	DB 2	DB 1	DB 0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC.	1.52ms
Return Home	0	0	0	0	0	0	0	0	1	×	Set DDRAM address to "00H" from AC and return cursor to it's original position if shifted. The contents of DDRAM are not changed.	1.52ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These operations are performed during data write and read .	37μs
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1 : entire display on C=1 : cursor on B=1 : cursor position on	37μs
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	×	×	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	37μs
Function Set	0	0	0	0	1	DL	N	F	×	×	DL: interface data is 8/4 bits NL: number of line is 2/1 F: font size is 5×11/5×8	37μs
Set CGRAM Address	0	0	0	1	AC 5	AC 4	AC 3	AC 2	AC 1	AC 0	Set CGRAM address in address counter.	37μs
Set DDRAM Address	0	0	1	AC 6	AC 5	AC 4	AC 3	AC 2	AC 1	AC 0	Set DDRAM address in address counter.	37μs

Read Busy Flag and Address	0	1	BF	AC 6	AC 5	AC 4	AC 3	AC 2	AC 1	AC 0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0μs
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	37μs
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	37μs

Note:

Be sure the ST7066U is not in the busy state (BF=0) before sending an instruction from the MPU to the ST7066.

If an instruction is sent without checking the busy flag , the time between the first instruction and next instruction will take much longer than the instruction time itself.

Before checking BF, be sure to wait at least 80us.. Do not keep “E” always “High” for checking BF.

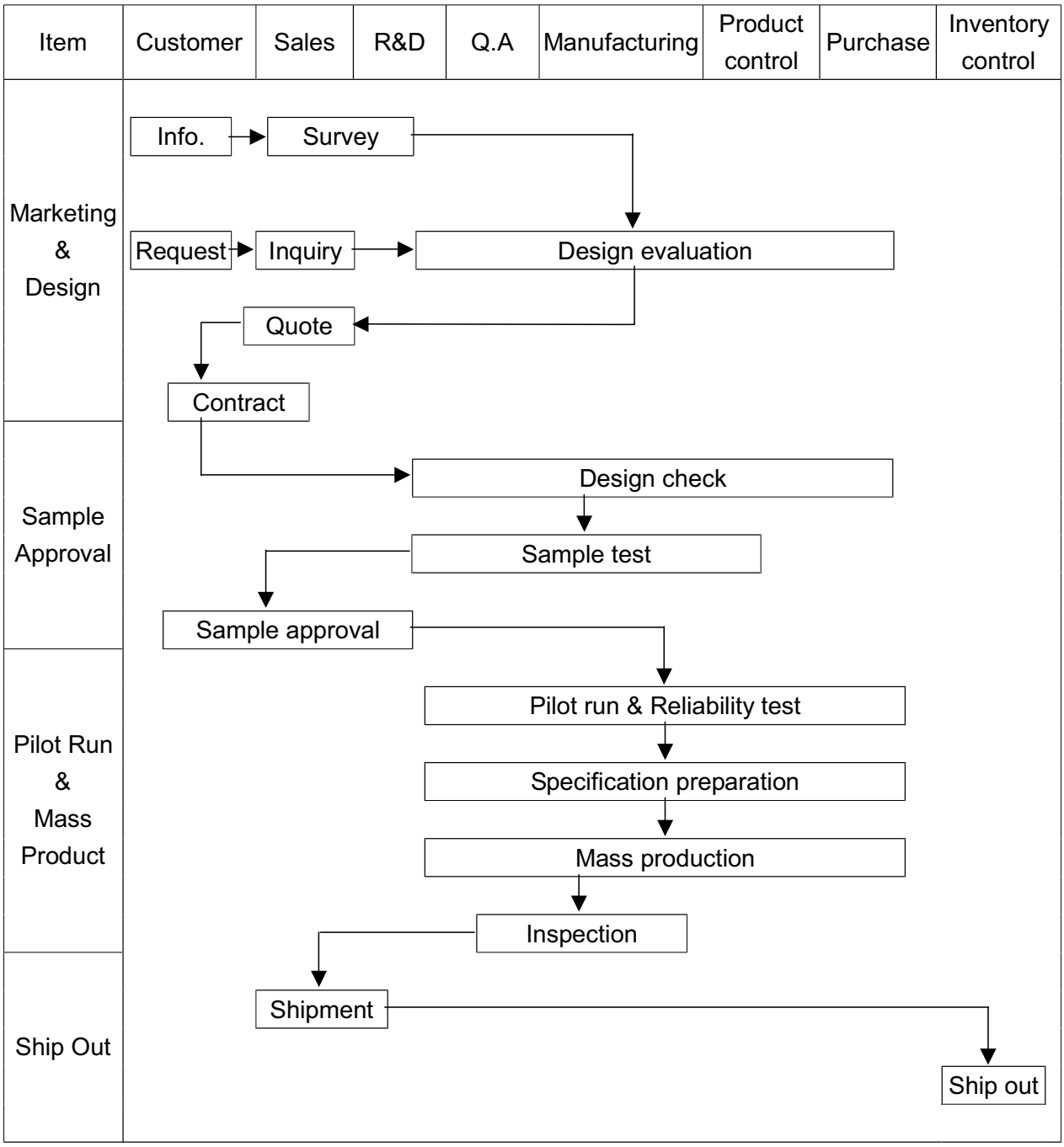
Refer to Instruction Table for the list of each instruction execution time.

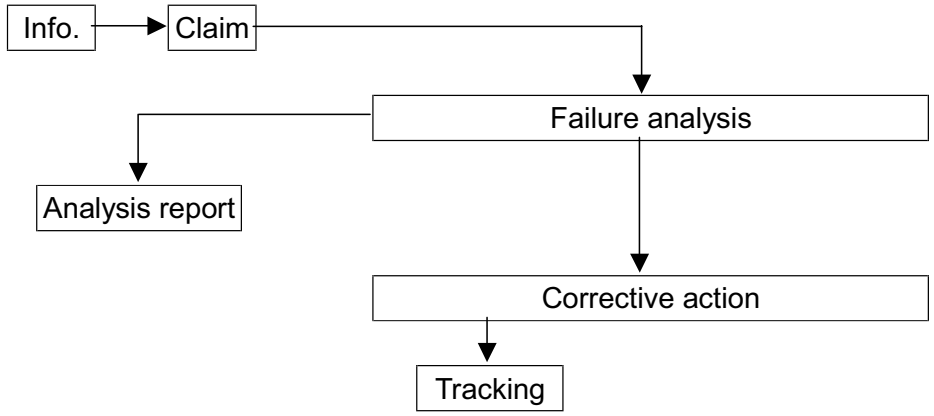
2.5 Character Pattern

■ CHARACTER PATTERN(SO/HO/EA,WA)

3. QUALITY ASSURANCE SYSTEM

3.1 Quality Assurance Flow Chart

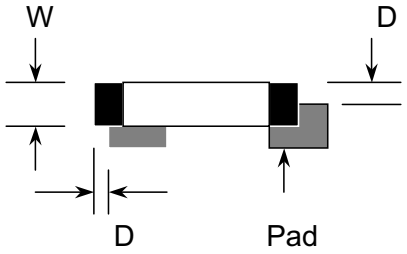


Sales Service	
Q.A Activity	1. ISO 9001 Maintenance Activities 2. Process improvement proposal 3. Equipment calibration 4. Education And Training Activities 5. Standardization Management

3.2 Inspection Specification

Inspection Standard：MIL-STD-105E Table Normal Inspection Single Sampling Level Ⅱ。
Equipment：Gauge、MIL-STD、Tester、Sample。
IQC Defect Level：Major Defect AQL 0.65; Minor Defect AQL 1.0。
FQC Defect Level：100% Inspection。
OUT Going Defect Level：Sampling。
Specification：

N O	Item	Specification	Judge	Level
1	Part Number	Inconsistent with the P/N on the flow chart of production	N.G.	Major
2	Quantity	Inconsistent Q'TY with the flow chart of production	N.G.	Major
3	Electronic characteristics A=(L + W)÷2	Display short	N.G.	Major
		Missing line	N.G.	Major
		Dot missing A＞1/2 Dot size	N.G.	Major
		No function	N.G.	Major
		Out put data error	N.G.	Major
4	Appearance A=(L + W)÷2 Dirty particle (Include scratch、bubble)	Material difference with flow chart	N.G.	Major
		LCD Assembled in opposite direction	N.G.	Major
		Bezel assembled in opposite direction	N.G.	Major
		Shadow within LCD V./A + 1.0 mm	N.G.	Major
		Dirty particle A＞0.4 mm	N.G.	Minor
		Dirty particle length ＞3.0mm And 0.01mm＜Width ≦0.05mm (Width＞0.05mm Measure by area)	N.G.	Minor
		Without protective film	N.G.	Minor
		Conductive rubber over bezel	N.G.	Minor
5	PCB Appearance A=(L + W)÷2	Burned PCB	N.G.	Major
		Green paint stripped & visible circuit A＞1.0mm (Finish coat not counted in)	N.G.	Minor
		A particle across the circuit	N.G	Minor
		Circuit split ＞1/2 Circuit width	N.G	Minor
		Any circuit risen	N.G	Minor
		0.2mm＜Tin ball area A≦0.4mm And Q'TY＞4 Pieces	N.G	Minor
		Tin ball area A＞0.4mm	N.G	Minor

N O	Item	Specification	Judge	Level
6	Molding appearance A=(L + W)÷2	Too soft：Shape by touch changed	N.G.	Major
		Insufficient epoxy：IC circuit or IC pad visible	N.G.	Minor
		Excessive epoxy：Diameter ＞20mm Or High＞2.5mm	N.G.	Minor
		Pin hole through to IC and A＞0.2mm	N.G.	Minor
7	Bezel appearance A=(L + W)÷2	Angle between frame and TAB＞45° +10°	N.G.	Minor
		Electroplate strip A ＞1.0mm (Top view only)	N.G.	Minor
		Rust (Top view only)	N.G.	Minor
		Crack	N.G.	Minor
8	Backlight electric characteristics A=(L + W)÷2	Error backlight color	N.G.	Major
		No function	N.G.	Major
		Any LED dot no function	N.G.	Major
		PIN soldering without tin A＞1/2 solder pad	N.G.	Minor
		Solder PIN high＞1.5mm	N.G.	Minor
9	LCD Appearance A=(L + W)÷2	Polarize rise over V/A	N.G.	Minor
10	Assembly parts A=(L + W)÷2	Components mark unclearly	N.G.	Minor
		Components' distance more than 0.7mm firm the PCB	N.G.	Minor
		Error position ,not in center D＞1/4W 	N.G.	Minor
		Non- solder area＞Twice solder area	N.G.	Minor
		Flux area A＞1/4 solder area	N.G.	Minor
		Component broken	N.G.	Minor

4. RELIABILITY TEST

4.1 Reliability Test Condition

No	Item	Test Condition	
1	High Temperature Storage	Storage at 80 ±2℃ 96~100 hrs surrounding temperature, then storage at normal condition 4hrs	
2	Low Temperature Storage	Storage at -30 ±2℃ 96~100 hrs surrounding temperature, then storage at normal condition 4hrs	
3	High Temperature /Humidity Storage	1.Storage 96~100 hrs 60±2℃, 90~95%RH surrounding temperature, then storage at normal condition 4hrs. (Excluding the polarizer). or 2.Storage 96~100 hrs 40±2℃, 90~95%RH surrounding temperature, then storage at normal condition 4 hrs.	
4	Temperature Cycling	-20℃ → 25℃ → 70℃ → 25℃ (30mins) (5mins) (30mins) (5mins) 10 Cycle	
5	Vibration	10~55Hz (1 minute) 1.5mm X,Y and Z direction * (each 2hrs)	
6	ESD Test	Air Discharge: Apply 6 KV with 5 times discharge for each polarity +/-.	Contact Discharge: Apply 250V with 5 times discharge for each polarity +/-.
		Testing location: Around the face of LCD.	Testing location: 1.Apply to bezel. 2.Apply to Vdd, Vss.
7.	Drop Test	Packing Weight (Kg)	Drop Height (cm)
		0 ~ 45.4	122
		45.4 ~ 90.8	76
		90.8 ~ 454	61
		Over 454	46

5. PRECAUTION RELATING PRODUCT HANDLING

5.1 SAFETY

5.1.1 If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin.

5.1.2 If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.

5.2 HANDLING

5.2.1 Avoid any strong mechanical shock which can break the glass.

5.2.2 Avoid static electricity which can damage the CMOS LSI—When working with the module , be sure to ground your body and any electrical equipment you may be using.

5.2.3 Do not remove the panel or frame from the module.

5.2.4 The polarizing plate of the display is very fragile. So , please handle it very carefully ,do not touch , push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)

5.2.5 Do not wipe the polarizing plate with a dry cloth , as it may easily scratch the surface of plate.

5.2.6 Do not touch the display area with bare hands , this will stain the display area.

5.2.7 Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.

5.2.8 To control temperature and time of soldering is 280±10℃and 3-5 sec.

5.2.9 To avoid liquid (include organic solvent) stained on LCM .

5.3 STORAGE

5.3.1 Store the panel or module in a dark place where the temperature is 25℃ ±5℃ and the humidity is below 65% RH.

5.3.2 Do not place the module near organics solvents or corrosive gases.

5.3.3 Do not crush , shake , or jolt the module.

5.4 TERMS OF WARRANTY

5.4.1 Applicable warrant period

The period is within thirteen months since the date of shipping out under normal using and storage conditions.

5.4.2 Unaccepted responsibility

This product has been manufactured to your company’s specification as a part for use in your company’s general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment , we cannot take responsibility if the product is used in nuclear power control equipment , aerospace equipment , fire and security systems or any other applications in which there is a direct risk to human life