POWERTIP TECH. CORP.

DISPLAY DEVICES FOR BETTER ELECTRONIC DESIGN

Specification For Approval

Customer : _____

Model Type : LCD MODULE

Sample Code : _____

Mass Production Code : PG12864LRU-JNN-B

Edition : 0

Customer Sign	Sales Sign	Checked By (QA)	Approved By	Prepared By

NO.PT-A-005-2

Revision Record

Date(y/m/d)	Rev.	Description	Note	Page
2002/06/21	0	Revised Contents		

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Contents

1. SPECIFICATIONS

1.1 Features

Item	Standard Value
Display Type	128 * 64 dots
LCD Type	STN, YG, Transflective, Positive, Normal Temp.
Driver Type	1/64 Duty , 1/9 Bias
Viewing Direction	6 O' clock
Backlight	Yellow-Green LED B/L
Weight	35.0g
Other	—

1.2 Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	75.0mm(L) * 52.7mm(w) * 8.9mm(H)(Max)	mm
Viewing Area	60.0mm(L) * 32.6mm(w)	mm
Active Area	55.01mm(L) * 27.49mm(w)	mm
Dot Size	0.39mm(L) * 0.39mm(w)	mm
Dot Pitch	0.43mm(L) * 0.43mm(w)	mm

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_{DD}-V_{EE}	—	V_{DD}-19.0	V_{DD}+0.3	V
Input Voltage	V_{IN}	—	-0.3	V_{DD}+0.3	V
Operating Temperature	T_{OP}	—	0	50	°C
Storage Temperature.	T_{ST}	—	-20	70	°C
Humidity	H_D	—		90	%RH

1.4 DC Electrical Characteristics

V_{DD} = 5.0 V ± 5%, V_{SS} = 0V, Ta = 25°C

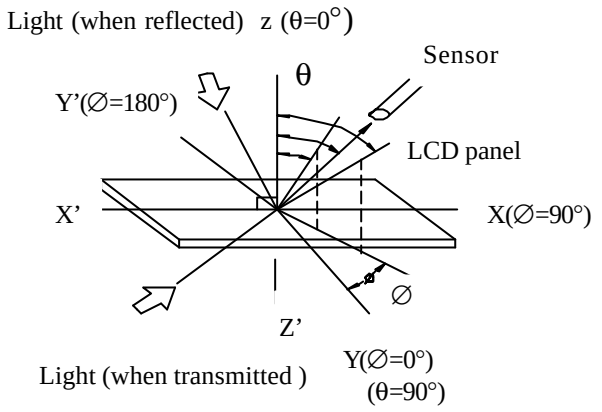
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Logic Supply Voltage	V_{DD}	—	4.5	5.0	5.5	V
"H" Input Voltage	V_{IH}	—	0.7 V_{DD}	-	V_{DD}	V
"L" Input Voltage	V_{IL}	—	0	-	0.3 V_{DD}	V
"H" Output Voltage	V_{OH}	I_{OH}=-0.2mA	2.4	-	-	V
"L" Output Voltage	V_{OL}	I_{OL}=1.6mA	-	-	0.4	V
Supply Current	I_{DD}	V_{DD} = 5.0 V	-	2.0	-	mA
LCD Driver Voltage	V_{OP}	V_{DD} - V_O (-20°C)	-	-	-	V
		V_{DD} - V_O (25°C)	8.85	9.0	9.15	
		V_{DD} - V_O (70°C)	-	-	-	

1.5 Optical Characteristics

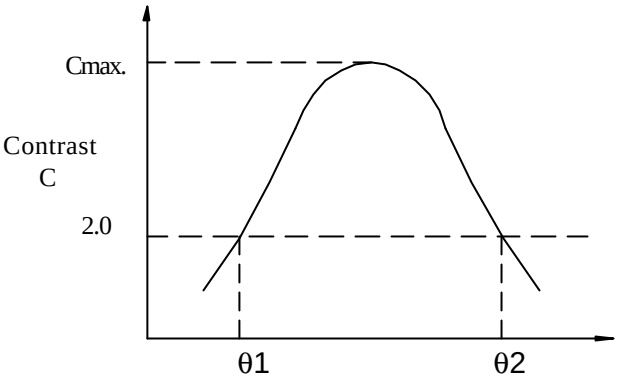
1/64Duty, 1/9Bias, VOP = 9.0V, Ta = 25°C

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 ∅



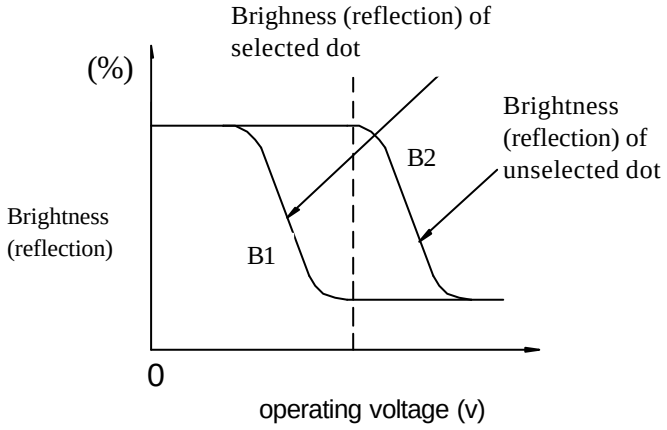
Note 2: Definition of viewing angles θ1 and θ2



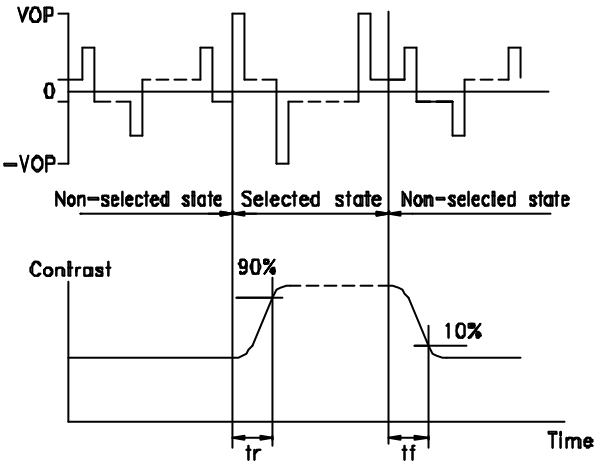
Note : Optimum viewing angle with the naked eye and viewing angle θ at Cmax. Above are not always the same

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_{OPR} : Operating voltage
t_r : Response time (rise)
f_{FRM} : Frame frequency
t_f : Response time (fall)

1.6 Backlight Characteristics

LCD Module with LED Backlight

Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Forward Current	I_F	Ta =25°C	-	250	mA
Reverse Voltage	V_R	Ta =25°C	-	8	V
Power Dissipation	P_O	Ta =25°C	-	1.1	W
Operating Temperature	T_{OP}	-	-20	70	°C
Storage Temperature	T_{ST}	-	-40	80	°C

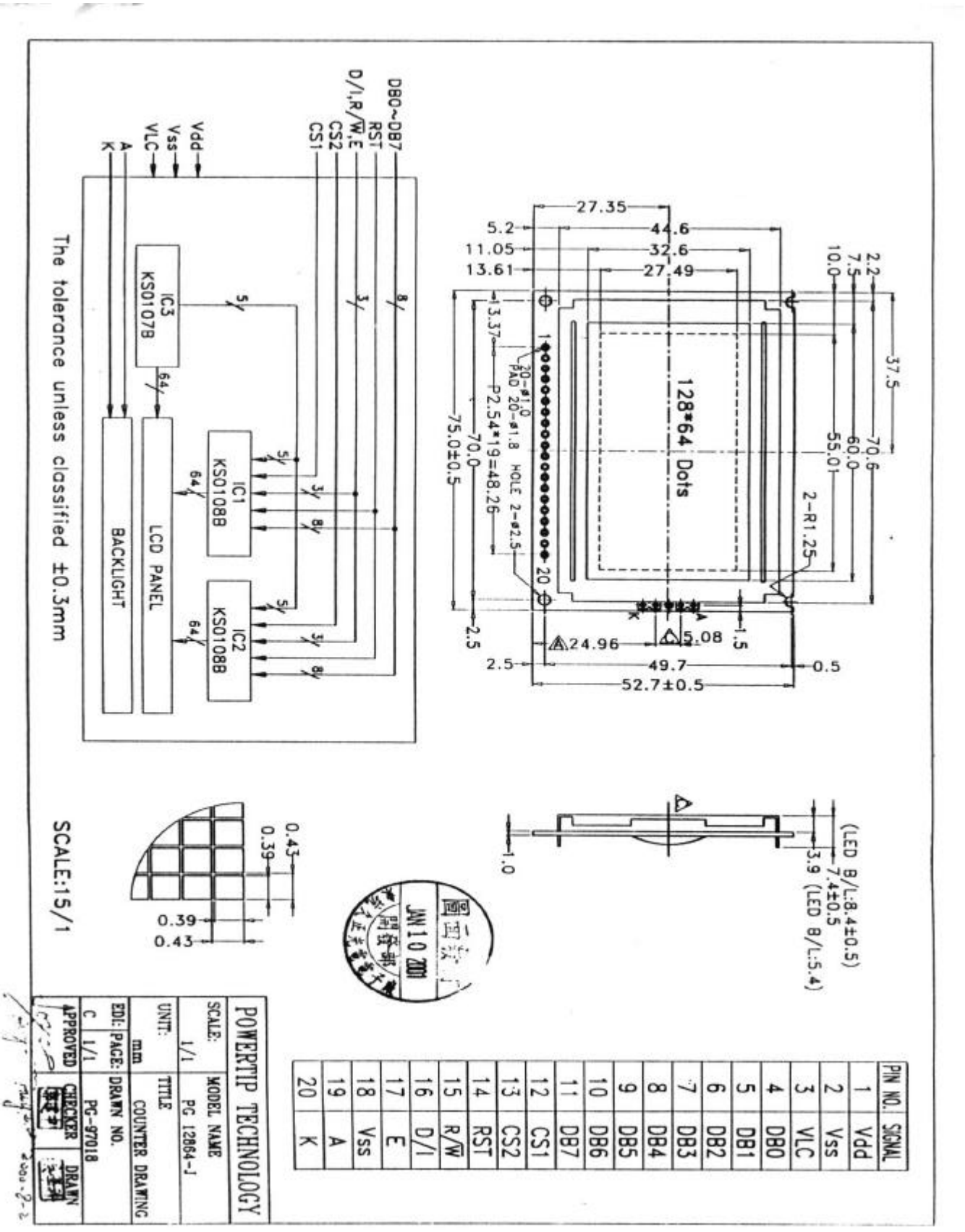
Electrical Ratings

Ta =25°C

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Forward Voltage	V_F	I_F=100 mA	-	4.1	4.4	V
Reverse Current	I_R	V_R=8V	-	-	0.2	mA
Luminous Intensity (with LCD, Dots Off)	I_V	I_F=100 mA	-	20	-	cd/m^2
Wavelength	λp	I_F=100 mA	571	-	576	nm
Color	Yellow-Green					

2. MODULE STRUCTURE

2.1 Counter Drawing

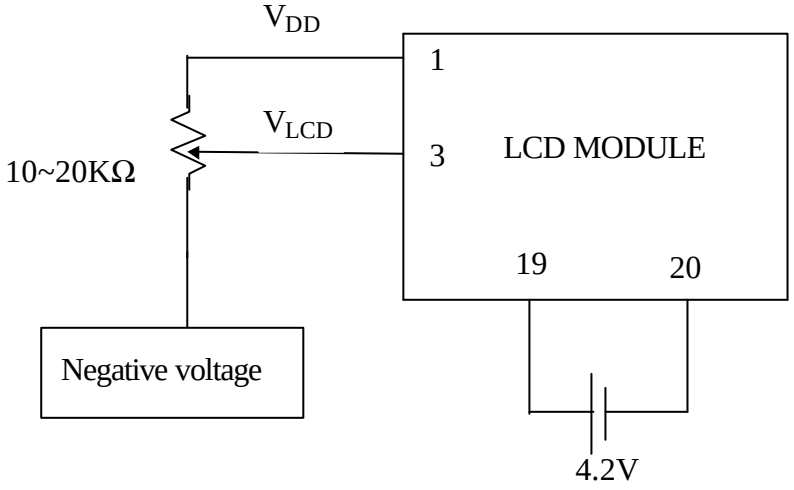


PIN NO.	SIGNAL
1	Vdd
2	Vss
3	VLC
4	DB0
5	DB1
6	DB2
7	DB3
8	DB4
9	DB5
10	DB6
11	DB7
12	CS1
13	CS2
14	RST
15	R/W
16	D/I
17	E
18	Vss
19	A
20	K

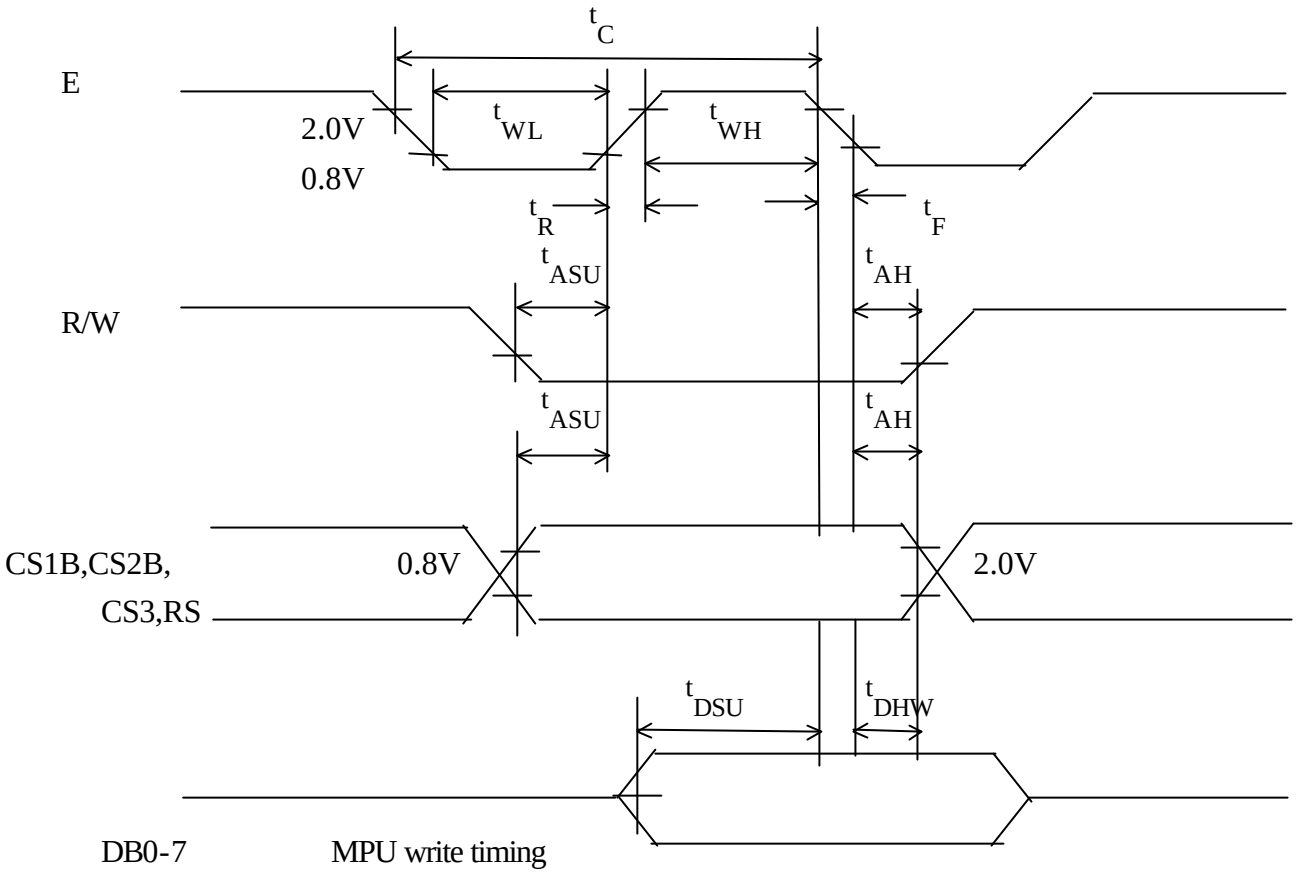
2.2 Interface Pin Description

Pin No.	Symbol	Function
1	V_{DD}	Power Supply (V_{DD}>V_{SS})
2	V_{SS}	Power Supply (V_{SS}=0)
3	V_{LCD}	Operating Voltage for LCD (variable)
4 -11	DB0~DB7	Data bus line
12	CS1	Chip enable for D2 (segment 1 to segment 64)
13	CS2	Chip enable for D3 (segment 65 to segment 128)
14	RST	Reset signal
15	$R/\overline{W}$	R/W signal input is used to select the read/write mode High =Read mode, Low =Write mode
16	D/I	Register selection input High =Data register Low =Instruction register (for write) Busy flag address counter (for read)
17	E	Start enable signal to read or write the data
18	V_{SS}	Power Supply (V_{SS}=0)
19	A	Power supply for LED B/L (+)
20	K	Power supply for LED B/L (-)

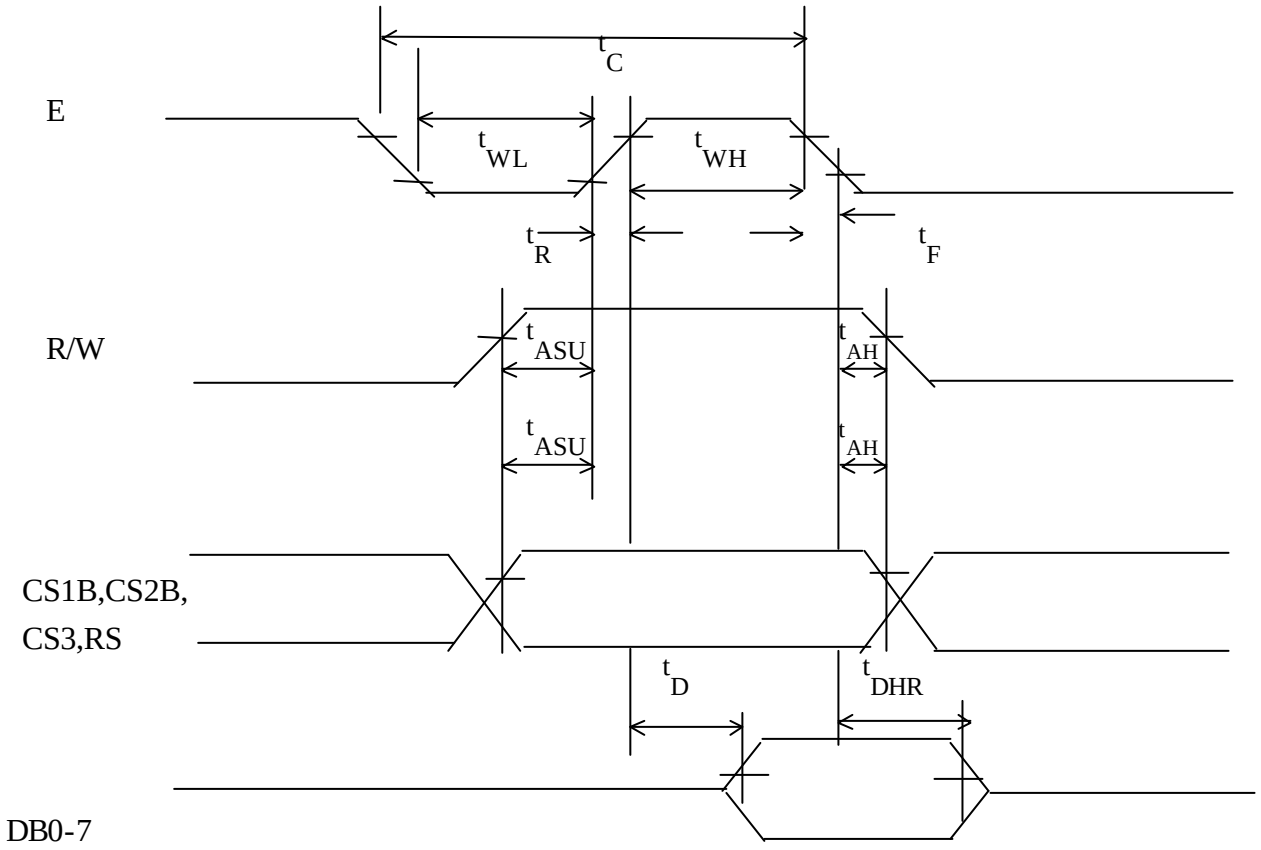
Contrast Adjust



2.3 Timing Characteristics



MPU write timing



MPU read timing

Characteristic	Symbol	Min.	Typ	Max	Unit
E Cycle	t_C	1000	-	-	ns
E High Level Width	t_{WH}	450	-	-	ns
E Low Level Width	t_{WL}	450	-	-	ns
E Rise Time	t_R	-	-	25	ns
E Fall Time	t_F	-	-	25	ns
Address Set-Up time	t_{ASU}	140	-	-	ns
Address Hold Time	t_{AH}	10	-	-	ns
Data Set-Up Time	t_{DSU}	200		-	ns
Data Delay Time	t_D	-	-	320	ns
Data Hold Time (Write)	t_{DHW}	10	-	-	ns
Data Hold Time (Read)	t_{DHR}	20	-	-	ns

2.4 Display command

Instructions	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Functions
Display on/off	0	0	0	0	1	1	1	1	1	0/1	Controls the display on or Off. Internal status and display RAM data is not affected. 0: OFF , 1: ON
Set address (Y address)	0	0	0	1	Y address (0~63)						Sets the Y address in the Y address counter.
Set Page (X address)	0	0	1	0	1	1	1	Page (0-7)			Sets the X address at the X register.
Display Start Line (Z address)	0	0	1	1	Display start line (0~63)						Indicates the display data RAM displayed at the top of the screen.
Status Read	0	1	BUSY	0	ON/OFF	RESET	0	0	0	0	Reads status. BUSY 1 : In operation 0 : Ready ON/OFF 1 : Display OFF 0 : Display ON RESET 1 : Reset 0 : Normal
Write Display Data	1	0	Write Data								Writes data (DB0:7) into display data RAM. After writing instruction, Y address is increased by 1 automatically.
Read Display Data	1	1	Read Data								Reads data (DB0:7) from display data RAM to the data bus.

Detailed Explanation

Display On/Off

	RS	R/W	DB7…… .DB0							
Code	0	0	0	0	1	1	1	1	1	D

The display data appears when D is 1 and disappears when D is 0. Though the data is not on the screen with D=0, it remains in the display data RAM. Therefore, you can make it appear by changing D=0 into D=1.

Display Start Line (Z Address)

	RS	R/W	DB7							DB0
Code	0	0	1	1	AC5	AC4	AC3	AC2	AC1	AC0

Z address(AC0-AC5) of the display data RAM is set in the display start line register and displayed at the top of the screen.When the display duty cycle is 1/64 or others(1/32-1/64),the data of total line number of LCD screen, form the line specified by display start line instruction, is displayed.
See figure 1.

Set page (X address)

	RS	R/W	DB7							DB0
Code	0	0	1	0	1	1	1	AC2	AC1	AC0

X address (AC0-AC2) of the display data RAM is set in the X address register.Writing or reading to or from MPU is executed in this specified page until the next page is set. See figure 2.

Set Adress (Y Address)

	RS	R/W	DB7							DB0
Code	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

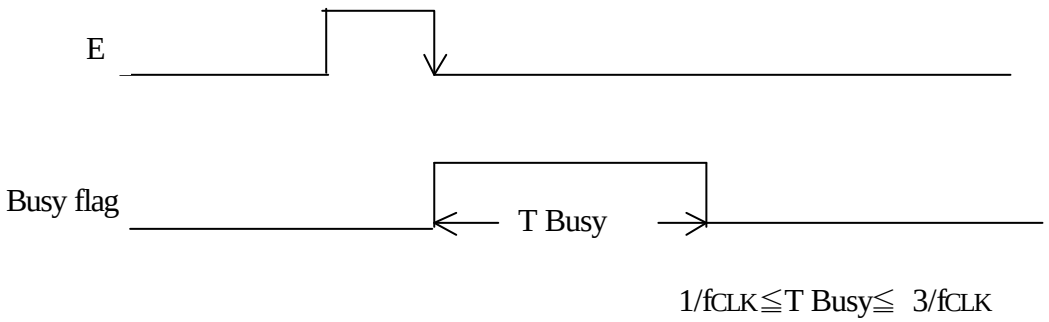
Y address(AC0-AC5) of the display data RAM is set in the Y address Counter. An address is set by instruction and increased by 1 automatically by read or write operations of display data.

Status Read

	RS	R/W	DB7							DB0
Code	0	1	BUSY	0	ON/OFF	REST	0	0	0	0

- Busy

When busy is 1, the Chip is executing internal operation and no instructions are accepted
When busy is 0, the Chip is ready to accept any instructions.



$1/f_{CLK} \leqq T\ Busy \leqq 3/f_{CLK}$

- ON/OFF

When on/off is 1, the display is OFF.

When on/off is 0, the display is ON.

- RESET

When RESET is 1, the system is being initialized.

In this condition, no instructions except status read can be accepted.

When RESET is 0,initializing has finished and the system is in the usual operation condition.

Write Display Data

	RS	R/W	DB7							DB0
Code	0	1	D7	D6	D5	D4	D3	D2	D1	D0

Write data(D0-D7) into the display data RAM.After writing instruction, Y address is increased by 1 automatically.

Read Display Data

	R/W	D/I	DB7							…DB0
Code	1	1	D7	D6	D5	D4	D3	D2	D1	D0

Reads data(D0-D7) from the display data RAM. After reading instruction, Y address is increased by 1 automatically

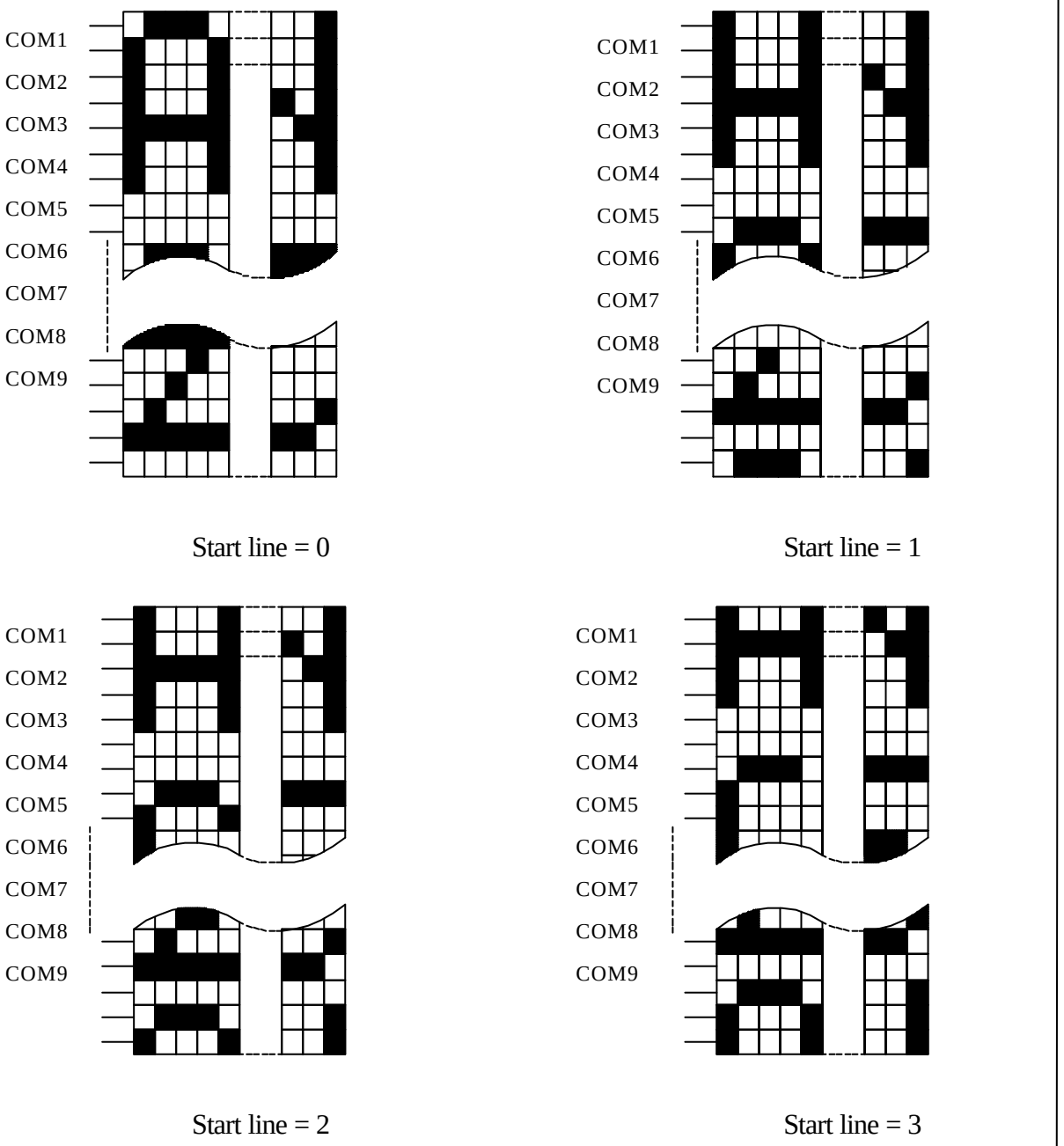


Figure 1 Relation between Start Line and Display

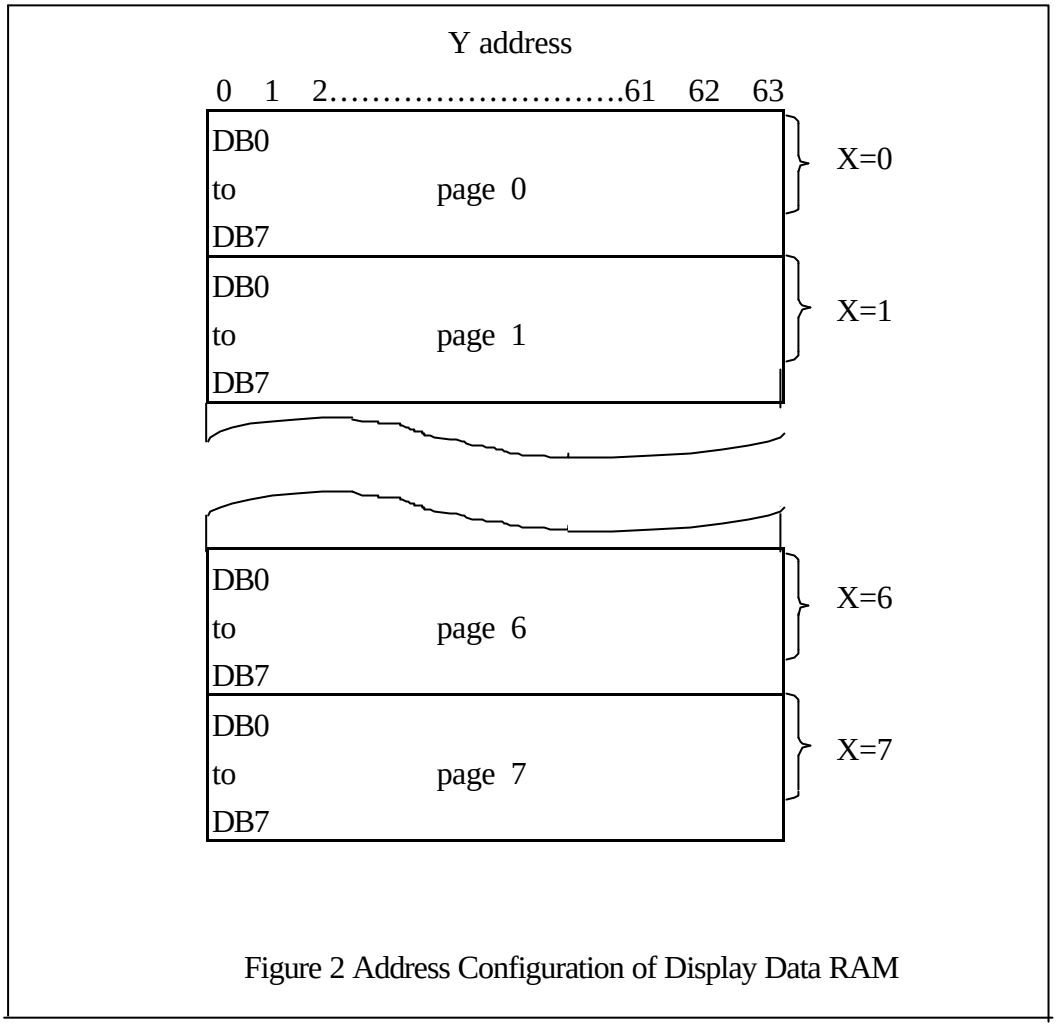


Figure 2 Address Configuration of Display Data RAM

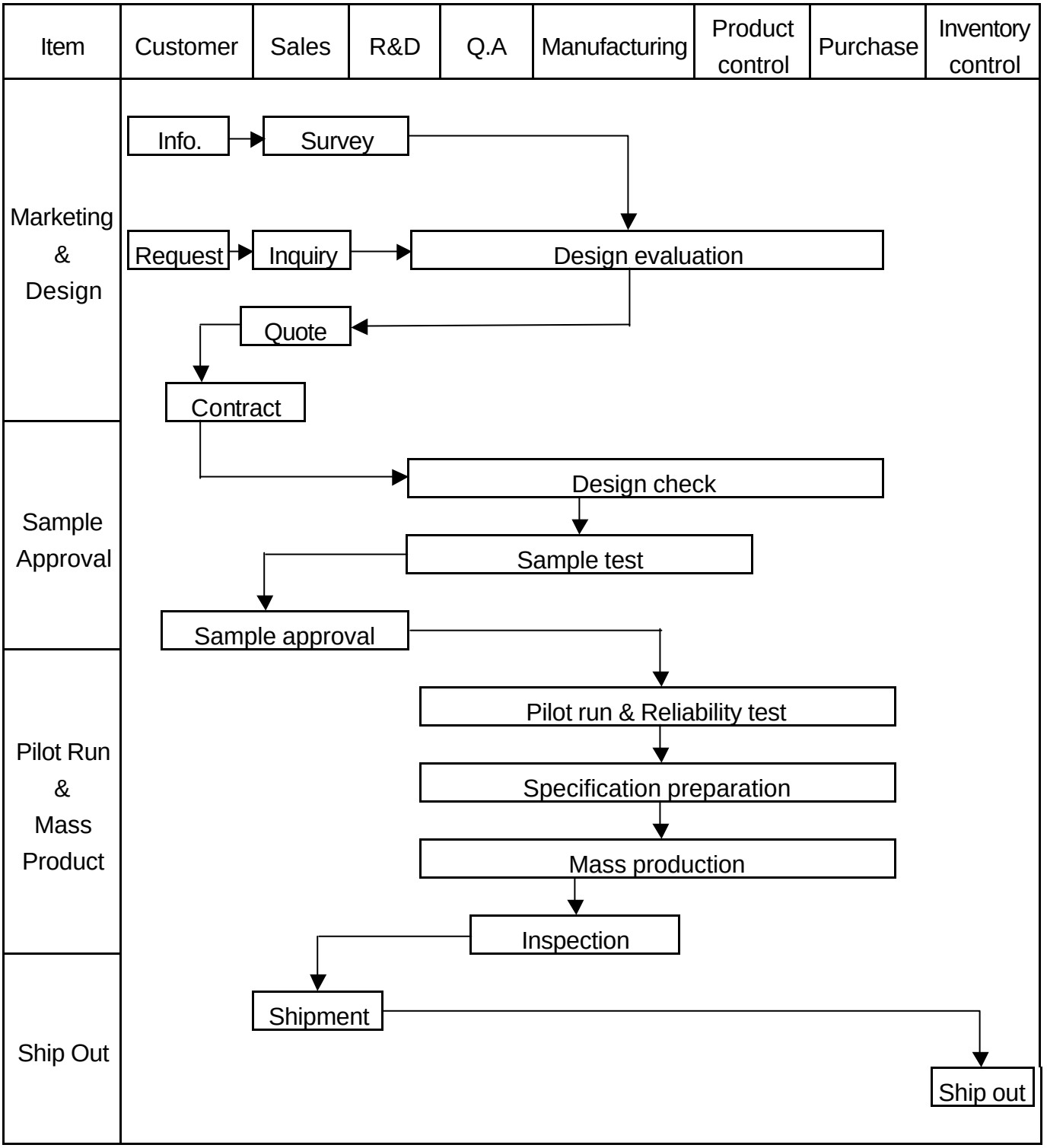
Note: "128*64" consist of 2 "64*64"

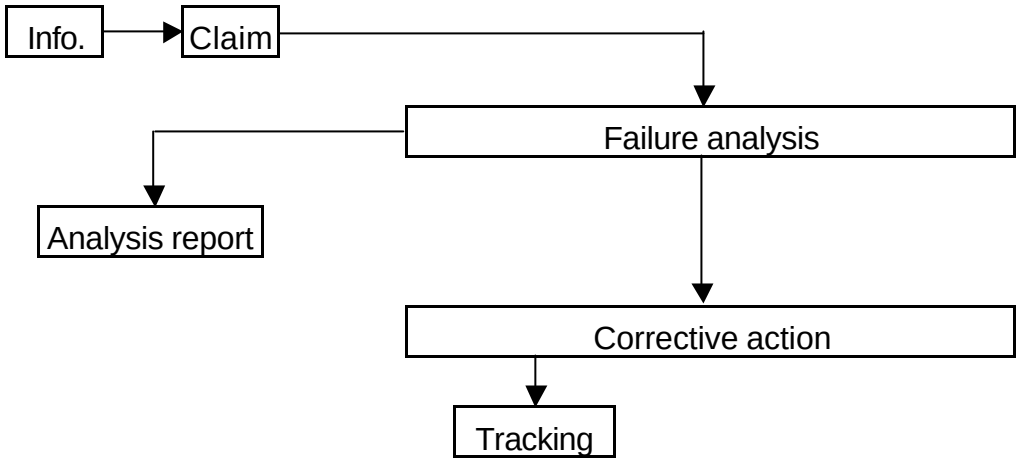
CS1⇒ Chip enable for left 64*64 (segment1 to segment 64)

CS2⇒ Chip enable for right 64*64 (segment 65 to segment 128)

3. QUALITY ASSURANCE SYSTEM

3.1 Quality Assurance Flow Chart

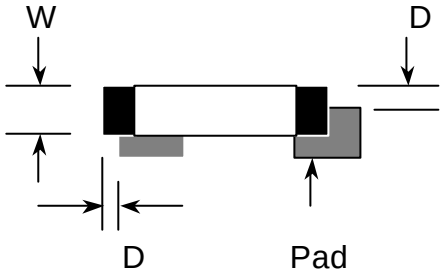


Sales Service	
Q.A Activity	1. ISO 9001 Maintenance Activities 2. Process improvement proposal 3. Equipment calibration 4. Education And Training Activities 5. Standardization Management

3.2 Inspection Specification

Inspection Standard：MIL-STD-105E Table Normal Inspection Single Sampling Level Ⅱ。
Equipment：Gauge、MIL-STD、Powertip 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		Applicable Standard
1	High Temperature Storage	Storage At 80 ±2℃ 96~100 hrs Surrounding Temperature, Then Storage At Normal Condition 4hrs.		MIL-202E
2	Low Temperature Storage	Storage At -30 ±2℃ 96~100 hrs Surrounding Temperature, Then Storage At Normal Condition 4hrs.		MIL-202E
3	High Temperature Humidity Storage	1.Storage 96~100 hrs 60 ±2℃, 90~95%RH Surrounding Temperature, Then Storage At Normal Condition 4hrs .(Polarizer may fail in this environment). or 2.Storage 96~100 hrs 40 ±2℃, 90~95%RH Surrounding Temperature, Then Storage At Normal Condition 4 hrs.		MIL-202E
4	Temperature Cycling	-20℃ → 25℃ → 70℃ → 25℃ (30Mins) (5Mins) (30Mins) (5Mins) 10 Cycle		MIL-202E
5	Vibration	10~55Hz (1 Minute) 1.5mm X,Y And Z Direction * (Each 2hrs)		MIL-202E
6	Drop Test	Packing Weight (Kg)	Drop High (Cm)	MIL-810E
		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.

5.3 STORAGE

5.3.1 Store the panel or module in a dark place where the temperature is 25°C ±5°C 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 medical devices , nuclear power control equipment , aerospace equipment , fire and security systems or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required.