深圳市诚皓光电有限公司
Shenzhen ChengHao Optoelectronic Co., Ltd.

SPECIFICATION

Product Model:　CH240QV23A-T

Designed by	R&D Checked by	Quality Department by	Approved by

Approval by Customer

OK

NG，Problem survey:

Approved By _____

V0

Revision Record

REV NO.	REV DATE	CONTENTS	Note
V0	2019-11-17	NEW ISSUE	

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1. Numbering System

CH XXX XX XX X – XX X

7. Extended version: A~Z

6. Touch panel or other materials, e.g. T:RTP, CT:CTP, L:LENS

5. Extended version: A~Z

4. Serial number: 01~99

3. Resolution, e.g. QV:QVGA 240*320; WV:WVGA 480*800; FH:FHD 1080*1920

2. Size, e.g. 2.4″: 240; 7″:700

1. Shenzhen ChengHao Optoelectronic Co., Ltd.

2. General Information

ITEM	STANDARD VALUES	UNITS
LCD type	2.4"TFT	--
Dot arrangement	240(RGB)×320	dots
Color filter array	RGB vertical stripe	--
Display mode	TN / Transmission / Normally White	--
Viewing Direction	6 o'clock	--
Gray Scale Inversion Direction	12 o'clock	--
Driver IC	ST7789V	--
Module size	42.72(W)×60.26(H)×2.45(T)	mm
Active area	36.72(W)×48.96(H)	mm
Dot pitch	0.153 (W)×0.153 (H)	mm
Interface	4-lines_8bit / 3-lines_9bit SPI 8-/9-/16-/18-bit 8080 system interface 6-/16-/18-bit RGB interface	--
Operating temperature	-20 ~ +70	℃
Storage temperature	-30 ~ +80	℃
Back Light	4 White LED In Parallel	--
Weight	TBD	g

3. External Dimensions

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NOTES:
1. DISPLAY TYPE: 2.4"TFT
2. VIEWING DIRECTION: 6:00
3. LCD DRIVE IC: ST7789V
4. POLARIZER MODE: TRANSMISSIVE/POSITIVE
5. OPERATING TEMP: -20°C~+70°C
6. STORAGE TEMP: -30°C~+80°C
7. UNMARKER TOLERANCE: ±0.20
8. REQUIREMENTS ON ENVIRONMENTAL PROTECTION: RoHS

TFT 2.41"
240*RGB*320 DOTS
VIEW DIRECTION

背光电路图
Vf=3.2V, If=80mA

FPC弯折示意图
FPC展开出货

双面胶
T=0.1mm

MODEL	CH240QV23A-T		深圳市诚皓光电有限公司 Shenzhen ChengHao Optoelectronic Co., Ltd.			
DRAWING	LGZ	DATE	2019.11.17			
CHECK		DATE				
APPROVE		DATE				
TOLERANCE	.X ±0.3, .XX ±0.2	PAGE	1 of 1	UNIT	mm	
		SCALE		SIZE	A4	

REV.	CONTENT	DATA
V0	NEW	2019.11.17

PIN DESCRIPTION	
PIN	SYMBOL
1	GND
2	YU
3	XL
4	YD
5	XR
6	DB17
7	DB16
8	DB15
9	DB14
10	DB13
11	DB12
12	DB11
13	DB10
14	DB9
15	DB8
16	DB7
17	DB6
18	DB5
19	DB4
20	DB3
21	DB2
22	DB1
23	DB0
24	SDI
25	DOTCLK
26	DE
27	HSYNC
28	VSYNC
29	/RD
30	/WR_SCL
31	RS
32	/CS
33	/RESET
34	IM0
35	IM1
36	IM2
37	VCI
38	IOVCC
39	GND
40	LEDA
41	LEDK

4. Interface Description

Pin	Symbol	Description.
1	XR	TOUCH PIN.
2	YD	
3	XL	
4	YU	
5	DB17	18-bit parallel bi-directional data bus for MPU-Ⅰ system: 　8-bit I/F: DB[7:0] is used. 　9-bit I/F: DB[8:0] is used. 　16-bit I/F: DB[15:0] is used. 　18-bit I/F: DB[17:0] is used. 18-bit input data bus for RGB I/F. 　6-bit/pixel: DB[5:0] is used; 　16-bit/pixel: DB[17:13]=R[4:0], DB[11:6]=G[5:0] and DB[5:1]=B[4:0]; 　18-bit/pixel: DB[17:12]=R[5:0], DB[11:6]=G[5:0] and DB[5:0]=B[5:0]; Connect unused pins to GND.
6	DB16	
7	DB15	
8	DB14	
9	DB13	
10	DB12	
11	DB11	
12	DB10	
13	DB9	
14	DB8	
15	DB7	
16	DB6	
17	DB5	
18	DB4	
19	DB3	
20	DB2	
21	DB1	
22	DB0	
23	SDI	Serial input signal in SPI I/F.
24	DOTCLK	Pixel clock signal in RGB I/F.
25	DE	Data enable signal in RGB I/F mode
26	HSYNC	Horizontal sync signal in RGB I/F.
27	VSYNC	Vertical sync signal in RGB I/F.
28	/RD	Reads strobe signal to write data when /RD is "Low" in MPU interface.
29	/WR_RS	MCU: Serves as a write signal and writes data at the rising edge. 4-line SPI: Serves as command or parameter select.
30	RS_SCL	Display data / command selection in 80-series MPU I/F. RS = "0" : Command　　　　RS = "1" : Display data. SPI: This pin is used serial interface clock in SPI.
31	/CS	Chip select input pin ("Low" enable) in MPU I/F and SPI I/F.
32	/RESET	Reset input pin, Active "L".

Pin	Symbol	System interface Mode				
33	IM0	IM2	IM1	IM0	Interface mode	DB Pin
		0	0	0	i80-system 8-bit interface Ⅰ	DB[7:0]
		0	0	1	i80-system 16-bit interface Ⅰ	DB[15:0]
34	IM1	0	1	0	i80-system 9-bit interface Ⅰ	DB[8:0]
		0	1	1	i80-system 18-bit interface Ⅰ	DB[17:0]
35	IM2	1	0	1	3-wires_9-bit SPI Ⅰ	/CS,SDI,SCL
		1	1	0	4-wires_8-bit SPI Ⅰ	/CS,RS,SDI,SCL

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36	VCI	System power supply.
37	IOVCC	I/O power supply.
38	GND	Power ground
39	LEDA1	LED backlight (Anode).
40	LEDK	LED backlight (Cathode).

5. Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit
Logic Supply Voltage	IOVCC	-0.3	4.6	V
Analog Supply Voltage	VCI	-0.3	4.6	V
Input Voltage	Vin	-0.3	IOVCC+0.3	V
Operating Temperature	T_{OP}	-20	70	°C
Storage Temperature	T_{ST}	-30	80	°C
Storage Humidity	HD	20	90	%RH

6. DC Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Logic Supply Voltage	IOVCC	1.65	1.8/2.8	3.3	V	-
Analog Supply Voltage	VCI	2.5	2.8	3.3	V	-
Input High Voltage	V_{IH}	0.7IOVCC	-	IOVCC	V	Digital input pins
Input Low Voltage	V_{IL}	GND	-	0.3IOVCC	V	Digital input pins
Output High Voltage	V_{OH}	0.8IOVCC	-	IOVCC	V	Digital output pins
Output Low Voltage	V_{OL}	GND	-	0.2IOVCC	V	Digital output pins
I/O Leak Current	I_{LI}	-0.1	-	0.1	uA	-

7. Timing Characteristics
7.1 Reset Timing Characteristics
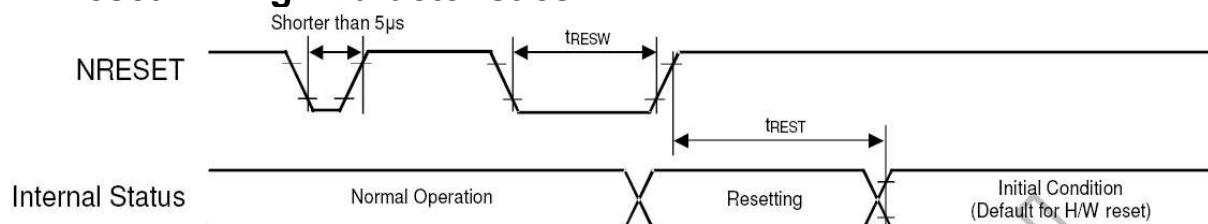
Symbol	Parameter	Related Pins	Spec.			Note	Unit
			Min.	Typ.	Max.		
tRESW	Reset low pulse width[1]	NRESET	10	-	-	-	μs
tREST	Reset complete time[2]	-	-	5	-	When reset applied during SLPIN mode	ms
			-	120	-	When reset applied during SLPOUT mode	ms

7.2 i80-System Interface Timing Characteristics
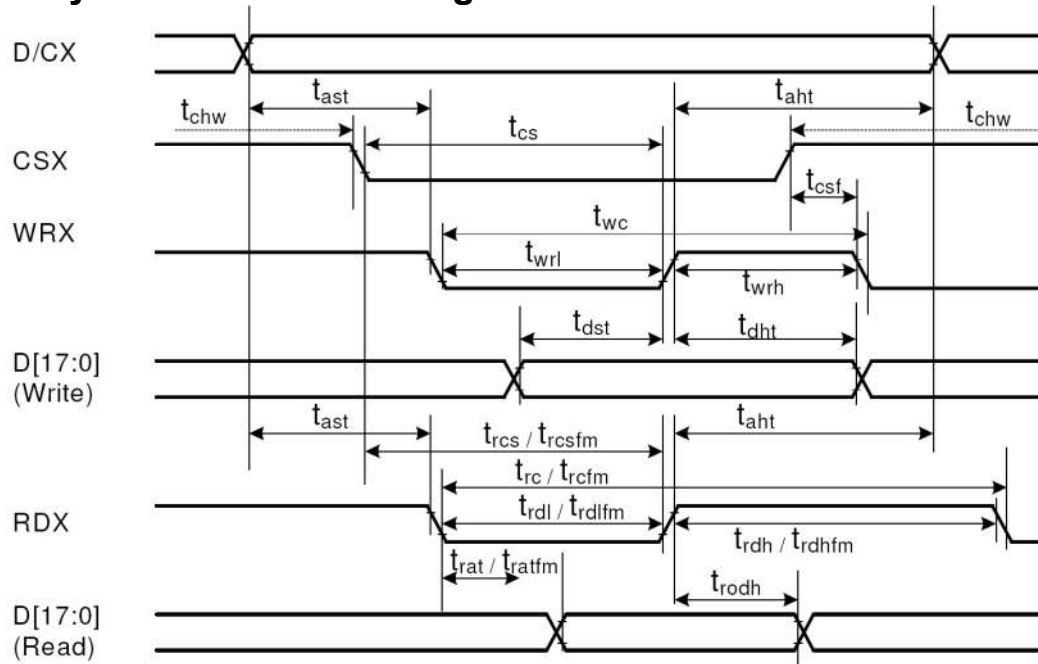
Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	0	-	ns	
CSX	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	twc	Write cycle	66	-	ns	
	twrh	Write Control pulse H duration	15	-	ns	
	twrl	Write Control pulse L duration	15	-	ns	
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
D[17:0], D[17:10]&D[8:1], D[17:10], D[17:9]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

7.3 3-line SPI Timing Characteristics
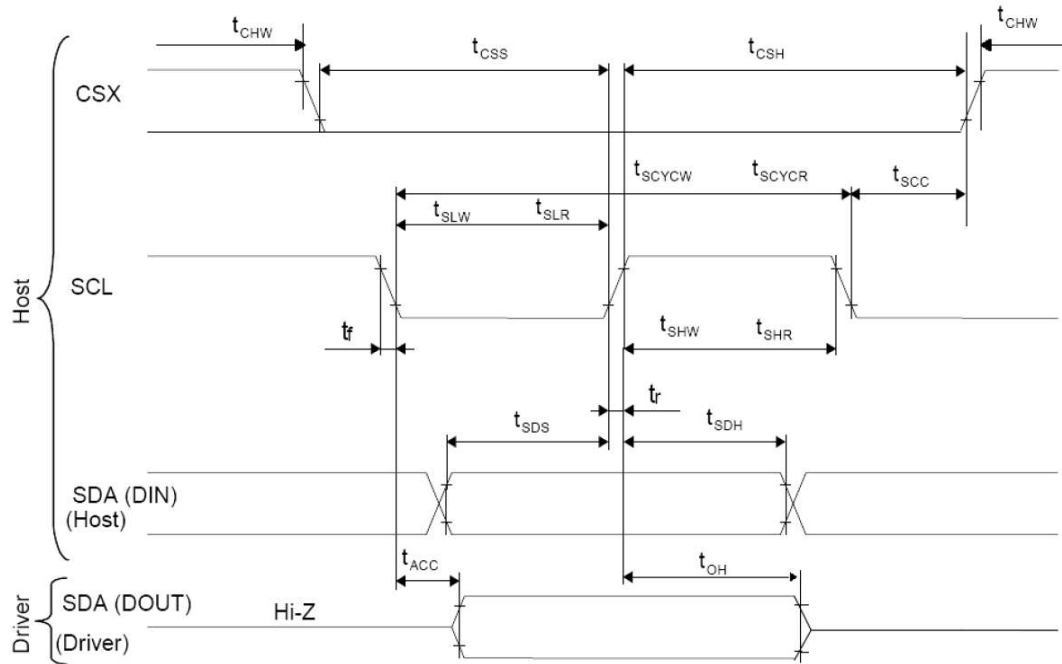
Signal	Symbol	Parameter	min	max	Unit	Description
SCL	tscycw	Serial Clock Cycle (Write)	100	-	ns	
	tshw	SCL "H" Pulse Width (Write)	40	-	ns	
	tslw	SCL "L" Pulse Width (Write)	40	-	ns	
	tscycr	Serial Clock Cycle (Read)	150	-	ns	
	tshr	SCL "H" Pulse Width (Read)	60	-	ns	
	tslr	SCL "L" Pulse Width (Read)	60	-	ns	
SDA / SDI (Input)	tsds	Data setup time (Write)	30	-	ns	
	tsdh	Data hold time (Write)	30	-	ns	
SDA / SDO (Output)	tacc	Access time (Read)	10	-	ns	
	toh	Output disable time (Read)	10	50	ns	
CSX	tscc	SCL-CSX	20	-	ns	
	tchw	CSX "H" Pulse Width	40	-	ns	
	tcss	CSX-SCL Time	60	-	ns	
	tcsh		65	-	ns	

7.4 4-line SPI Timing Characteristics
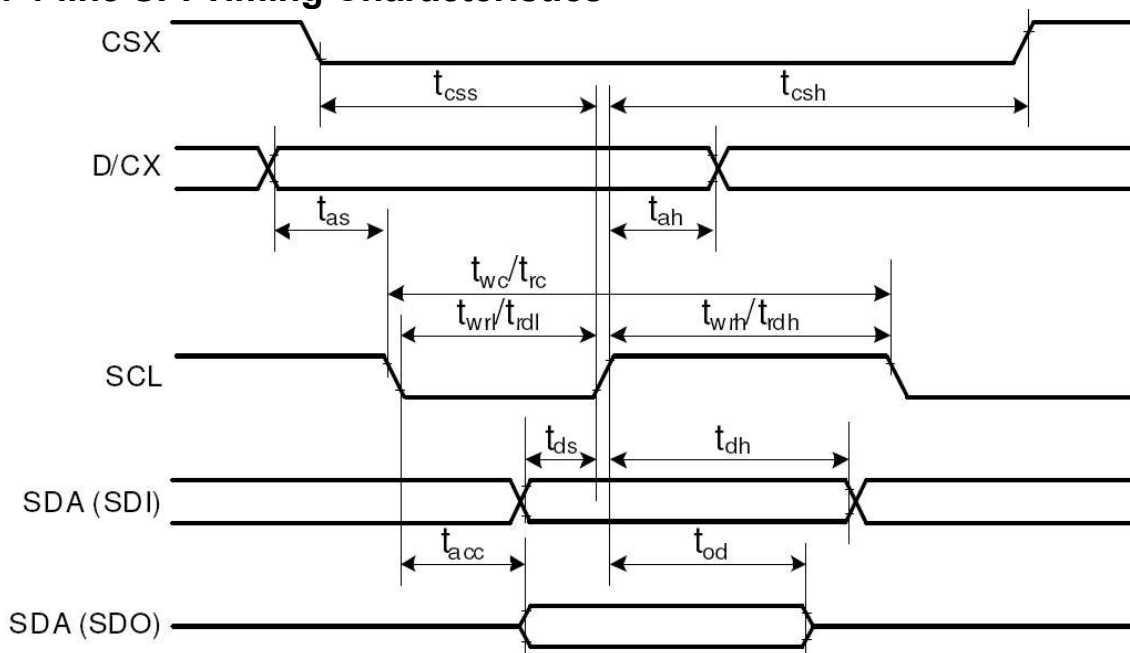
Signal	Symbol	Parameter	min	max	Unit	Description
CSX	tcss	Chip select time (Write)	40	-	ns	
	tcsh	Chip select hold time (Read)	40	-	ns	
SCL	twc	Serial clock cycle (Write)	100	-	ns	
	twrh	SCL "H" pulse width (Write)	40	-	ns	
	twrl	SCL "L" pulse width (Write)	40	-	ns	
	trc	Serial clock cycle (Read)	150	-	ns	
	trdh	SCL "H" pulse width (Read)	60	-	ns	
	trdl	SCL "L" pulse width (Read)	60	-	ns	
D/CX	tas	D/CX setup time	10	-		
	tah	D/CX hold time (Write / Read)	10	-		
SDA / SDI (Input)	tds	Data setup time (Write)	30	-	ns	
	tdh	Data hold time (Write)	30	-	ns	
SDA / SDO (Output)	tacc	Access time (Read)	10	-	ns	For maximum CL=30pF
	tod	Output disable time (Read)	10	50	ns	For minimum CL=8pF

7.5 Parallel 18/16/6-bit RGB Interface Timing Characteristics
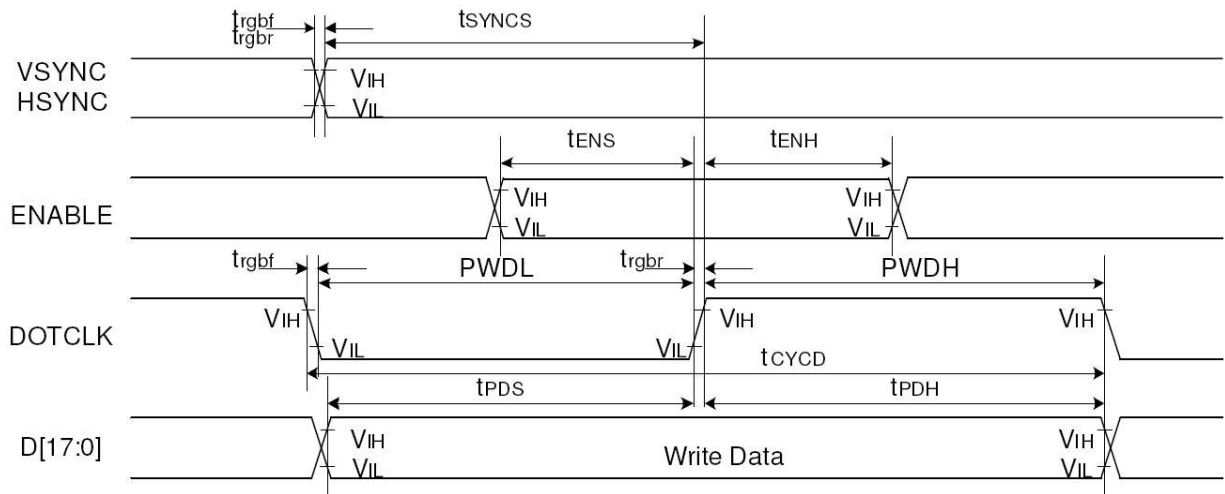
Signal	Symbol	Parameter	min	max	Unit	Description
VSYNC / HSYNC	t_{SYNCS}	VSYNC/HSYNC setup time	15	-	ns	
	t_{SYNCH}	VSYNC/HSYNC hold time	15	-	ns	
DE	t_{ENS}	DE setup time	15	-	ns	
	t_{ENH}	DE hold time	15	-	ns	
D[17:0]	t_{POS}	Data setup time	15	-	ns	18/16-bit bus RGB interface mode
	t_{PDH}	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level period	15	-	ns	
	PWDL	DOTCLK low-level period	15	-	ns	
	t_{CYCD}	DOTCLK cycle time	100	-	ns	
	t_{rgbr} , t_{rgbf}	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns	
VSYNC / HSYNC	t_{SYNCS}	VSYNC/HSYNC setup time	15	-	ns	
	t_{SYNCH}	VSYNC/HSYNC hold time	15	-	ns	
DE	t_{ENS}	DE setup time	15	-	ns	
	t_{ENH}	DE hold time	15	-	ns	
D[17:0]	t_{POS}	Data setup time	15	-	ns	6-bit bus RGB interface mode
	t_{PDH}	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level pulse period	15	-	ns	
	PWDL	DOTCLK low-level pulse period	15	-	ns	
	t_{CYCD}	DOTCLK cycle time	100	-	ns	
	t_{rgbr} , t_{rgbf}	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns	

8. Backlight Charasterics

LEDA — LEDK
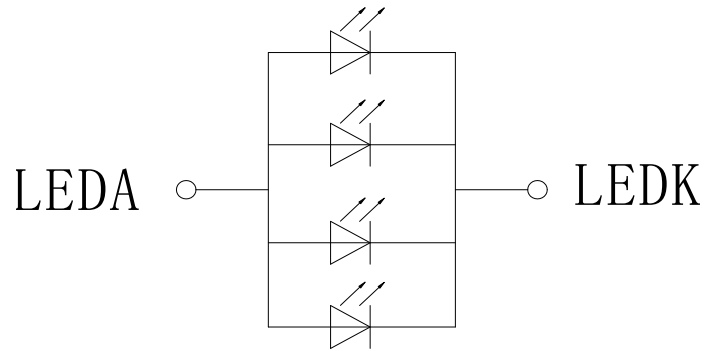
Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition
Supply Voltage	Vf	2.9	3.2	3.4	V	If=80mA
Supply Current	If	-	80	-	mA	-
Luminous Intensity for LCM	-	250	300	-	Cd/m^2	If=80mA
Uniformity for LCM	-	80	-	-	％	If=80mA
Life Time	-	20000	-	-	Hr	If=80mA
Backlight Color	White					

9. Optical Characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Transmittance (without Polarizer)		T(%)	—	—	(14.4)	—	—	
Contrast Ratio		CR	Θ=0	400	500	—	—	(1)(2)
Response time	Rising	T_R	Normal viewing angle — —	—	4	8	msec	(1)(3)
	Falling	T_F		—	12	24		
Color gamut		S(%)			60		%	
Color chromaticity (CIE1931)	White	W_x		0.283	0.303	0.323		(1)(4) CF glass (C-light)
		Wy		0.305	0.325	0.345		
	Red	Rx		0.606	0.626	0.646		
		Ry		0.314	0.334	0.354		
	Green	Gx		0.257	0.277	0.297		
		Gy		0.529	0.549	0.569		
	Blue	Bx		0.122	0.142	0.162		
		By		0.102	0.122	0.142		
Viewing angle	Hor.	$Θ_L$	CR>10	35	45	—		
		$Θ_R$		35	45	—		
	Ver.	$Θ_U$		35	45	—		
		$Θ_D$		10	20	—		

Measuring Condition:
Dark room, 25±2℃, 15min. warm-up time.

Measuring Equipment
FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

Note (1) Definition of Viewing Angle :
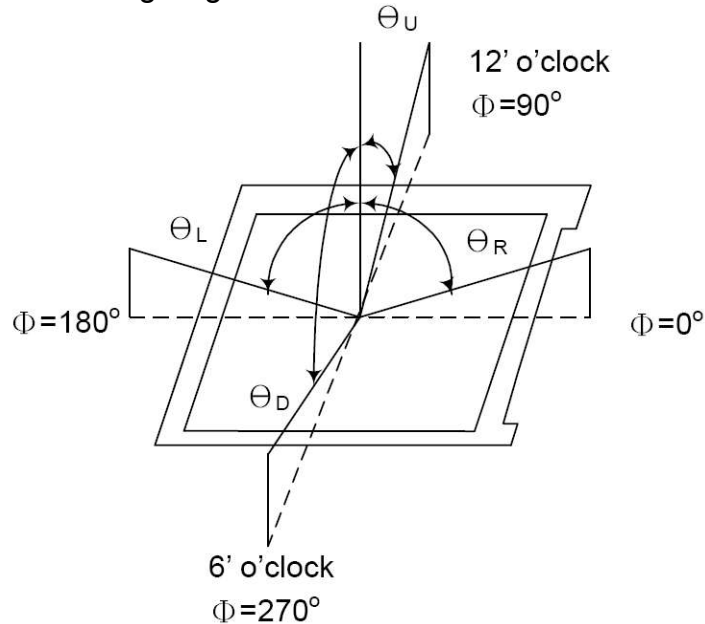
Note (2) Definition of Contrast Ratio(CR) :
Measured at the center point of panel

CR = Luminance with all pixels white / Luminance with all pixels black

Note (3) Definition of Response Time : Sum of T_R and T_F
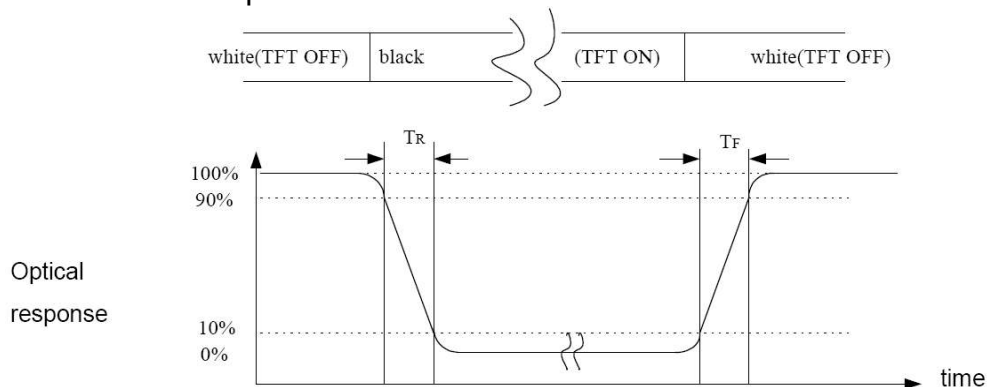
Note (4) Definition of optical measurement setup

12/18
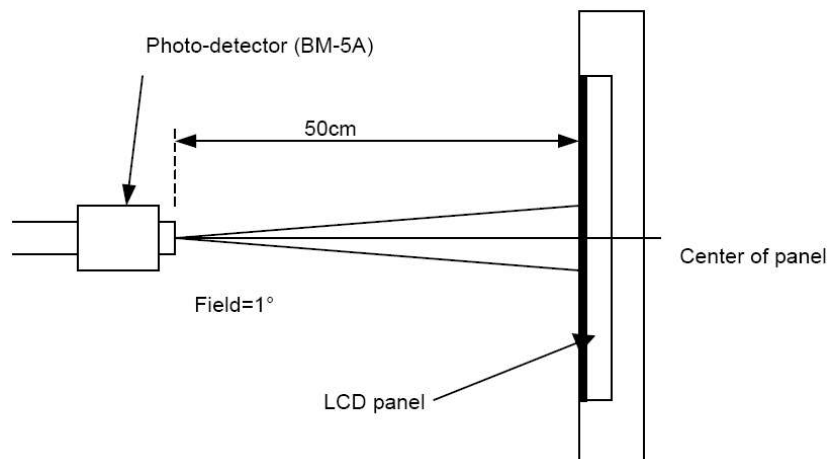
10. Reliability Test Conditions And Methods

NO.	TEST ITEMS	TEST CONDITION	INSPECTION AFTER TEST
①	High Temperature Storage	80℃±2℃×96Hours	Inspection after 2~4hours storage at room temperature,the samples should be free from defects: 1,Air bublle in the LCD. 2,Sealleak. 3,Non-display. 4,Missing segments. 5,Glass crack. 6,Current IDD is twice higher than initial value. 7,The surface shall be free from damage. 8,The electric charateristic requirements shall be satisfied.
②	Low Temperature Storage	-30℃±2℃×96Hours	
③	High Temperature Operating	70℃±2℃×96Hours	
④	Low Temperature Operating	-20℃±2℃×96Hours	
⑤	Temperature Cycle(Storage)	-20℃ ⟺ 25℃ ⟺ 70℃ (30min) (5min) (30min) 1cycle Total 10cycle	
⑥	Damp Proof Test (Storage)	50℃±5℃×90%RH×96Hours	
⑦	Vibration Test	Frequency:10Hz~55Hz~10Hz Amplitude:1.5M X,Y,Z direction for total 3hours (Packing Condition)	
⑧	Drooping Test	Drop to the ground from 1M height one time every side of carton. (Packing Condition)	
⑨	ESD Test	Voltage:±8KV,R:330Ω,C:150PF,Air Mode,10times	

REMARK:
1,The Test samples should be applied to only one test item.
2,Sample side for each test item is 5~10pcs.
3,For Damp Proof Test,Pure water(Resistance＞10MΩ)should be used.
4,In case of malfunction defect caused by ESD damage,if it would be recovered to normal state after resetting,it would be judge as a good part.
5,EL evaluation should be excepted from reliability test with humidity and temperature:Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
6,Failure Judgment Criterion:Basic Specification Electrical Characteristic,Mechanical Characteristic,Optical Characteristic.

11. Inspection Standard

This standard apply to C-STN/TFT module

1. **Spot check plan：**

   According to spot check level Ⅱ,MIL-STD-105D Level Ⅱ,the rank of accept or reject is below:

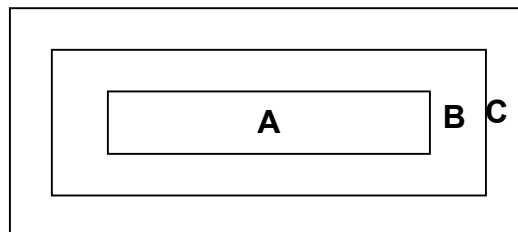   3A 级、2A 级：major non-conformance：AQL 0.25 minor non-conformance：AQL 0.4

   A 级：major non-conformance： AQL 0.65   minor non-conformance： AQL 1.

2. **Inspection condition：**
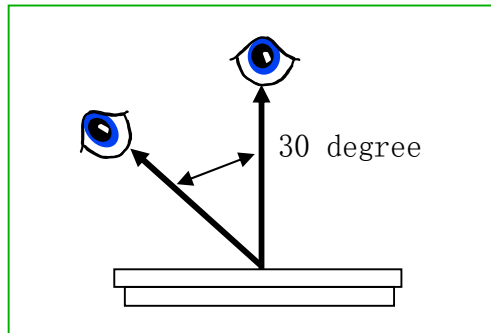
   30 degree

   Under daylight lamp 20～40W，product distance inspector'eye 30cm,incline degree 30°。

3. **LCD area define：**

   Area A：display area

   Area B：VA area

   Area C：out of VA area,not in sight after assemby
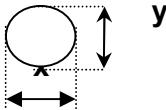
   Remark :non-conformance at area C,but is OK that isn't influence raliability of product & assembly by customer.
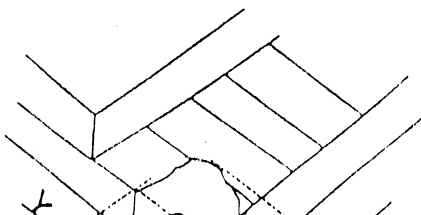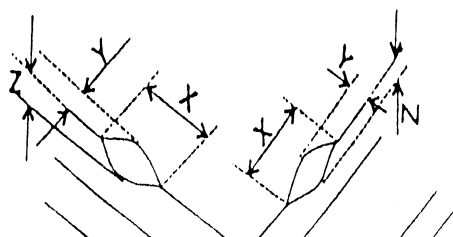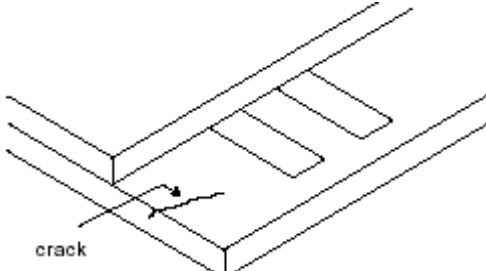
4. Inspection standard
4.1 Major non-conformance

NO.	Item	Inspection standard	Rate
4.1.1	Function non-conformance	1) No display,display abnormaly 2) Miss line, short 3) B/L no function or function abnormaly 4) TP no function	**major**
4.1.2	miss	No matter miss what component	
4.1.3	Out of size	Module dimension out of spec	

4.2 Appearance non-conformance

NO.	Item	Inspection standard	Rate
4.2.1	Black or white spot （power on）	**dot non-conformance define** Φ $\Phi = \dfrac{(x+y)}{2}$ **A grade** Most approve 4 damages, dot to dot ≥10mm	Minor
4.2.2	Black or white line （power on）	**A grade** Most approve 3 damages, line to line ≥10mm	Minor
4.2.3	Polarizer position	1) polarizer attach meet drawing,disallow out of LCD. 2) polarizer must cover display area（special require unless）	Minor

4.2.1 A grade

size（mm） \ area	Most approve q'ty		
	A	B	C
$\Phi \leq 0.10$	ignore		ignore
$0.10 < \Phi \leq 0.15$	3		
$0.15 < \Phi \leq 0.20$	2		
$0.20 < \Phi \leq 0.25$	1		
$0.25 < \Phi$	0		

4.2.2 A grade

Size(mm)		Most approve q'ty		
L(length）	W(width)	A	B	C
ignore	W≤0.03	ignore		ignore
L≤5.0	0.03＜W≤0.05	2		
L≤3.0	0.05＜W≤0.07	1		
	0.07＜W	Treat with dot non-conformance		

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4.2.4	LCD non-conformance	**(i) crash at side（remark: S=ITO length）** 	X	Y	Z
≤3.0	≤S	ignore | **Crash disallow extend to ITO or seal.** **(ii) commonly surface scathe** | X	Y	Z
≤2.0	<frame edge	ignore	 **(iii) crack** **Disallow extend crack** crack	Minor	
4.2.5	Contrast voltage warp	VOP/VIcd voltage of confirmed sample±0.15V	Minor	
4.2.6	color	Color & luminance of module scope reference spec	Minor	
4.2.7	Cross talk	Reference confirmed limit sample	Minor	

12. Handling Precautions

12.1 Mounting method

The LCD panel of CH LCD module consists of two thin glass plates with polarizes which easily be damaged. And since the module in so constructed as to be fixed by utilizing fitting holes in the printed circuit board.

Extreme care should be needed when handling the LCD modules.

12.2 Caution of LCD handling and cleaning

When cleaning the display surface, Use soft cloth with solvent
[recommended below] and wipe lightly
- Isopropyl alcohol
- Ethyl alcohol

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:
- Water
- Aromatics

Do not wipe ITO pad area with the dry or hard materials that will damage the ITO patterns

Do not use the following solvent on the pad or prevent it from being contaminated:
- Soldering flux
- Chlorine (Cl) , Salfur (S)

If goods were sent without being sili8con coated on the pad, ITO patterns could be damaged due to the corrosion as time goes on.

If ITO corrosion happen by miss-handling or using some materials such as Chlorine (Cl), Salfur (S) from customer, Responsibility is on customer.

12.3 Caution against static charge

The LCD module use C-MOS LSI drivers, so we recommended that you:

Connect any unused input terminal to Vdd or Vss, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

12.4 packing

- Module employ LCD elements and must be treated as such.
- Avoid intense shock and falls from a height.
- To prevent modules from degradation, do not operate or store them exposed direct to sunshine or high temperature/humidity

12.5 Caution for operation

- It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit cause the shorter LCD life.
- An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.
- Response time will be extremely delayed at lower temperature then the operating temperature range and on the other hand at higher temperature LCD's how dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operation temperature.
- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

Usage under the maximum operating temperature, 50%Rh or less is required.

12.6 storage

In the case of storing for a long period of time for instance, for years for the purpose or replacement use, the following ways are recommended.
- Storage in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it . And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light's keeping the storage temperature range.
- Storing with no touch on polarizer surface by the anything else.

[It is recommended to store them as they have been contained in the inner container at the time of delivery from us

12.7 Safety

- It is recommendable to crash damaged or unnecessary LCD's into pieces and wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.
- When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water

13. Precaution For Use

13.1

A limit sample should be provided by the both parties on an occasion when the both parties agreed its necessity. Judgment by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

13.2

On the following occasions, the handing of problem should be decided through discussion and agreement between responsible of the both parties.

- When a question is arisen in this specification
- When a new problem is arisen which is not specified in this specifications
- When an inspection specifications change or operating condition change in customer is reported to CH LCD , and some problem is arisen in this specification due to the change
- When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.

14. Packing Method