PRODUCT SPECIFICATION

DESCRIPTION

TFT Module – 3.5”
640 x 480 x (RGB)

PART NUMBER

LTTD640480035-L1

VERSION

1.0

ROHS COMPLIANT

Revision Status

Revision	Revision Date	Page	Content	Notes
1.0	26.01.2014		Initial release	

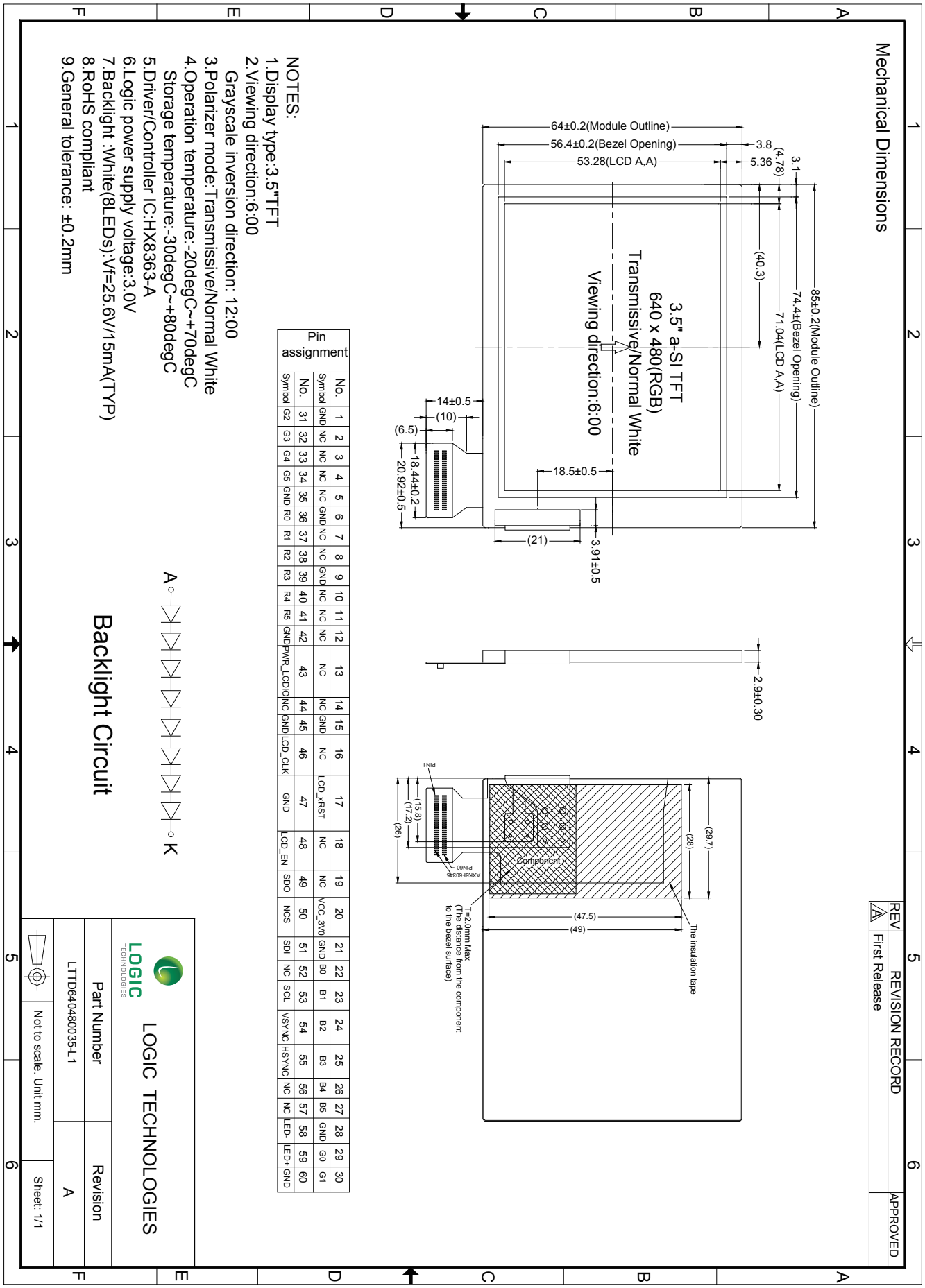
Table of Contents

- GENERAL INFORMATION

Item	Contents	Unit
LCD Type	TFT Transmissive	Note 1
Technology	a-Si TFT	---
Viewing Angle	6:00 (Landscape: FPC on bottom)	O'clock
Module dimensions (W x H x T)	85 x 64 x 2.9	mm (Note2)
Active area (W x H)	71.04 x 53.28	mm
Number of pixels	640 x 480 x RGB	---
Colours	262,144(6 bits)	---
Contrast ratio	500 (typical)	---
Backlight	LED	---
Backlight Brightness	500 (typical)	cd/m^2
Controller	HX8363-A	---
Interface	3 SPI+18 bit RGB interface	---
Operating temperature	-20 to +70	°C
Storage temperature	-30 to +80	°C

Note 1: We can change polariser to make TFT transflective LCD type.
Note2: If with RTP, the thickness is 4.1mm(include T/P).

- MECHANICAL DIMENSIONS



- ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min.	Max.	Unit	Note
Power Voltage(VDD2 & VDD3)	VCI	- 0.3	5.0	V	
Input voltage (VDD1 & DSI_VCC)	IOVCC	- 0.3	4.6	V	Note 1
Operating Temperature	T_{OPR}	- 30	70	°C	
Storage temperature	T_{ST}	- 40	80	°C	

- ELECTRICAL CHARACTERISTICS

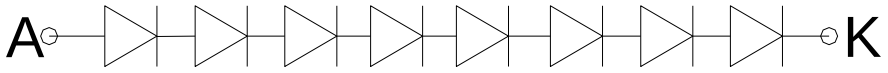
Parameter	Symbol	Min	Typ.	Max	Unit	Remark
Supply Voltage(VDD2 & VDD3)	VCI	2.8	3.0	3.2	V	
Input voltage (VDD1 & DSI_VCC)	IOVCC	1.75	3.0	3.2	V	
VCI Power Consumption	I_{DD}	---	125	300	mW	Note 1

Note 1: To test the current dissipation, use “all Black Pattern” testing pattern.

- BACKLIGHT CHARACTERISTICS

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Forward Current	I_F	---	15	25	mA	Note 1
Forward Current Voltage	V_F	---	3.2*8	---	V	Note 2
Backlight Power Consumption	WBL	---	384	---	mW	Note 1
LED Lifetime	---	30 000	---	---	Hrs	Note 3

Note 1: The LED driving condition is defined for total backlight consumption.
Note 2: Forward Voltage adjusting should depend on Forward Current setting.



Note 3: Optical performance should be evaluated at Ta=25℃ only.
If the LEDs are driven by high current, high ambient temperature & humidity condition, the lifetime of the LEDs will be reduced.
Operating life means brightness reduces to 50% of initial brightness.
Typical operating lifetime is estimated data.
Backlight drive conditions: constant current driving method and IF=15mA

- ELECTRO-OPTICAL CHARACTERISTICS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Refer	Note
Response Time		T_{ON}	25°C	---	15	30	ms	Fig 1	4
		T_{OFF}		---	25	30			
Contrast ratio		Cr	∅=Θ=0°	---	500	---	---	Fig 2	1
Uniformity		U	---	70	75	---	%	Fig 2	3
NTSC		---	---	---	50	---	%		
Surface Luminance		Lv		---	500	---	cd/m^2	Fig 2	2
Viewing angle ratio			∅=270°	---	50	---	deg	Fig 3	6
			∅=90°	---	70	---			
			∅=0°	---	70	---			
			∅=180°	---	70	---			
CIE (x,y) chromaticity	Red	x	Backlight On	---	0.640	---	---	Fig 2.	5
		y		---	0.321	---			
	Green	x		---	0.293	---			
		y		---	0.579	---			
	Blue	x		---	0.134	---			
		y		---	0.142	---			
	White	x		---	0.299	---			
		y		---	0.355	---			

Note1. Contrast ratio (CR) is defined mathematically in Figure 2.

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P3, P4, P5)}}$$

Note 2. Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see figure 2.

Lv = Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5…)

Note 3. Uniformity of surface luminance, White, is defined mathematically in figure 2.

$$\text{White} = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}$$

Note 4. Response time is the time required for the display to transition form white to black (rise time Tr) and from black to white (decay or fall time, Tf). The industry standard test equipment used is the Autronic-Melcher's Conoscope.

Note 5. Without backlight, CIE (x,y) chromaticity. The x,y value is determined by measuring luminance at each test position 1 through 5, then calculating the average value.

Note 6. The Viewing angle is the angle at which the contrast ratio is greater than 2. For a TFT module, the contrast ratio is greater than 10. The angles are determined for the horizontal or 'x' axis and the vertical or 'y' axis with respect to the 'z' axis, being the LCD surface reference. Also see figure 3.

Note 7. For viewing angle and response time testing, the testing data is based on Autronic-Melcher's BM-7A. For the contrast ratio, surface luminance, luminance uniformity and chromaticity (CIE), the test data is based on the industry's standard SR-3A photo detector.

Note 8. For TFT modules, grey scale reversing occurs in the opposite direction of the panel viewing angle.

Figure 1. Definition of response time

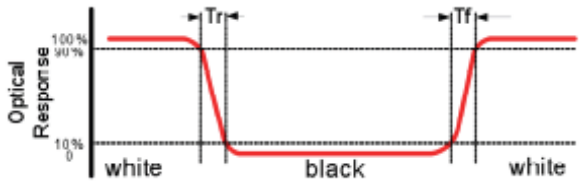


Figure 2. Measuring contrast ratio, surface luminance, luminance uniformity and CIE (chromaticity.)

A: 5mm. B: 5mm. H, V: Active area. Light spot size θ=7mm, 500mm distance from the LCD surface to the detector lens.
Measurement instrument is Topcon's luminance meter BM-7.

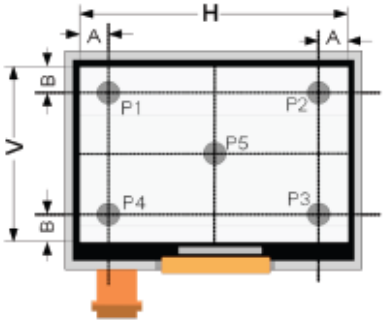
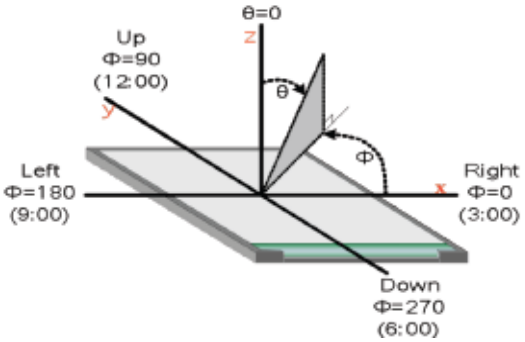


Figure 3. Definition of viewing angle



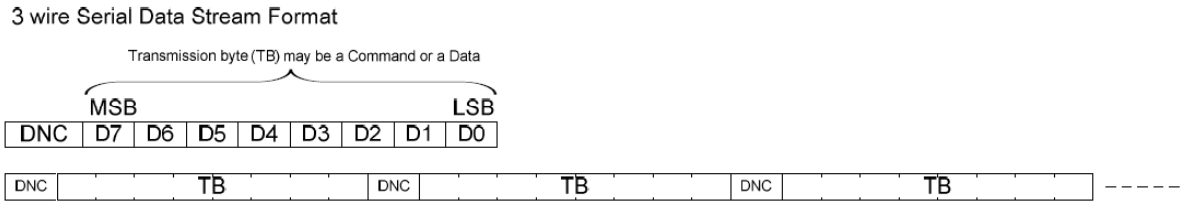
- INTERFACE DESCRIPTION

No.	Symbol	Function	No.	Symbol	Function
1	GND	Digital GND	31	G2	Green data
2	NC /(YU)	Not connector (W/O TP) Y axis pos. Top (W TP)	32	G3	
3	NC /(XR)	Not connector (W/O TP) X axis pos. Right(W TP)	33	G4	
4	NC /(YD)	Not connector (W/O TP) Y axis pos. Bottom(W TP)	34	G5	
5	NC /(XL)	Not connector (W/O TP) X axis pos. Left(W TP)	35	GND	Digital GND
6	GND	Digital GND	36	R0	Red data
7	open	NC	37	R1	
8	open	NC	38	R2	
9	GND	Digital GND	39	R3	
10	open	NC	40	R4	
11	open	NC	41	R5	
12	open	NC	42	GND	Digital GND
13	open	NC	43	PWR_LCDIO	Logic Supply voltage
14	open	NC	44	open	NC
15	GND	Digital GND	45	GND	Digital GND
16	open	NC	46	LCD_CLK	Clock Signal
17	LCD_xRST	Reset Signal	47	GND	Digital GND
18	open	NC	48	LCD_EN	Data Enable
19	open	NC	49	SDO	Serial interface data output
20	VCC_3V0	Power Supply for booster	50	NCS	Chip select signal.
21	GND	Digital GND	51	SDI	Serial interface data input
22	B0	Blue data	52	open	NC
23	B1		53	SCL	Serial interface clock input
24	B2		54	VSYNC	Vertical sync input
25	B3		55	HSYNC	Horizontal sync input
26	B4		56	open	NC
27	B5		57	open	NC
28	GND	Digital GND	58	LED-	Cathode of LED
29	G0	Green data	59	LED+	Anode of LED
30	G1		60	GND	Digital GND

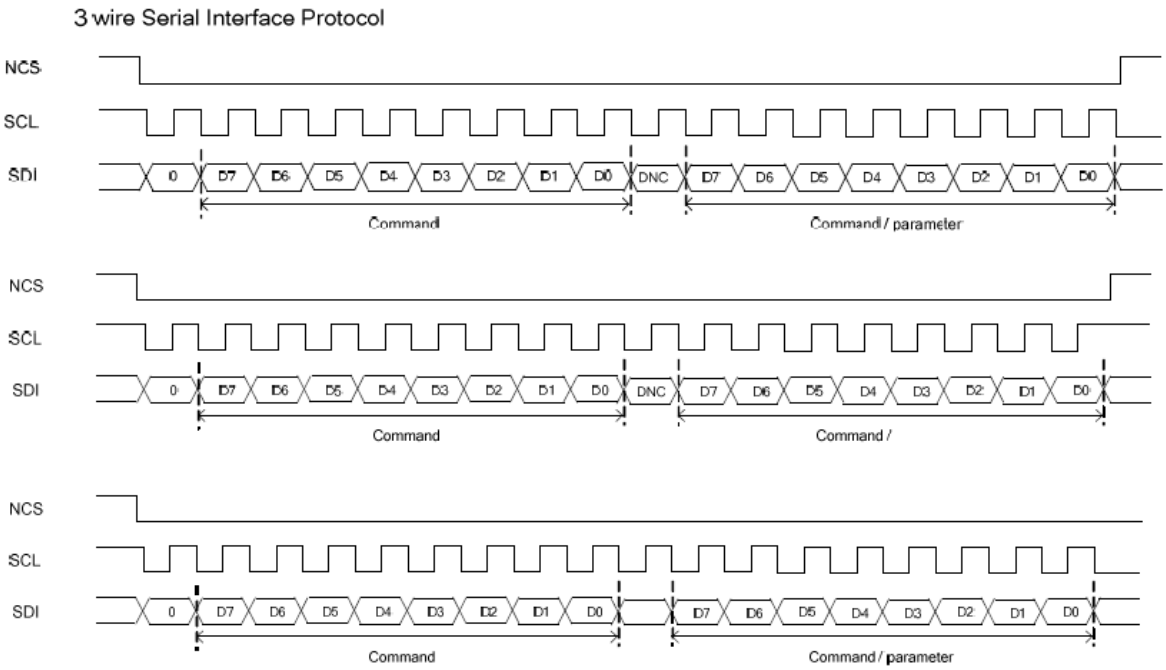
- TIMING CHART and DATA

  - Recommended Input Timing of SPI-3 Transmitter

The 3-Pin serial data packet contains a control bit DNC and a transmission byte. If DNC is low, the transmission byte is command byte. If DNC is high, the transmission byte is stored to command register. The MSB is transmitted first. The serial interface is initialized when NCS is high. In this state, SCL clock pulse or SDI/SDO data have no effect. A falling edge on NCS enables the serial interface and indicates the start of data transmission.



Serial Data stream, write mode

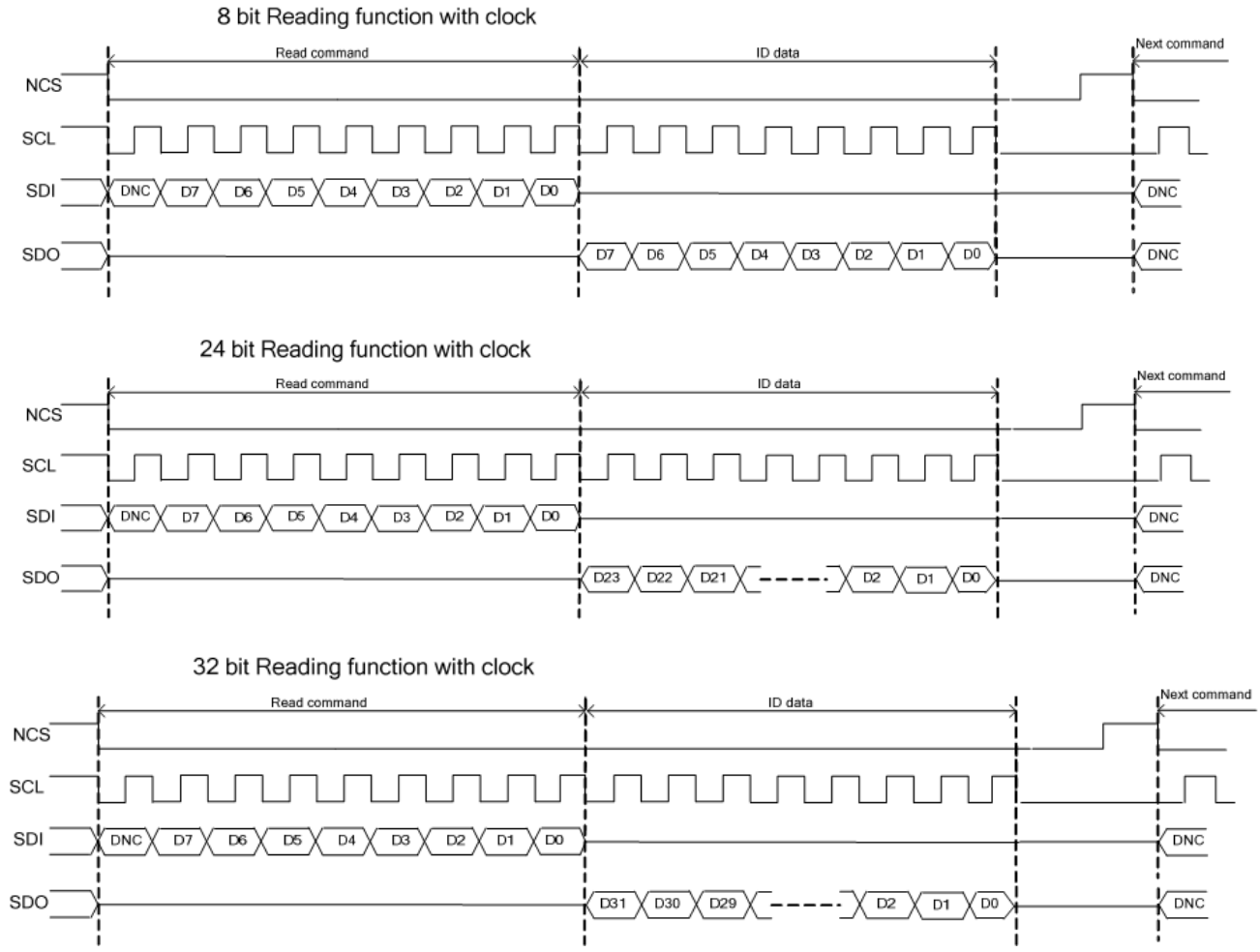


Serial Interface Protocal 3 wire serial interface (write mode)

Serial Data Read Mode

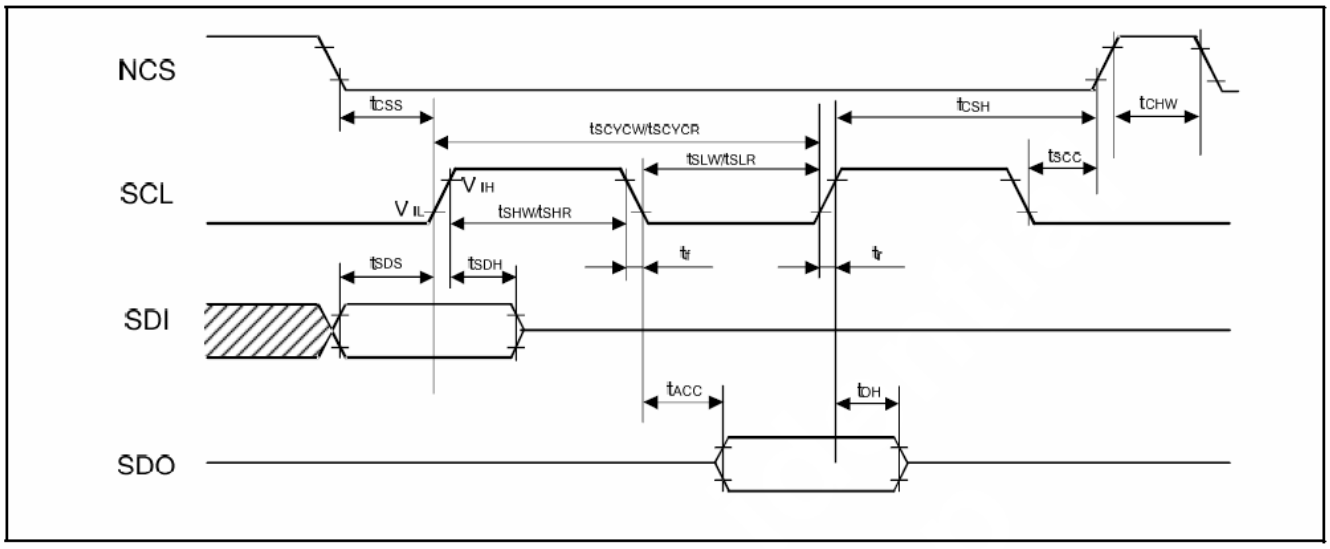
The micro controller firstly has to send a command and then the following byte is transmitted in the opposite direction. The read mode has three types of command data transmitted (8-/24- /32-bit) according command code.

3 wire Serial Interface Protocol



3 wire Serial Interface protocol,read mode

Serial Interface Characteristics (3-Pin Serial)

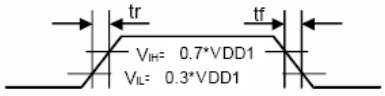


(VSSA=VSSD=0V, VDD1=1.65V to 1.95V, VDD2=2.5 to 3.3V, VDD3=2.5 to 3.3V, T_A = -30 to 70℃)

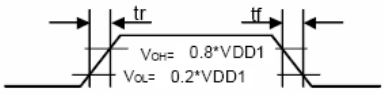
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Serial clock cycle (Write)	t_{SCYCW}	SCL	80	-	-	ns
SCL "H" pulse width (Write)	t_{SHW}		30	-	-	
SCL "L" pulse width (Write)	t_{SLW}		30	-	-	
Data setup time (Write)	t_{SDS}	SDI	10	-	-	ns
Data hold time (Write)	t_{SDH}		10	-	-	
Serial clock cycle (Read)	t_{SCYCR}	SCL	150	-	-	ns
SCL "H" pulse width (Read)	t_{SHR}		60	-	-	
SCL "L" pulse width (Read)	t_{SLR}		60	-	-	
Access rime	t_{ACC}	SDO For maximum C_L=30pF For maximum C_L=8pF	10	-	60	ns
Output disable time	t_{OH}	SDO For maximum C_L=30pF For maximum C_L=8pF	15	-	100	ns
SCL to Chip select	t_{SCC}	NCS	30	-	-	ns
NCS "H" pulse width	t_{CHW}	NCS	60	-	-	ns
NCS-SCL time (write)	t_{CSS}	NCS	30	-	-	ns
NCS-SCL time (write	t_{CSH}		30	-		
NCS-SCL time (Read)	t_{CSS}	NCS	60	-	-	ns
NCS-SCL time (Read)	t_{CSH}		65	-		

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.
Logic high and low levels are specified as 30% and 70% of VDD1 for Input signals.

Input Signal Slope



Output Signal Slope

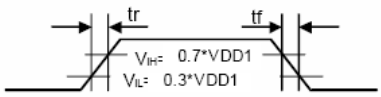


(VSSA=VSSD=0V, VDD1=1.95V to 3.3V, VDD2=2.5 to 3.3V, VDD3=2.5 to 3.3V, T_A = -30 to 70℃)

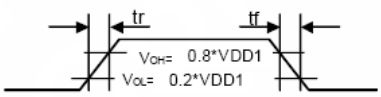
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Serial clock cycle (Write)	t_{SCYCW}	SCL	80	-	-	ns
SCL "H" pulse width (Write)	t_{SHW}		30	-	-	
SCL "L" pulse width (Write)	t_{SLW}		30	-	-	
Data setup time (Write)	t_{SDS}	SDI	10	-	-	ns
Data hold time (Write)	t_{SDH}		10	-	-	
Serial clock cycle (Read)	t_{SCYCR}	SCL	150	-	-	ns
SCL "H" pulse width (Read)	t_{SHR}		60	-	-	
SCL "L" pulse width (Read)	t_{SLR}		60	-	-	
Access rime	t_{ACC}	SDO For maximum C_L=30pF For maximum C_L=8pF	5	-	60	ns
Output disable time	t_{OH}	SDO For maximum C_L=30pF For maximum C_L=8pF	8	-	100	ns
SCL to Chip select	t_{SCC}	NCS	30	-	-	ns
NCS "H" pulse width	t_{CHW}	NCS	60	-	-	ns
NCS-SCL time (write)	t_{CSS}	NCS	30	-	-	ns
NCS-SCL time (write	t_{CSH}		30	-		
NCS-SCL time (Read)	t_{CSS}	NCS	60	-	-	ns
NCS-SCL time (Read)	t_{CSH}		65	-		

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.
Logic high and low levels are specified as 30% and 70% of VDD1 for Input signals.

Input Signal Slope

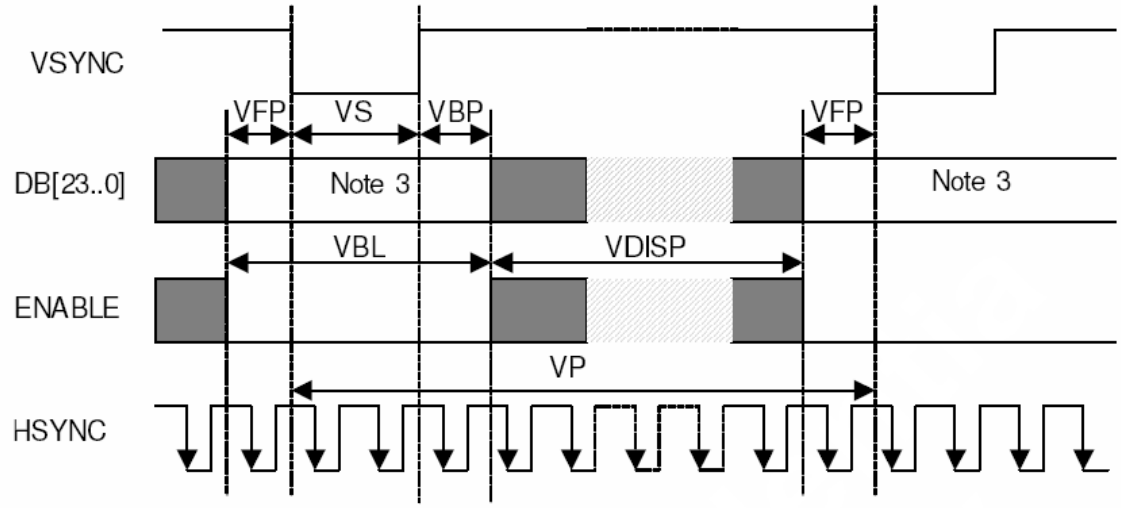


Output Signal Slope



- RGB Interface Timing

Vertical Timings for RGB I/F



(Resolution=480x854, VSSA=VSSD=0V, VDD1=1.65V to 3.3V, VDD2=2.5 to 3.3V, VDD3=2.5 to 3.3V, T_A = -30 to 70℃)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Vertical cycle	VP	-	860	-	864	Line
Vertical low pulse width	VS	-	2	-	4	Line
Vertical front porch	VFP	-	2	-	4	Line
Vertical back porch	VBP	-	2	-	4	Line
Vertical data start point	-	VS+VBP	4	-	8	Line
Vertical blanking period	VBL	VS+VBP+VFP	6	-	10	Line
Vertical active area	-	VDISP	-	854	-	Line
Vertical Refresh rate	VRR	-	50	-	70	Hz

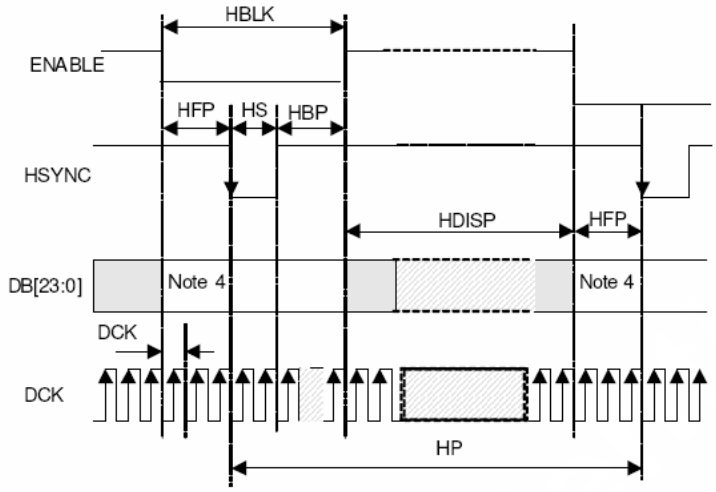
Note: (1) Signal rise and fall times are equal to or less than 20 ns.
(2) Input signals are measured by 0.30 x VDD1 for low state and 0.70 x VDD1 for high state.
(3) Data lines can be set to "High" or "Low" during blanking time – Don't care.
(4) VRR must keep from 50Hz to 70Hz when adjust other items.

(Resolution=480x800, VSSA=VSSD=0V, VDD1=1.65V to 3.3V, VDD2=2.5 to 3.3V, VDD3=2.5 to 3.3V, T_A = -30 to 70℃)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Vertical cycle	VP	-	806	-	810	Line
Vertical low pulse width	VS	-	2	-	4	Line
Vertical front porch	VFP	-	2	-	4	Line
Vertical back porch	VBP	-	2	-	4	Line
Vertical data start point	-	VS+VBP	4	-	8	Line
Vertical blanking period	VBL	VS+VBP+VFP	6	-	10	Line
Vertical active area	-	VDISP	-	800	-	Line
Vertical Refresh rate	VRR	-	50	-	70	Hz

Note: (1) Signal rise and fall times are equal to or less than 20 ns.
(2) Input signals are measured by 0.30 x VDD1 for low state and 0.70 x VDD1 for high state.
(3) Data lines can be set to "High" or "Low" during blanking time – Don't care.
(4) VRR must keep from 50Hz to 70Hz when adjust other items.

Horizontal Timings for RGB I/F



(Resolution=480x854, VSSA=VSSD=0V, VDD1=1.65V to 3.3V, VDD2=2.5 to 3.3V, VDD3=2.5 to 3.3V, T_A = -30 to 70°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
HS cycle	HP	Note(3)	504	-	568	DCK
HS low pulse width	HS	-	5	-	78	DCK
Horizontal back porch	HBP	-	5	-	78	DCK
Horizontal front porch	HFP	-	5	-	78	DCK
Horizontal data start point	-	HS+HBP	19	-	83	DCK
Horizontal blanking period	HBLK	HS+HBP+HFP	24	-	88	DCK
Horizontal active area	HDISP	-	-	480	-	DCK
Pixel clock frequency	DCK	VRR = Min. 50Hz	21.6	-	34.3	MHz
When RGB I/F is running		- Max. 70Hz	29.1	-	46.2	ns

Note: (1) Signal rise and fall times are equal to or less than 20 ns.
(2) Input signals are measured by 0.30 x VDD1 for low state and 0.70 x VDD1 for high state.
(3) HP is multiples of eight DCK.
(4)Data lines can be set to "High" or "Low" during blanking time – Don't care.
(5) VRR must keep from 50Hz to 70Hz when adjust other items.

(Resolution=480x800, VSSA=VSSD=0V, VDD1=1.65V to 3.3V, VDD2=2.5 to 3.3V, VDD3=2.5 to 3.3V, T_A = -30 to 70°C)

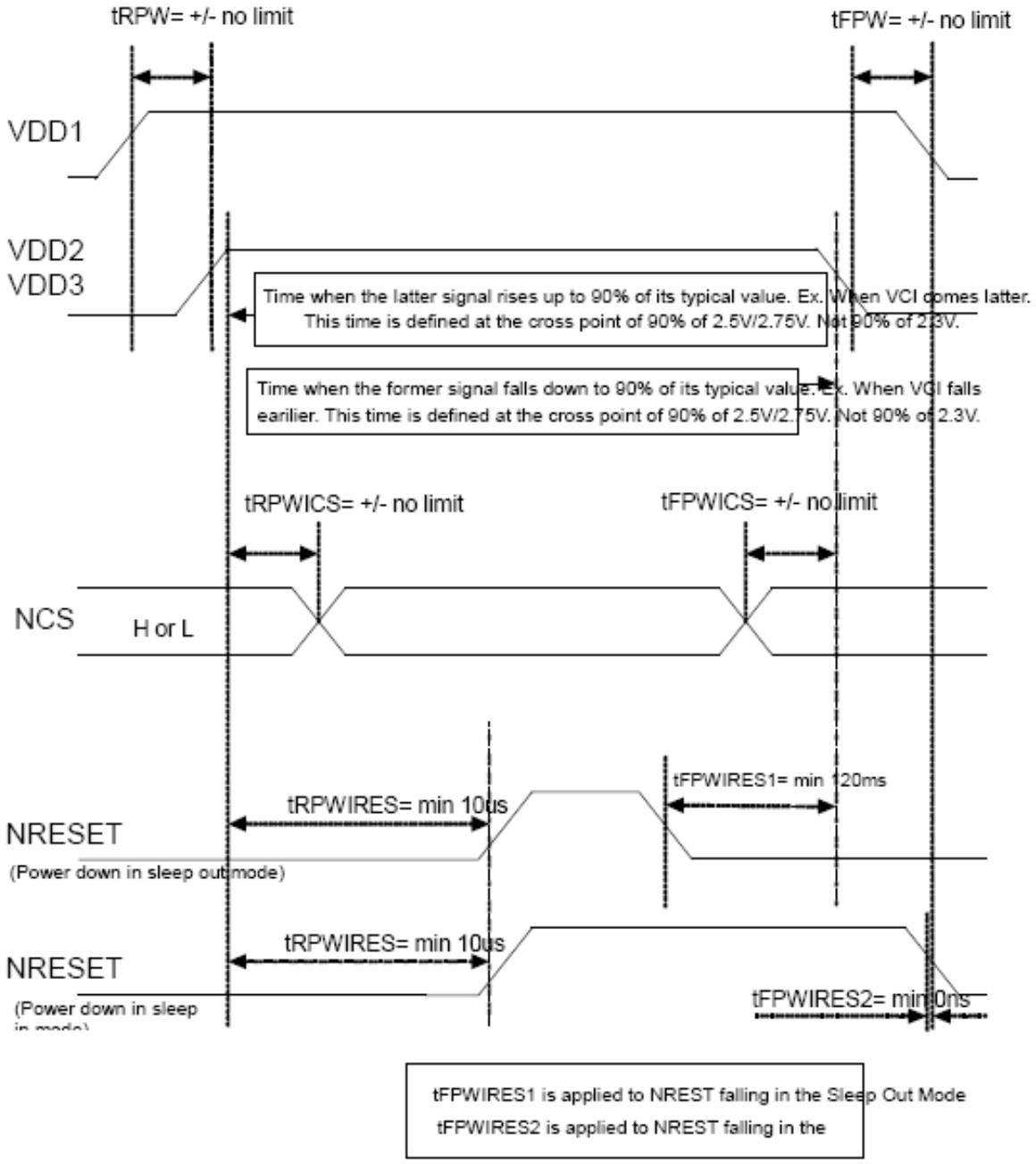
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
HS cycle	HP	Note(3)	504	-	568	DCK
HS low pulse width	HS	-	5	-	78	DCK
Horizontal back porch	HBP	-	5	-	78	DCK
Horizontal front porch	HFP	-	5	-	78	DCK
Horizontal data start point	-	HS+HBP	19	-	83	DCK
Horizontal blanking period	HBLK	HS+HBP+HFP	24	-	88	DCK
Horizontal active area	HDISP	-	-	480	-	DCK
Pixel clock frequency	DCK	VRR = Min. 50Hz	20.3	-	32.2	MHz
When RGB I/F is running		- Max. 70Hz	31	-	49.2	ns

Note: (1) Signal rise and fall times are equal to or less than 20 ns.
(2) Input signals are measured by 0.30 x VDD1 for low state and 0.70 x VDD1 for high state.
(3) HP is multiples of eight DCK.
(4)Data lines can be set to "High" or "Low" during blanking time – Don't care.
(5) VRR must keep from 50Hz to 70Hz when adjust other items.

- Power On/Off Sequence

Power On Sequence

If NRESET line is held low (and stable) by the host during power on, then the NRESET must be held low for minimum 10µsec after both VDD1, VDD2 and VDD3 have been applied.



Power Off Sequence

The uncontrolled power off means a situation when e.g. there is removed a battery without the controlled power off sequence. There will not be any damages for the display module or the display module will not cause any damages for the host or lines of the interface. At an uncontrolled power off the display will go blank and there will not be any visible effects within 1 second on the display (blank display) and remains blank until “Power On Sequence” powers it up.

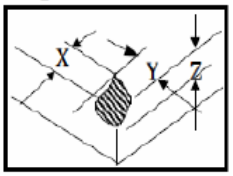
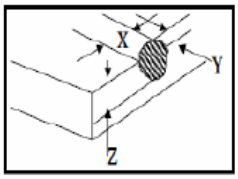
- Mechanical Specification

1. The material of the display metal housing is SUS304.

2. Rear metal bezel frame diagonal resistance <0.5ohm.

3. Once with RTP,, the product's abrasion resistance of the T/P surface is >=3H.

4. The dimension of the chip of touch panel glass has to be as follow:

Chip of Touch Panel Glass	Corner: X≦1.0mm,Y≦1.0mm,Z<T	T=T/P depth 
	Side: X≦2.0mm,Y≦1.0mm,Z<T	T=T/P depth 

- RELIABILITY TESTING

NO.	Item	Condition	Criteria
1	High Temperature Operating	70°C +/-2°C, 96Hrs	IEC60068-2-1 GB2423.2
2	Low Temperature Operating	-20°C +/-2°C, 96Hrs	IEC60068-2-1 GB2423.1
3	High Temperature Storage	80°C +/-2°C, 96Hrs	IEC60068-2-1 GB2423.2
4	Low Temperature Storage	-30°C +/-2°C, 96Hrs	IEC60068-2-1 GB2423.2
5	Hi Temperature & High Humidity Operation	40°C, 90%RH max, 96Hrs	IEC60068-2-78 GB/T2423.3
6	Humidity (non-condensing)	Average over one year: 75%; maximum 95% on 30 days and occasionally 85%; rarely and slightly condensing permitted verified with: 92%r.h., 65°C, 62h	-
7	Humidity (condensing)	+23°C/83%,30min; +40°C/92%,30min; 5 cycles Change time: 5min,	-

8	Vibration (non operating)	Frequency range:10～55Hz, Stroke:1.5mm Sweep:10Hz～55Hz～10Hz2hours for each direction of x.y.z (6 hours for total)	IEC60068-2-6 GB/T2423.10
9	Package Vibration Test	Random Vibration: 0.015GxG/Hz for 5-200Hz, -6dB/Octave from 200-500Hz 2 hours for each direction of X,Y,Z (6 hours for total)	IEC60068-2-34 GB/T2423.11
10	Drop Test (packaged)	Height:80 cm,1 corner, 3 edges, 6 surfaces	IEC60068-2-32 GB/T2423.8
11	Thermal Shock (non operating)	-20°C to 30min to 70℃, 30min Change time: 5min, 50cycles	Start with cold temperature, End with high temperature, IEC60068-2-14:1984,GB2423.22
12	Shock (non-operation)	80G 6ms, ±X,±Y,±Z 3 times for each direction	IEC60068-2-27 GB/T2423.5
13	ESD (operation)	C=150pF,R=330Ω, Air:±8Kv, Contact:±4Kv, 10times/terminal	IEC61000-4-2 GB/T17626.2
14	Bump	25g, 6ms, 4’000 shocks in each direction and axis within the operating temperature range	-

Notes:

1. Test samples are applied to one test item.
2. Sample size for each test item is 2-10pcs.
3. For humidity testing, a pure water resistance of >10MW should be used.
4. (a) In the case of a malfunction caused by ESD damage, if the LCM returns to it’s normal state after resetting, the item is considered to have passed the ESD test.

   (b) It is recommended to use an anti-static blower (ionizer) to reduce the electro-static voltage in the working area.

   (c) When removing the protection film from the LCM panel, peel off the film slowly (more than 1sec) while blowing the ioniser towards the peeling area to minimize ESD. This will reduce the risk of damaging the electrical circuitry.
5. If it is installed, please use the automatic test mode on the LCM &/or demonstration box when testing.

- INSPECTION CRITERIA

This specification is designed to be used as the standard acceptance/rejection criteria for normal LCM products.

1. Sampling plan.

The sampling plan according to GB/T 2828.1-2003 / ISO2859-16 1999 and ANSI/ASQC Z1.4 1993, normal level 2 and based on:

- Major defect: AQL 0.65
- Minor defect: AQL 1.5

2. Inspection condition

- The viewing distance for cosmetic inspection is approximately 30cm with the naked eye, and under an environment of 20-40W light intensity, in all directions, within 45° against a perpendicular line. (Normal temperature 20-25°C and normal humidity 60+/-15 RH.)
- Driving voltage - The Vop value from which the most optimal contrast can be obtained near the specified Vop in the specification (within +/-0.5V of the typical value at 25°C.)

3. Definition of inspection zone in LCD.

Zone A: active area
Zone B: viewing area except Zone A (Zone A + Zone B = Minimum viewing area)
Zone C: outside viewing area (invisible area after assembling customer's product.

Figure 4

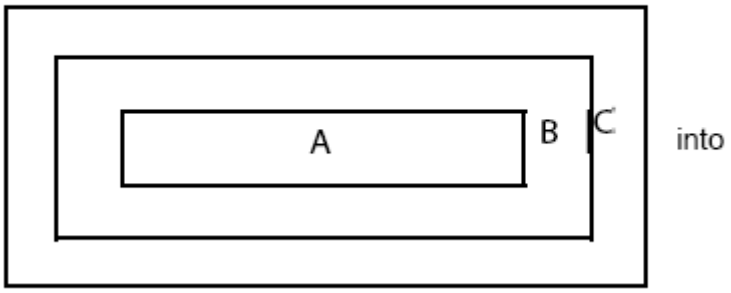


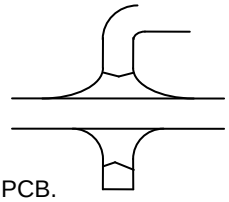
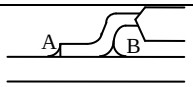
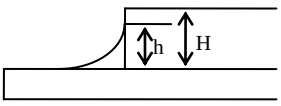
Figure 4 inspection zones in an LCD

Note: As a general rule visual defects in Zone C are permissible when there is no visual effect once assembled into the customer's product.

- INSPECTION STANDARD

No.	Item	Judgment Criteria	Partition
1	All functional defects	1) No display 2) Display abnormal 3) Missing vertical or horizontal segment 4) Short circuit 5) Backlight not working, flickering and abnormal light	Major
2	Missing	Missing component	Major
3	Outline dimension	Overall outline dimension beyond the drawing dimension is not allowed	Major

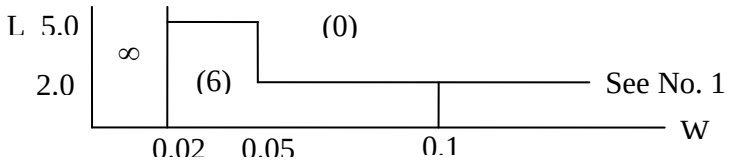
- **COSMETIC CRITERIA**

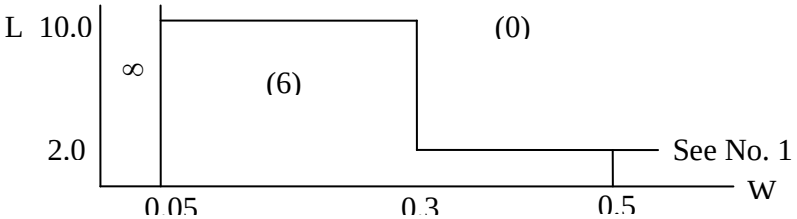
No.	Item	Judgment Criteria	Partition
1	Difference in Spec.	None allowed	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing No soldering bridge No cold soldering	Major Major Major
4	Resist flaw on substrate	Invisible copper foil (∅0.5mm or more) on substrate pattern	Minor
5	Accretion of metallic Foreign matter	No soldering dust No accretion of metallic foreign matters (Not exceed ∅0.2mm)	Minor Minor
6	Stain	No stain to spoil cosmetic badly	Minor
7	Plate discoloring	No plate fading, rusting and discoloring	Minor
8	Solder amount 1. Lead parts	a. Soldering side of PCB Solder to form a 'Filet' all around the lead. Solder should not hide the lead form perfectly. (too much) b. Components side (In case of 'Through Hole PCB') Solder to reach the Components side of PCB. 	Minor
	2. Flat packages	Either 'toe' (A) or 'heal' (B) of the lead to be covered by 'Filet'. Lead form to be assume over solder. 	Minor
	3. Chips	(3/2) H ≥ h ≥ (1/2) H 	Minor
9	Solder ball/solder splash	a) The spacing between solder ball and the conductor or solder pad h ≥ 0.13mm. The diameter of the solder ball d ≤ 0.15mm. b) The quantity of solder balls or solder splashes isn't more than 5 in 600mm2. c) Solder balls / splashes do not violate minimum electrical clearance d) Solder balls/splashes must be not be able to be dislodged with normal product usage	Minor Minor Major Minor

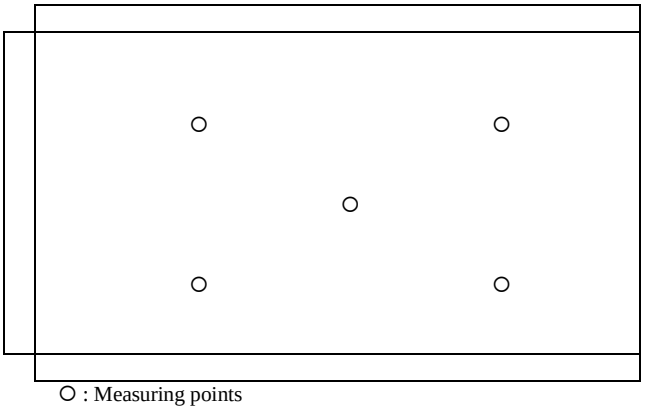
- **COSMETIC CRITERIA (non-operating)**

<table>
<tr><th>No.</th><th>Defect</th><th>Judgment Criteria</th><th>Classification</th></tr>
<tr><td>1</td><td>Spots</td><td>In accordance with Screen Cosmetic Criteria (Operating) No.1.</td><td>Minor</td></tr>
<tr><td>2</td><td>Lines</td><td>In accordance with Screen Cosmetic Criteria (Operating) No.2.</td><td>Minor</td></tr>
<tr><td>3</td><td>Bubbles in polarizer</td><td><table><tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr><tr><td>$d \le 0.3$</td><td>Disregard</td></tr><tr><td>$0.3 < d \le 1.0$</td><td>3</td></tr><tr><td>$1.0 < d \le 1.5$</td><td>1</td></tr><tr><td>$1.5 < d$</td><td>0</td></tr></table></td><td>Minor</td></tr>
<tr><td>4</td><td>Scratch</td><td>In accordance with spots and lines operating cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.</td><td>Minor</td></tr>
<tr><td>5</td><td>Allowable density</td><td>Above defects should be separated more than 30mm each other.</td><td>Minor</td></tr>
<tr><td>6</td><td>Coloration</td><td>Not to be noticeable coloration in the viewing area of the LCD panels.
Back-lit type should be judged with back-lit on state only.</td><td>Minor</td></tr>
<tr><td>7</td><td>Contamination</td><td>Not to be noticeable.</td><td>Minor</td></tr>
</table>

- **COSMETIC CRITERIA (operating)**

<table>
<tr><th>No.</th><th>Defect</th><th>Judgment Criteria</th><th>Classification</th></tr>
<tr><td>1</td><td>Spots</td><td>A) Clear<table><tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr><tr><td>$d \le 0.1$</td><td>Disregard</td></tr><tr><td>$0.1 < d \le 0.2$</td><td>6</td></tr><tr><td>$0.2 < d \le 0.3$</td><td>2</td></tr><tr><td>$0.3 < d$</td><td>0</td></tr></table>Note : Including pin holes and defective dots which must be within one pixel size.
B) Unclear<table><tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr><tr><td>$d \le 0.2$</td><td>Disregard</td></tr><tr><td>$0.2 < d \le 0.5$</td><td>6</td></tr><tr><td>$0.5 < d \le 0.7$</td><td>2</td></tr><tr><td>$0.7 < d$</td><td>0</td></tr></table></td><td>Minor</td></tr>
<tr><td>2</td><td>Lines</td><td>A) Clear
 

Note :( ) - Acceptable Qty in active area
L - Length (mm)
W - Width (mm)
∞ - Disregard
B) Unclear
 
</td><td>Minor</td></tr>
<tr><td>3</td><td>Rubbing line</td><td>Not to be noticeable.</td><td></td></tr>
<tr><td>4</td><td>Allowable density</td><td>Above defects should be separated more than 10mm each other.</td><td>Minor</td></tr>
<tr><td>5</td><td>Rainbow</td><td>Not to be noticeable.</td><td>Minor</td></tr>
<tr><td>6</td><td>Dot size</td><td>To be 95% ~ 105% of the dot size (Typ.) in drawing.
Partial defects of each dot (ex. pin-hole) should be treated as ‘spot’.</td><td>Minor</td></tr>
</table>

		(see Screen Cosmetic Criteria (Operating) No.1)	
7	Uneven brightness (only back-lit type module)	Uneven brightness must be BMAX / BMIN ≤ 2 - BMAX : Max. value by measure in 5 points - BMIN : Min. value by measure in 5 points Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure.  ○ : Measuring points	Minor

Note :

(1) Size : d = (long length + short length) / 2

(2) The limit samples for each item have priority.

(3) Complex defects are defined item by item, but if the number of defects are defined in above table, the total number should not exceed 10.

(4) In case of 'concentration', even the spots or the lines of 'disregarded' size should not allowed. Following three situations should be treated as 'concentration'.

- 7 or over defects in circle of ∅5mm.
- 10 or over defects in circle of ∅10mm.
- 20 or over defects in circle of ∅20mm.

- PRECAUTIONS FOR USING LCD MODULES

  - HANDLING PRECAUTIONS

(1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.

(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.

(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents :

- Isopropyl alcohol
- Ethyl alcohol

(6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.

- Water
- Ketone
- Aromatic solvents

(7) Exercise care to minimize corrosion of the electrode. Water droplets, moisture condensation or a current flow in a high-humidity environment, accelerate corrosion of the electrodes.

(8) 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.

(9) Do not attempt to disassemble or process the LCD module.

(10) NC terminal should be open. Do not connect anything.

(11) If the logic circuit power is off, do not apply the input signals.

(12) 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.

• STORAGE PRECAUTIONS

When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags (avoid high temperature / high humidity and low temperatures below the stated storage temperature of the LCM specification).

• OTHER

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

- Exposed area of the printed circuit board.
- Terminal electrode sections.

• USING LIQUID CRYSTAL DISPLAY MODULES

An LCD is composed of glass and polarizer. Pay attention to the following items when handling.

(1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

(2) Do not touch, push or rub the exposed polarisers with anything harder than an HB pencil lead (glass, tweezers, etc.).

(3) N-hexane is recommended for cleaning the adhesives used to attach front/rear polarisers and reflectors made of organic substances that may be damaged by chemicals such as acetone, toluene, ethanol and isopropyl alcohol.

(4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzene. Do not scrub hard to avoid damaging the display surface.

(5) Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.

(6) Avoid contacting oil and fats.

(7) Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarisers. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.

(8) Do not put or attach anything on the display area to avoid leaving marks on.

(9) Do not touch the display with bare hands. This will stain the display area and degrade the insulation between the terminals.

(10) As glass is fragile. It tends to become chipped during handling especially on the edges.

(11) Mounting Method

The panel of the LCD Module consists of two thin glass plates with polarizes, which easily get damaged. Since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD Modules.

(12) Caution against static charge

The LCD Module use C-MOS LSI drivers, so we recommend 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 table. And assembly equipment to protect against static electricity.

- PRECAUTIONS FOR SOLDERING

	Manual Soldering	Machine Drag Soldering	Machine Pre-soldering
Non ROHS Product	290°C ~ 350°C Speed : 3 ~ 5 mm/s	330°C ~ 350°C Speed : 4 ~ 8mm/s	300°C ~ 330°C Time : 3 ~ 6S Pressure : 0.8 to 1.2Mpa
RoHS Product	340°C ~ 370°C Time : 3 ~ 5S.	350°C ~ 370°C Time : 4 ~ 8 mm/S.	330°C ~ 360°C Time : 3 ~ 6S. Pressure : 0.8 ~ 1.2Mpa.

(1) If solder flux is used, be sure to remove any remaining flux after finishing the soldering process. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during the soldering process to prevent any damage due to the flux sparks.

(2) When soldering a backlight panel and PCB, the panel and PCB should not be detached more than 3 times. The temperature determines this number and time conditions as mentioned in the above table, although there may be some variance depending on the actual temperature of the soldering iron.

(3) When removing a backlight panel from the PCB, ensure the solder has completely melted; otherwise the solder pads on the backlight panel and/or PCB may be damaged.

- CAUTIONS FOR OPERATION

(1) It is recommended to drive LCDs within their specified voltage limit since the higher voltage than the upper limit shortens the LCD life. An electrochemical reaction due to direct current causes the LCD to deteriorate. Therefore, avoid the use of direct current drive.

(2) Response time will be extremely delayed at lower temperatures than the operating temperature range. At higher temperatures LCD's will experience a dark color. However those phenomena do not mean a malfunction or the LCD's. Once the LCDs are returned to the specified operating temperature range, the response time and coloration should return to the normal state.

(3) If the display area is physically pressed hard during it's operation, some pixels may be abnormally displayed, but should return to their normal condition after resetting the LCM.

(4) Moisture sitting on the LCM terminals is a cause for an electro-chemical reaction resulting in a terminal open circuit. Usage under the relative condition of 40°C, 50%RH or less is therefore required.

- SAFETY

(1) It is recommended to crush any damaged or unnecessary LCDs into pieces and wash off the liquid crystal by using solvents such as acetone and ethanol, which should then be burned up later.

(2) When any liquid crystal has leaked out of a damaged glass cell and comes in contact with skin, please wash it off well with soap and water.

- WARRANTY

Unless otherwise agreed between Logic Technologies Ltd and the customer, Logic Technologies will replace or repair any of its products that are found to be functionally defective when inspected in accordance with Logic Technologies' acceptance criteria (copies available upon request) for a period of one year from date of shipment. Cosmetic/visual defects must be returned to Logic Technologies within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of Logic Technologies is limited to the repair and/or replacement on the terms set forth above. Logic Technologies will not be responsible for any subsequent or consequential losses and/or events.

Returning products under warranty

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are:

- Broken LCD glass.
- PCB eyelet's damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- Soldering to or modifying the bezel in any manner.

Product repairs will be invoiced to the customer upon mutual agreement. Products must be returned with sufficient description of the failures and/or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet's, conductors and terminals.