一众显示科技有限公司

TEAM SOURCE DISPLAY TECH. CO, LTD.

TFT-LCD Module Specification

Module NO.：TSM043WQHS-72P

Version：V1.0

□ APPROVAL FOR SPECIFICATION   □ APPROVAL FOR SAMPLE

For Customer's Acceptance：	
Approved by	**Comment**

Team Source Display：		
Presented by	**Reviewed by**	**Approved by**
Zahi	Aron	Aron

Version No.	Date	Content	Remark
V1.0	2023-02-14	The initial release	

CONTENTS

1   General Characteristics

1.1   Introduction

TSM043WQHS-72P   is a transmissive type color active matrix liquid crystal display(LCD) which uses amorphous thin film transistor(TFT) as switching devices. This product is composed of a TFT LCD panel, a drive IC, a FPC, and a LED-backlight unit,and a   Resistor touch screen and a driving circuit. The active display area is 4.3inches diagonally measured and the native resolution is 480*RGB*272.Features of this product are listed in the following table.

1.2   Features

- ■ 4.3 inch configuration
- ■ MCU8/16-bit interface
- ■ Resistor touch screen
- ■ RoHS Compliance

1.3   Applications

- ■ TFT LCD Monitor
- ■ Consumer Application
- ■ Amusement

1.4   General Information

ITEM	Specification	Unit
LCD Type	a-Si TFT,Transmissive,Normally black	-
LCD Size	4.3	inch
Resolution (W x H)	480x (RGB) × 272	pixel
Outline size	105.50(H) x 67.20(V) x7.65(T)	mm
Active Area	95.04(H) x53.86 (V)	mm
Pixel Pitch	0.1980(H) × 0.1980(V)	mm
Viewing Direction	ALL o'clock	-
Color Depth	16.7M	-
Pixel Arrangement	RGB-stripe	-
Surface Luminance	560(TYP)600(MAX)	cd/m²
Lens Surface Treatment	Clear	-
Driver IC	SSD1963	
Interface Type	MCU8/16bit	-
Input Voltage	VCC=5.0V,IOVCC=3.3V	V
With/Without TP or Lens	With RTP	-
Weight	TBD	g

4.3inch

480*RGB*272

0.198(H)*RGB*0.198(V)

free viewing direction

YU
XL — XR
YD

易撕贴

LCM O.D 105.50±0.2 ①
TP O.D 104.70±0.15
TP V.A 99.00
TP A.A 97.00
LCD A.A 95.04
TP V.A 57.60
TP A.A 55.50
LCD A.A 53.86

LCM O.D 67.20±0.2 ②
TP O.D 64.90±0.15

0.40
3.30
4.20
5.23

0.20
2.35
3.20
4.23

20.95
3.67
41.99
26.18
0.80

7.65±5(Total) ③
LCM+TP=4.25±0.3
LCM 3.05±0.1
TP 1.20±0.1
1.00(PCB)

105.31±0.3(PCB)
40.00±0.3(PCB)
2.50±1

PCB-TFT control board V2.1

CN1
1
32
40   1
XR XL

	CN1
Pin	Symbol
1	GND
2	VCC(5.0V)
3	BL_EN
4	RS
5	WR
6	RD
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	DB8
16	DB9
17	DB10
18	DB11
19	DB12
20	DB13
21	DB14
22	DB15
23	NC
24	NC
25	CS
26	RESET
27	NC
28	XR
29	YD
30	XL
31	YU
32	DISP

LED-A1
LED-A2
1 2 3 4 5 6
LED-K1
LED-K2

BL_EN: High, Backlight ON;
Low, Backlight OFF.

All I/O port operating voltage is 3.3V.

NOTES:
1. GENERAL TOLERANCE:±0.2
2. ( )REFERENCE DIMENSION
3. Important dimension: ①～③

LCD Type	4.3"TFT,Transmissive
	Normally black
Resolution	480(RGB)*272
View Direction	All O'CLOCK
LCD Driver IC	SSD1963
Color Depth	16.7M
Interface Types	MCU8/16-bit
Operating voltage	VCC=5.0V,IOVCC=3.3V
TP/Lens	With RTP
Backlight LEDs	12 LEDs，40mA
Surface luminance	560(Typ) ,600(max) cd/m²
Operating temperature	−20 ℃~70 ℃
Storage temperature	−30 ℃~80 ℃

版本 (Version)	变更记录(Revise History)	日期(Date)	设计(DESIGN)	Hcr
A0	Initial release	2020.11.11	审核(CHECKED)	Aron
			批准(APPROVED)	Aron
			客户承认 (CUSTOMER APPROVAL)	

TITLE: LCM+RTP+PCBA
Drawing No. TSM043WQHS-72P

页面(Page) 1 / 1
单位(Unit) mm
比例(SCALE) 1 : 1
角度(Angle)

TEAM SOURCE DISPLAY

3 Interface description

3.1 LCM interface description

Pin No.	Symbol	Description
1	GND	System Ground. (0V)
2	VCC(5.0V)	Power supply +5.5V
3	BL_EN	High, Backlight ON;Low, Backlight OFF
4	RS	Data/Command Selection pin
5	WR	Write signal
6	RD	Read signal
7-22	DB0-DB15	MCU16-bit Data BUS
23	NC	Not connection
24	NC	Not connection
25	CS	Chip select signal
26	RESET	Reset input signal
27	NC	Not connection
28	XR	The touch panel X right
29	YD	The touch panel Y down
30	XL	The touch panel X left
31	YU	The touch panel Y up
32	DISP	Standby mode control. (Normally pull high) DISP="L", enter standby mode for power saving. Timing controller and source driver will turn off, all outputs are Hi-Z. DISP="H", normal operation.

4 LCM Interface Timing

4.1 Parallel 8080-series Interface Timing
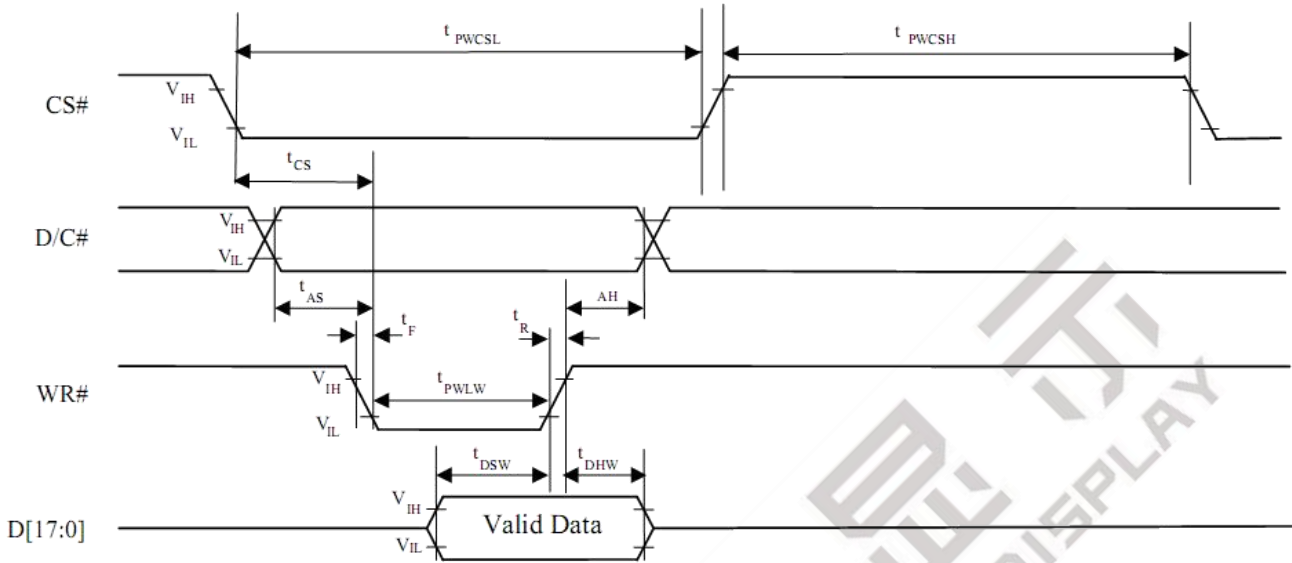
Parallel 8080-series Interface Timing Diagram (Write Cycle)
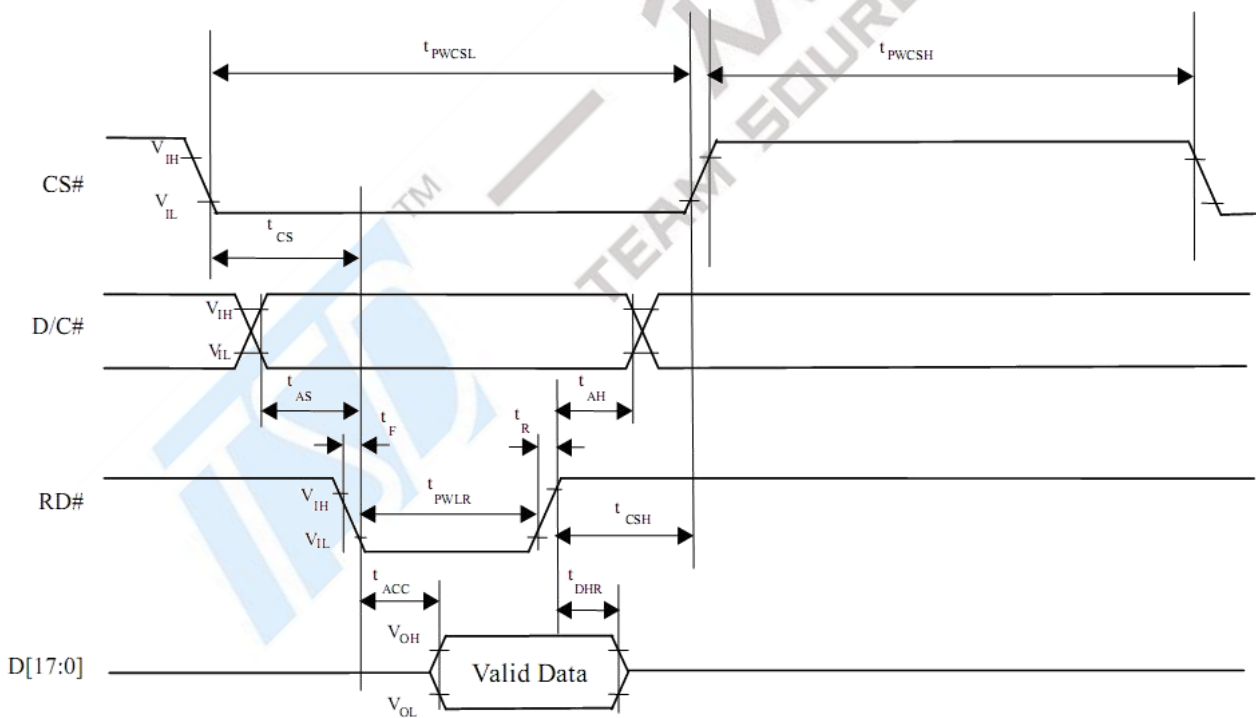
Parallel 8080-series Interface Timing Diagram (Read Cycle)

Symbol	Parameter			Min	Typ	Max	Unit
f$_{MCLK}$	System Clock Frequency*			1	-	110	MHz
t$_{MCLK}$	System Clock Period*			1/ f$_{MCLK}$	-	-	ns
t$_{PWCSL}$	Control Pulse High Width	Write		13	1.5* t$_{MCLK}$	-	ns
		Read		30	3.5* t$_{MCLK}$		
t$_{PWCSH}$	Control Pulse Low Width	Write (next write cycle)		13	1.5* t$_{MCLK}$	-	ns
		Write (next read cycle)		80	9* t$_{MCLK}$		
		Read		80	9* t$_{MCLK}$		
t$_{AS}$	Address Setup Time			1	-	-	ns
t$_{AH}$	Address Hold Time			2	-	-	ns
t$_{DSW}$	Write Data Setup Time			4	-	-	ns
t$_{DHW}$	Write Data Hold Time			1	-	-	ns
t$_{PWLW}$	Write Low Time			12	-	-	ns
t$_{DHR}$	Read Data Hold Time			1	-	-	ns
t$_{ACC}$	Access Time			32	-	-	ns
t$_{PWLR}$	Read Low Time			36	-	-	ns
t$_R$	Rise Time			-	-	0.5	ns
t$_F$	Fall Time			-	-	0.5	ns
t$_{CS}$	Chip select setup time			2	-	-	ns
t$_{CSH}$	Chip select hold time to read signal			3	-	-	ns

* System Clock denotes external input clock (PLL-bypass) or internal generated clock (PLL-enabled)

4.2 LCD RGB Timing Characteristics

DE Mode Timing Diagram
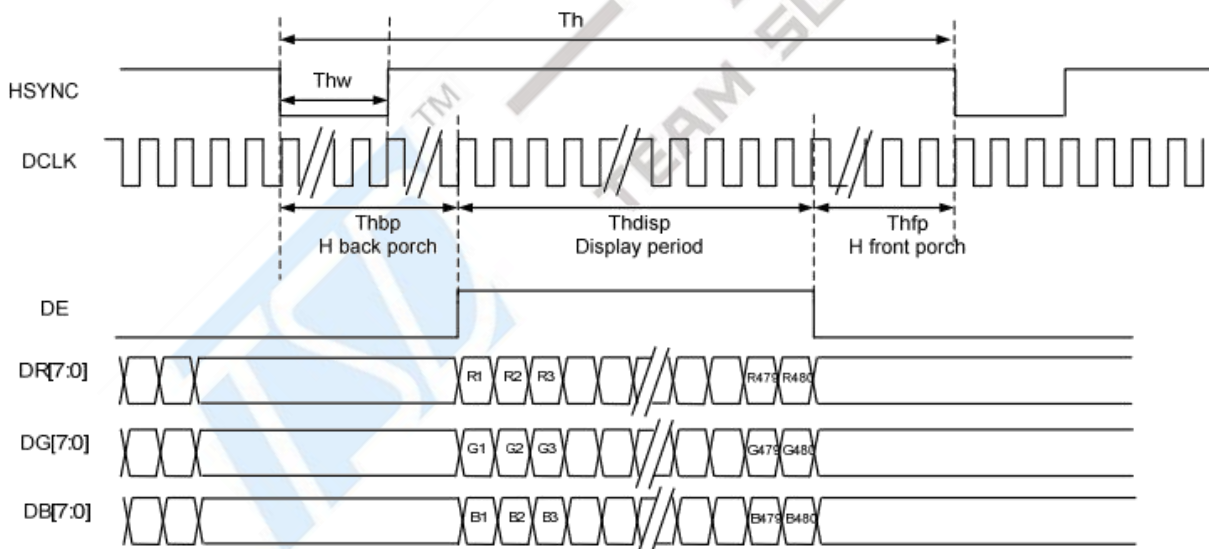
Horizontal Input Timing

Parameter	Symbol	min	Typ.	max	Unit
Horizontal display area	tHD	-	480	-	CLKIN
CLKIN frequency	f$_{clk}$	8	9	12	MHz
1 Horizontal line period	Th	485	531	-	CLKIN
HSD pulse width	Thw	2	4	-	
HSD back porch	Thbp	3	43	-	
HSD front porch	Thfp	2	8	-	
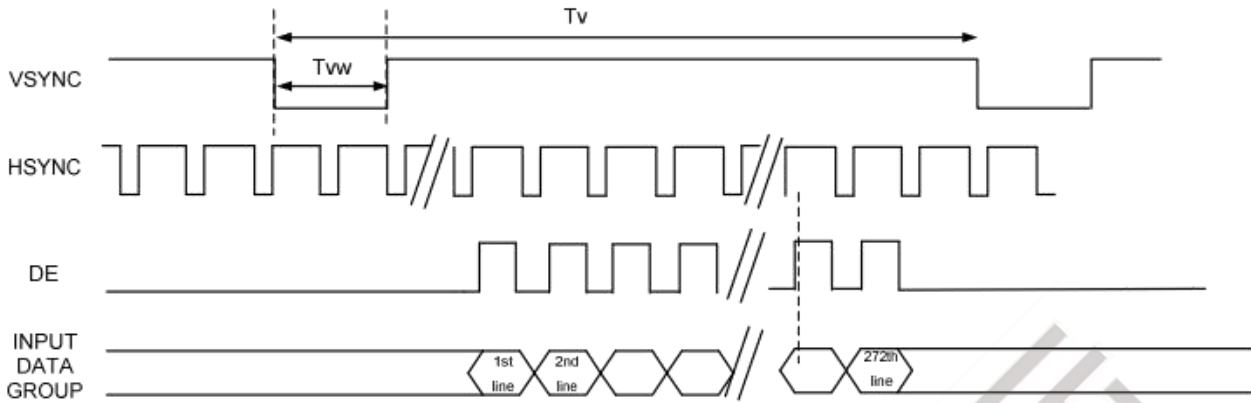
Vertical Input Timing

Parameter	Symbol	min	Typ.	max	Unit
Vertical display area	t_{VD}	-	272	-	
VSD period time	t_V	276	292	-	
VSD pulse width	T_{VPW}	2	4	-	HSD
VSD back porch	t_{VBP}	2	12	-	
VSD front porch	t_{VFP}	2	8	-	

4.3 Input Pixel Data Format

Interface	Cycle	D[23]	D[22]	D[21]	D[20]	D[19]	D[18]	D[17]	D[16]	D[15]	D[14]	D[13]	D[12]	D[11]	D[10]	D[9]	D[8]	D[7]	D[6]	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]
24 bits	1st	R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
18 bits	1st							R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
16 bits (565 format)	1st									R5	R4	R3	R2	R1	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1
16 bits	1st									R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0
	2nd									B7	B6	B5	B4	B3	B2	B1	B0	R7	R6	R5	R4	R3	R2	R1	R0
	3rd									G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
12 bits	1st													R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4
	2nd													G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
9 bits	1st																R5	R4	R3	R2	R1	R0	G5	G4	G3
	2nd																G2	G1	G0	B5	B4	B3	B2	B1	B0
8 bits	1st																	R7	R6	R5	R4	R3	R2	R1	R0
	2nd																	G7	G6	G5	G4	G3	G2	G1	G0
	3rd																	B7	B6	B5	B4	B3	B2	B1	B0

*note: The TSM043WQZO-06C module support 8-bit and 16-bit only.

5 Command Table

Hex Code	Command	Description
0x00	nop	No operation
0x01	soft_reset	Software Reset
0x0A	get_power_mode	Get the current power mode
0x0B	get_address_mode	Get the frame buffer to the display panel read order
0x0C	Reserved	Reserved
0x0D	get_display_mode	The SSD1963 returns the Display Image Mode.
0x0E	get_tear_effect_status	Get the Tear Effect status
0x0F	Reserved	Reserved
0x10	enter_sleep_mode	Turn off the panel. This command will pull low the GPIO0. If GPIO0 is configured as normal GPIO or LCD miscellaneous signal with command set_gpio_conf, this command will be ignored.
0x11	exit_sleep_mode	Turn on the panel. This command will pull high the GPIO0. If GPIO0 is configured as normal GPIO or LCD miscellaneous signal with command set_gpio_conf, this command will be ignored.
0x12	enter_partial_mode	Part of the display area is used for image display.
0x13	enter_normal_mode	The whole display area is used for image display.
0x20	exit_invert_mode	Displayed image colors are not inverted.
0x21	enter_invert_mode	Displayed image colors are inverted.
0x26	set_gamma_curve	Selects the gamma curve used by the display panel.
0x28	set_display_off	Blanks the display panel
0x29	set_display_on	Show the image on the display panel
0x2A	set_column_address	Set the column address
0x2B	set_page_address	Set the page address
0x2C	write_memory_start	Transfer image information from the host processor interface to the SSD1963 starting at the location provided by set_column_address and set_page_address
0x2E	read_memory_start	Transfer image data from the SSD1963 to the host processor interface starting at the location provided by set_column_address and set_page_address
0x30	set_partial_area	Defines the partial display area on the display panel
0x33	set_scroll_area	Defines the vertical scrolling and fixed area on display area
0x34	set_tear_off	Synchronization information is not sent from the SSD1963 to the host processor
0x35	set_tear_on	Synchronization information is sent from the SSD1963 to the host processor at the start of VFP
0x36	set_address_mode	Set the read order from frame buffer to the display panel
0x37	set_scroll_start	Defines the vertical scrolling starting point
0x38	exit_idle_mode	Full color depth is used for the display panel
0x39	enter_idle_mode	Reduce color depth is used on the display panel.
0x3A	Reserved	Reserved
0x3C	write_memory_continue	Transfer image information from the host processor interface to the SSD1963 from the last written location
0x3E	read_memory_continue	Read image data from the SSD1963 continuing after the last read_memory_continue or read_memory_start

Hex Code	Command	Description
0x44	set_tear_scanline	Synchronization information is sent from the SSD1963 to the host processor when the display panel refresh reaches the provided scanline
0x45	get_scanline	Get the current scan line
0xA1	read_ddb	Read the DDB from the provided location
0xA8	Reserved	Reserved
0xB0	set_lcd_mode_	Set the LCD panel mode and resolution
0xB1	get_lcd_mode	Get the current LCD panel mode, pad strength and resolution
0xB4	set_hori_period	Set front porch
0xB5	get_hori_period	Get current front porch settings
0xB6	set_vert_period	Set the vertical blanking interval between last scan line and next LFRAME pulse
0xB7	get_vert_period	Set the vertical blanking interval between last scan line and next LFRAME pulse
0xB8	set_gpio_conf	Set the GPIO configuration. If the GPIO is not used for LCD, set the direction. Otherwise, they are toggled with LCD signals.
0xB9	get_gpio_conf	Get the current GPIO configuration
0xBA	set_gpio_value	Set GPIO value for GPIO configured as output
0xBB	get_gpio_status	Read current GPIO status. If the individual GPIO was configured as input, the value is the status of the corresponding pin. Otherwise, it is the programmed value.
0xBC	set_post_proc	Set the image post processor
0xBD	get_post_proc	Set the image post processor
0xBE	set_pwm_conf	Set the image post processor
0xBF	get_pwm_conf	Set the image post processor
0xC0	set_lcd_gen0	Set the rise, fall, period and toggling properties of LCD signal generator 0
0xC1	get_lcd_gen0	Get the current settings of LCD signal generator 0
0xC2	set_lcd_gen1	Set the rise, fall, period and toggling properties of LCD signal generator 1
0xC3	get_lcd_gen1	Get the current settings of LCD signal generator 1
0xC4	set_lcd_gen2	Set the rise, fall, period and toggling properties of LCD signal generator 2
0xC5	get_lcd_gen2	Get the current settings of LCD signal generator 2
0xC6	set_lcd_gen3	Set the rise, fall, period and toggling properties of LCD signal generator 3
0xC7	get_lcd_gen3	Get the current settings of LCD signal generator 3
0xC8	set_gpio0_rop	Set the GPIO0 with respect to the LCD signal generators using ROP operation. No effect if the GPIO0 is configured as general GPIO.
0xC9	get_gpio0_rop	Get the GPIO0 properties with respect to the LCD signal generators.
0xCA	set_gpio1_rop	Set the GPIO1 with respect to the LCD signal generators using ROP operation. No effect if the GPIO1 is configured as general GPIO.
0xCB	get_gpio1_rop	Get the GPIO1 properties with respect to the LCD signal generators.
0xCC	set_gpio2_rop	Set the GPIO2 with respect to the LCD signal generators using ROP operation. No effect if the GPIO2 is configured as general GPIO.

Hex Code	Command	Description
0xCD	get_gpio2_rop	Get the GPIO2 properties with respect to the LCD signal generators.
0xCE	set_gpio3_rop	Set the GPIO3 with respect to the LCD signal generators using ROP operation. No effect if the GPIO3 is configured as general GPIO.
0xCF	get_gpio3_rop	Get the GPIO3 properties with respect to the LCD signal generators.
0xD0	set_dbc_conf	Set the dynamic back light configuration
0xD1	get_dbc_conf	Get the current dynamic back light configuration
0xD4	set_dbc_th	Set the threshold for each level of power saving
0xD5	get_dbc_th	Get the threshold for each level of power saving
0xE0	set_pll	Start the PLL. Before the start, the system was operated with the crystal oscillator or clock input
0xE2	set_pll_mn	Set the PLL
0xE3	get_pll_mn	Get the PLL settings
0xE4	get_pll_status	Get the current PLL status
0xE5	set_deep_sleep	Set deep sleep mode
0xE6	set_lshift_freq	Set the LSHIFT (pixel clock) frequency
0xE7	get_lshift_freq	Get current LSHIFT (pixel clock) frequency setting
0xE8	Reserved	Reserved
0xE9	Reserved	Reserved
0xF0	set_pixel_data_interface	Set the pixel data format of the parallel host processor interface
0xF1	get_pixel_data_interface	Get the current pixel data format settings
0xFF	Reserved	Reserved

Note: command descriptions please see SSD1963 Datasheet

6 Absolute Maximum Ratings

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage (Analog)	VCC~GND	-0.3	5.5	V
Operating Temperature	TOP	-20	70	° C
Storage Temperature	TST	-30	80	° C
Storage Humidity	RH	-	90%(Max 60° C)	RH

7 Electrical Characteristics

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Analog operating voltage	VCC	4.50	5.0	5.5	V
Logic operating voltage	IOVCC	3.0	3.3	3.6	V
Input Voltage ' H ' level	VIH	0.7IOVCC	-	IOVCC	
Input Voltage ' L ' level	VIL	GND	-	0.3IOVCC	V
Output Voltage ' H ' level	VOH	0.8IOVCC	-	IOVCC	
Output Voltage ' L ' level	VOL	GND	-	0.2IOVCC	

8 Backlight Characteristics

ITEM	SYMBOL	MIN	TYP	MAX	UNIT
Voltage for LED backlight	V_f	-	18.6	-	V
Current for LED backlight	I_f	-	40	-	mA
Power consumption	Wbl	-	744	-	mW
Uniformity	Avg	80	-	-	%
LED Life Time	-	30000	40000	-	Hrs

Note:

1.The LED life time is defined as the module brightness decrease to 50% original brightness at Ta=25°C, 60%RH ±5 %.

2. The life time of LED will be reduced if LED is driven by high current, high ambient temperature and humidity conditions.

3. Typical operating life time is an estimated data.

4. Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded .Functional operation should be restricted to the conditions described under normal operating conditions.

9 LCD Optical specifications

Item	Symbol	Condition	Specification			Unit	Remark
			Min	Typ	Max		
Response time (By Quick)	Tr+Tf	θ = 0°	-	30	40	ms	
Contrast ratio	CR	θ = 0°	640	800	-		
Color Gamut	S	θ = 0°	45	50		%	
Luminance of White	L	θ = 0°	560	-	600	cd/m²	
Viewing angle	Top	CR>10	70	80	-	Deg.	
	Bottom	CR>10	70	80	-		
	Left	CR>10	70	80	-		
	Right	CR>10	70	80	-		
Color chromaticity （CIE1931）	Wx	θ = 0°	-0.03	0.33	+0.03		
	Wy			0.36			
	Rx			0.61			
	Ry			0.33			
	Gx			0.36			
	Gy			0.59			
	Bx			0.15			
	By			0.11			

Note 1: Ambient temperature = 25°C.

Note 2: To be measured with a viewing cone of 2°by Topcon luminance meter BM-7.

Note 3: Definition of Response Time (TR, TF) and measurement method:
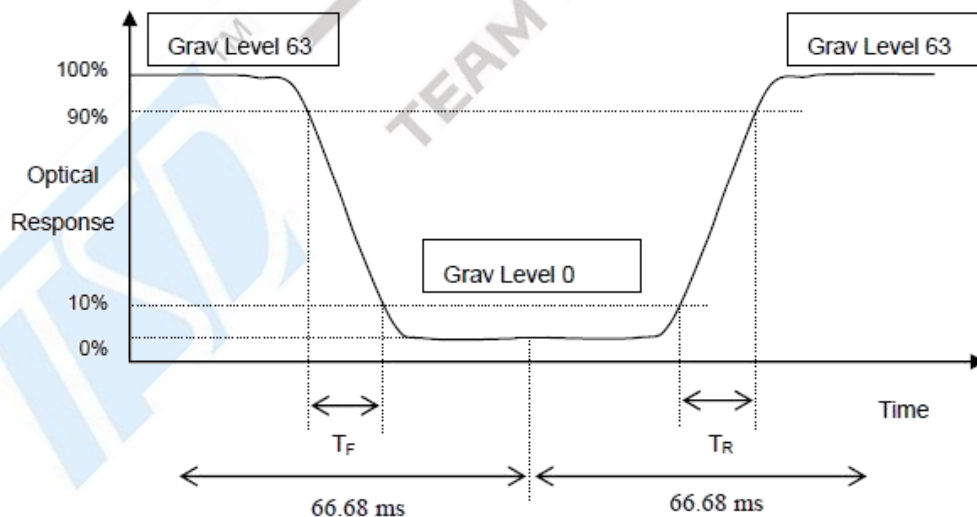
Note 4: Definition of contrast ratio:

Contrast ratio is calculated by the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "white" state}}{\text{Brightness on the "black" state}}$$
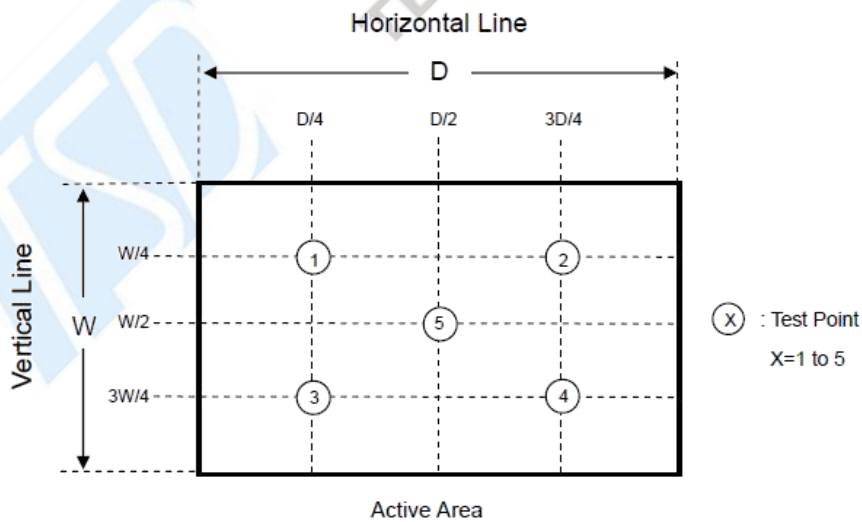
Note 5: Definition of viewing angle
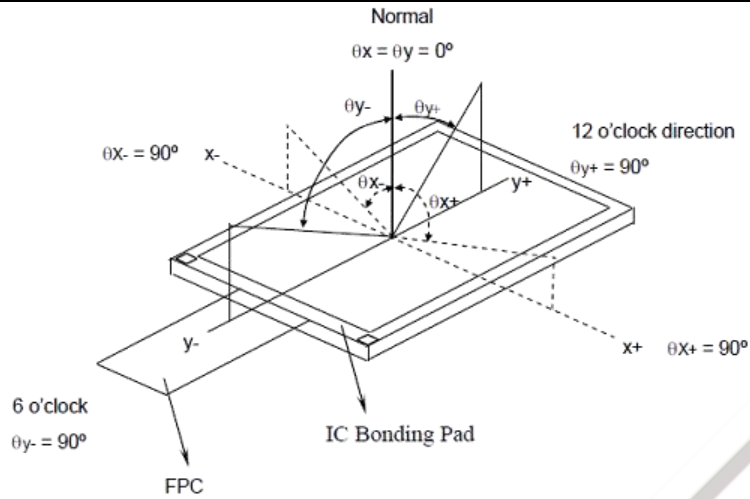
Note 6: Optical characteristic measurement setup.
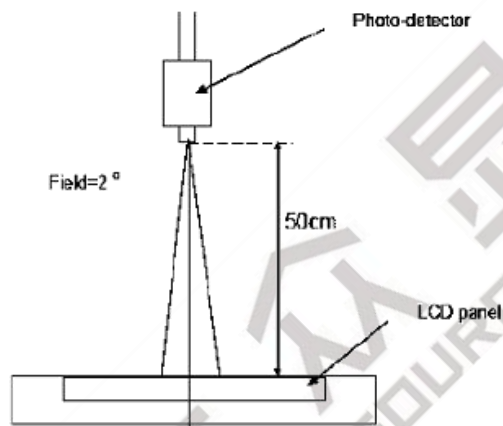
Note 7:Definition of White Variation (δ W):

Measure the luminance of gray level 63 at 5 points

δ W = Maximum [L (1), L (2), L (3), L (4), L (5)] / Minimum [L (1), L (2), L (3), L (4), L (5)]

# 10 Touch Panel specifications

ITEM	VALUE			UNIT	REMARK
	Min	Typ	Max		
Linearity	-	-	1.5	%	Analog X and Y directions
Terminal Resistance	300	-	1100	Ω	x
	100	-	500		y
Insulation Resistance	10	-	-	MΩ	DC 25V
Voltage	-	3	5	V	DC
Chattering	-	-	10	ms	100kΩ pull-up
Transparency	78	-	-	%	-
Operation Force	80	-	120	g	-
Endurance	1,000,000	-	-	Touches	100g Operation Force
	-	-	30,000	Slides	

11 RELIABILITY TEST

NO.	TEST ITEM	TEST CONDITION	INSPECTION AFTER TEST
1	High Temperature Storage	80±2°C/96 hours	Inspection after 2~4 hours storage at room temperature and humidity. The condensation is not accepted. The sample shall be free from defects: 1. Air bubble in the LCD 2. Seal leak 3. Non-display 4. Missing segments 5. Glass crack
2	Low Temperature Storage	-30±2°C/96 hours	
3	High Temperature Operating	70±2°C/96 hours	
4	Low Temperature Operating	-20±2°C/96 hours	
5	Temperature Cycle	-30±2°C ~ 25~ 80± 2°C × 10 cycles (30 min.) (5min.) (30min.)	
6	Damp Proof Test	60°C ±5°C × 90%RH/96 hours	
7	Vibration Test	Frequency 10Hz~55Hz Stroke: 1.5mm Sweep: 10Hz~150 Hz~10Hz 2 hours For each direction of X, Y, Z	
8	Shock Test	Half-sine, wave, 300m/s	
9	Packing Drop Test	Height: 80 cm 1 corner, concrete floor	
10	Electrostatic Discharge Test	C=150pF, R=330 Ω Air: ±8KV 150pF/330Ω 30 times Contact: ±4KV,20 times	
11	Image Sticking	25°C,60%RH (ref.to Remark(1))/30 minutes	

Remark (1): Switch the image to Grey 127 after displaying the 5*8 chess pattern for 60 minutes,the afterimage disappears within 10 seconds.
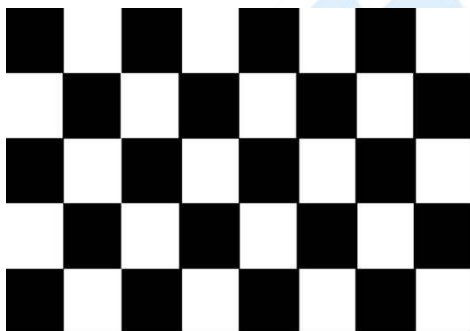
5*8 chess pattern   Gray127

11.1 About Image Sticking

11.1.1   What is Image Sticking?

If you remain a fixed image on LCD Display for a long period of time, you may experience a phenomenon called Image Sticking. Image Sticking - sometimes also called "image retention" or "ghosting" - is a phenomenon where a faint outline of a previously displayed image remains visible on the screen when the image is changed. It can occur at variable levels of intensity depending on the specific image makeup, as well as the amount of time the core image elements are allowed to remain unchanged on the screen. In POS applications, for example, a button menu which remains fixed, or in

which the "frame" elements (core image) remain fixed and the buttons may change, may be susceptible to image sticking. It is important to note that if the screen is used exclusively for this application, the user may never notice this phenomenon since the screen never displays other content. `It is only when an image other than the "retained" image is shown on the screen that this issue becomes evident. Image sticking is different that the "burn-in" effect commonly associated with phosphor based devices.

11.1.2 What causes Image Sticking?

Image sticking is an intrinsic behavior of LCD displays due to the susceptibility to polarization of the interior materials (liquid crystals) when used under static, charged conditions (continuously displaying the same image). The individual liquid crystals in an LCD panel have unique electrical properties. Displaying a fixed pattern - such as the POS menu described above – over prolonged periods can cause a parasitic charge build-up (polarization) within the liquid crystals which affects the crystals' optical properties and ultimately prevents the liquid crystal from returning to its normal, relaxed state when the pattern is finally changed. This effect takes place at a cellular level within the LCD, and the effect can cause charged crystal alignment at the bottom or top of a crystal cell in the "z" axis, or even crystal migration to the edges of a cell, again based on their polarity. These conditions can cause image sticking over an entire area, or at boundaries of distinct color change respectively. In either case, when the liquid crystals in the pixels and sub-pixels utilized to display the static image are polarized such that they can not return fully to their "relaxed" state upon deactivation, the result is a faint, visible, retained image on the panel upon presentation of a new, different image. The actual rate of image retention depends on variation factors such as the specific image, how long it is displayed unchanged, the temperature within the panel and even the specific panel brand due to manufacturing differences amongst panel manufacturers.

11.1.3 How to Avoid Image Sticking?

- Try not to operate the LCD with a "fixed" image on the screen for more than 1 hours.
- If you are operating the monitor in an elevated temperature environment and with a displayed image which is contrary to the recommendations in "For Software Developers" below, image stick can occur in as little as 30 minutes. Adjust your screen saver settings accordingly.
- Power down the unit during prolonged periods of inactivity such as the hours a store is closed or a shift during which the piece of equipment isn't used.
- Use a screensaver with a black or medium gray background that is automatically set to come on if the device is inactive for more than 5-10 minutes.
- Avoid placing the monitor in poorly ventilated areas or in areas that will create excess heat around the monitor for software developers.
- In defining the icons, buttons, or windows in the screen, try to utilize block patterns instead of distinct lines as borders for dividing the display into distinct areas.
- If it is necessary to display a static image, try to use colors that are symmetric to the middle grey level at the boundary of two different colors, and slightly shift the borders line once in a while.
- Try to utilize medium gray hues for those areas that will have prolonged display times or remain static as other menu elements change.

11.1.4 How to Fix the Image Sticking?

Unlike the usually irreversible "burn-in" effects commonly associated with direct view phosphor display devices such as CRTs, an image retained on an LCD display can be reversed – often to a point of total invisibility.

However, the severity of the underlying causes (as described above) of the image retained on a specific display, as well as the variation factors (see "For Software Developers" above) under which the retained image was created, will dictate the final level of retention reversal. One way to erase a retained image on a panel is to run the screen (monitor "on") in an "all black" pattern for 4-6 hours. It is also helpful to do this in an elevated temperature environment of approximately 35° to 50° C. Again, utilizing a dynamic screen saver with an all black background during prolonged idle display periods is a good way to avoid image retention issues.

11.1.5 Is Image Sticking Covered by TSD RMA Warranty?

Image sticking is a phenomenon inherent to LCD Display technology itself, and as such, the occurrence of this "ghosting" effect is considered normal operation by the manufacturers of the LCD display modules which are integrated into today's monitor solutions. TSD does not warrant any display against the occurrence of image sticking. We strongly advise that you follow the operating recommendations listed above to avoid the occurrence of this phenomenon.

11.2 Others

1. Issues that are not defined in this document shall be discussed and agreed with both parties. (Customer and supplier)

2. Unless otherwise agreed upon in writing, the criteria shall be applied to both parties. (Customer and supplier)

12 Suggestions for using LCD modules

12.1 Handling of LCM

1. The LCD screen is made of glass. Don't give excessive external shock, or drop from a high place.

2. If the LCD screen is damaged and the liquid crystal leaks out, do not lick and swallow. When the liquid is attach to your hand, skin, cloth etc, wash it off by using soap and water thoroughly and immediately.

3. Don't apply excessive force on the surface of the LCM.

4. If the surface is contaminated, clean it with soft cloth. If the LCM is severely contaminated, use Isopropyl alcohol/Ethyl alcohol to clean. Other solvents may damage the polarizer. The following solvents is especially prohibited: water , ketone Aromatic solvents etc.

5. Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

6. Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.

7. Don't disassemble the LCM.

8. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Be sure to ground the body when handling the LCD modules.

- Tools required for assembling, such as soldering irons, must be properly grounded.

- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.

- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

9. Do not alter, modify or change the the shape of the tab on the metal frame.

10. Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.

11. Do not damage or modify the pattern writing on the printed circuit board.

12. Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector

13. Except for soldering the interface, do not make any alterations or modifications with a soldering iron.

14. Do not drop, bend or twist LCM.

12.2 Storage

1. Store in an ambient temperature of 5 to 25 ℃, and in a relative humidity of 40% to 60%. Don't expose to sunlight or fluorescent light.

2. Storage in a clean environment, free from dust, active gas, and solvent.

3. Store in antistatic container.

13 Limited Warranty

1.Our warranty liability is limited to repair and/or replacement. We will not be responsible for any consequential loss.

2.If possible, we suggest customer to use up all LCD modules as soon as possible. If the LCD module storage time over twelve months, we suggest to recheck it before being used.

3.Any product issues must be feedback to TSD within 12 months since delivery, otherwise, we will not be responsible for the subsequent or consequential events.