



LOGIC
TECHNOLOGIES

PRODUCT SPECIFICATION

DESCRIPTION

TFT Module – 1.8” a-Si TFT
128 x (RGB) x 160

PART NUMBER

LTTD128160018-L3

VERSION

1.3

ROHS COMPLIANT

Table of Contents

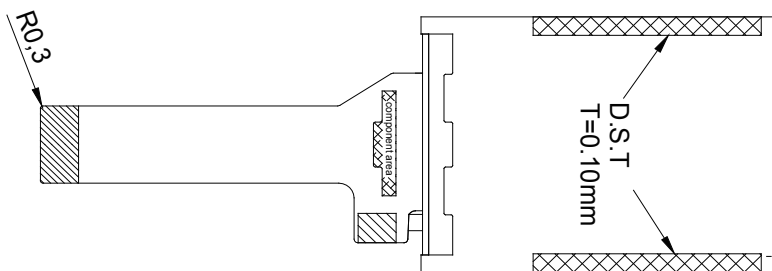
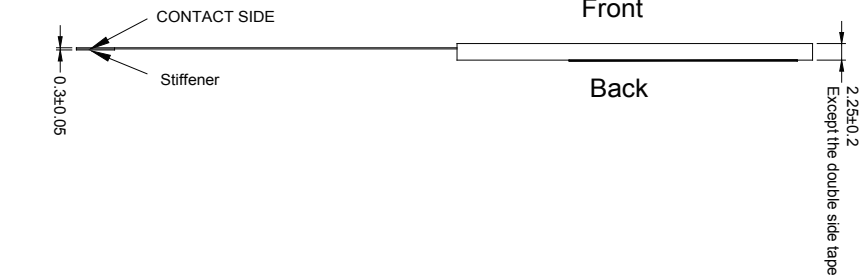
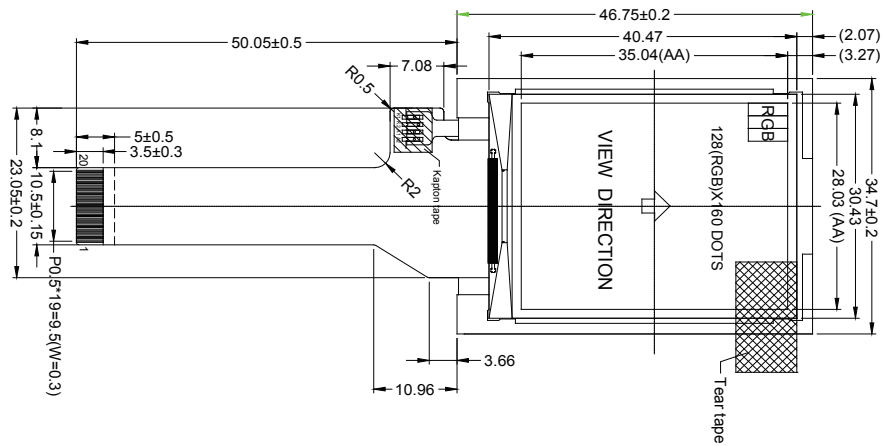
- GENERAL INFORMATION
- MECHANICAL DIMENSIONS
- ABSOLUTE MAXIMUM RATINGS
- ELECTRICAL CHARACTERISTICS
- BACKLIGHT CHARACTERISTICS
- ELECTRO-OPTICAL CHARACTERISTICS
- INTERFACE DESCRIPTION
- TIMING CHART & DATA
- RELIABILITY TESTING
- INSPECTION CRITERIA
- INSPECTION STANDARD
- PRECAUTIONS FOR USING LCD MODULES

- GENERAL INFORMATION

Item	Contents	Unit
LCD Type	TFT Transmissive, normally white	---
Technology	a-Si TFT	---
Viewing Direction	6:00	O'clock
Viewing Angle (Grayscale inversion direction)	12:00	O'clock
Module dimensions (W x H x T)	34.70 x 46.75 x 2.25	mm
Active area (W x H)	28.03 x 35.04	mm
Number of pixels	128 RGB x160	---
Pixel pitch (W x H)	0.219 x 0.219	mm ²
Colours	65k	---
Backlight	LED (2 LED parallel)	---
Interface	MCU 8-bit	---
Controller IC	ILI9163V or equivalent	---
Operating temperature	-20 to +70	°C
Storage temperature	-30 to +80	°C

MECHANICAL DIMENSIONS

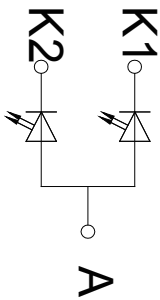
Mechanical Dimensions



No:	Symbol
1	GND
2	IOVCC1.8V
3	VCC 2.8V
4	CSB
5	RST
6	RS
7	WRB
8	RDB
9	DB0
10	DB1
11	DB2
12	DB3
13	DB4
14	DB5
15	DB6
16	DB7
17	BL_A
18	BL_K1
19	BL_K2
20	GND

Note:

1. Display type: 1.77" TFT
2. Viewing direction: 6 O'Clock
3. Polarizer mode: Transmissive/Negative
4. Operation temperature: -20degC~+70degC
5. Storage temperature: -30degC~+80degC
6. Driver/Controller IC: ILI9163V / A
7. Power supply voltage: VCC=2.8V, IOVCC=1.8V
8. Backlight : White(2 LED); Vf=3.0~3.4V(40mA(TYP))
9. ROHS complaint



Version A: First release.
Version B: Mechanical same but driver IC and TFT panel are changed.

LOGIC TECHNOLOGIES

Part Number	LTTD128160018-L3	Revision	B
Not to scale. Unit mm.		Sheet: 1/1	

• ABSOLUTE MAXIMUM RATINGS

 $V_{SS}=0V, T_a=25^{\circ}C$

Item	Symbol	Min.	Max.	Unit	
Supply Voltage	Logic	VDDIO	-0.3	4.6	V
	Analog	VDD	-0.3	4.6	V
LED forward voltage	V_F	-	3.4	V /One LED	
LED forward current	I_F	-	20	mA /One LED	
Storage temperature	T_{STG}	-30	+80	$^{\circ}C$	
Operating temperature	T_{OP}	-20	+70	$^{\circ}C$	

Note 1: If T_a below $50^{\circ}C$, the maximal humidity is 90%RH, if T_a over $50^{\circ}C$, absolute humidity should be less than 60%RH.

Note 2: The response time will be extremely slow when the operating temperature is around $-10^{\circ}C$, and the back ground will become darker at high temperature operating.

• ELECTRICAL CHARACTERISTICS

Ite	Symbol	Min.	Typ.	Max.	Unit	
Supply Voltage	Logic	VDD	1.65	2.8	3.3	V
	Analog	VCI	2.5	2.8	3.3	V
Logic Low input voltage	V_{IL}	-0.3	-	$0.3*VDD$	V	
Logic High input voltage	V_{IH}	$0.7*VDD$	-	VDD	V	
Logic Low output voltage	V_{OL}	-	-	$0.2*VDD$	V	
Logic High output voltage	V_{OH}	$0.8*VDD$	-	-	V	

• BACKLIGHT CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	V_F	$T_a=25^{\circ}C, I_F=20mA/LED$	-	3.2	3.4	V
Forward Current	I_F	$T_a=25^{\circ}C, V_F=3.2V/LED$	-	$20*2$	$25*2$	mA
Reverse Voltage	V_R	-	-	3.0	-	V
Reverse current	I_R		-	-	10	μA
Power dissipation	P_D		-	128	170	mW
Uniformity	Avg		75	-	-	%
Drive method	Constant current					
LED Configuration	2 White LEDs in parallel					

Notes

- Backlight drive conditions : constant current driving method.
- The LED driving condition is defined for the total backlight consumption.
- Forward Voltage adjusting should depend on Forward Current setting.
- Optical performance should be evaluated at $T_a=25^{\circ}C$ 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.

• ELECTRO-OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Refer	Note	
Response Time	T _{ON}	25°C	---	10	15	ms	Fig 1	1	
	T _{OFF}		---	15	25				
Contrast ratio	Cr	$\theta = 0^\circ$	400	500	---	---	Fig 2	1	
Uniformity	U	---	70	80	---	%	Fig 2	3	
Surface Luminance	Lv		250	300	---	cd/m ²	Fig 2	2	
Viewing angle ratio	θ	$\varnothing = T$	60	70	---	deg	Fig 3	6	
		$\varnothing = B$	50	60	---				
		$\varnothing = L$	60	70	---				
		$\varnothing = R$	60	70	---				
CIE (x,y) chromaticity	Red	x	Backlight On	---	0.617	---	---	Fig 2.	5
		y		---	0.334	---			
	Green	x		---	0.339	---			
		y		---	0.593	---			
	Blue	x		---	0.147	---			
		y		---	0.085	---			
	White	x		---	0.289	---			
		y		---	0.314	---			

Note

1. 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.

$$L_v = \text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5...)}$$

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

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

Note 4. Response time is the time required for the display to transition from 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. 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 direction of the panel viewing angle.

Figure 1. Definition of response time

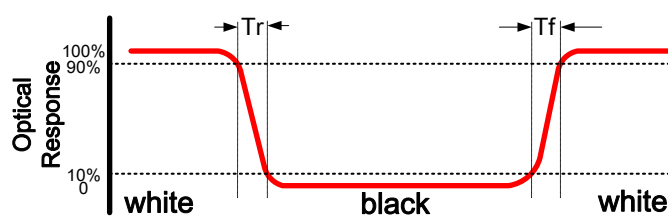


Figure 2. Measuring contrast ratio, surface luminance, luminance uniformity and CIE (chromaticity.)

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

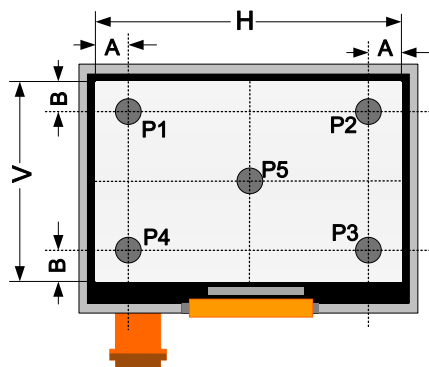
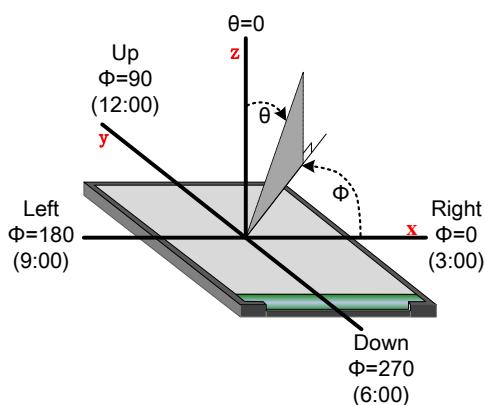
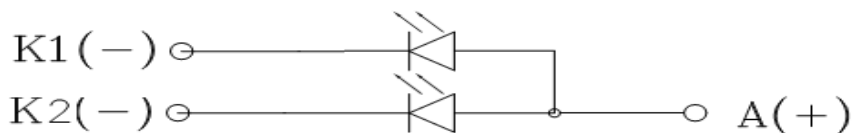
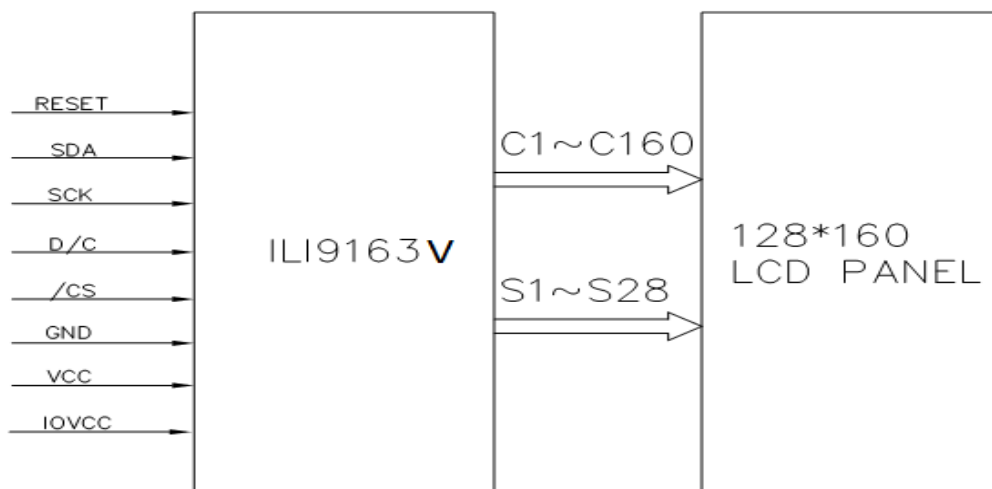


Figure 3. Definition of viewing angle

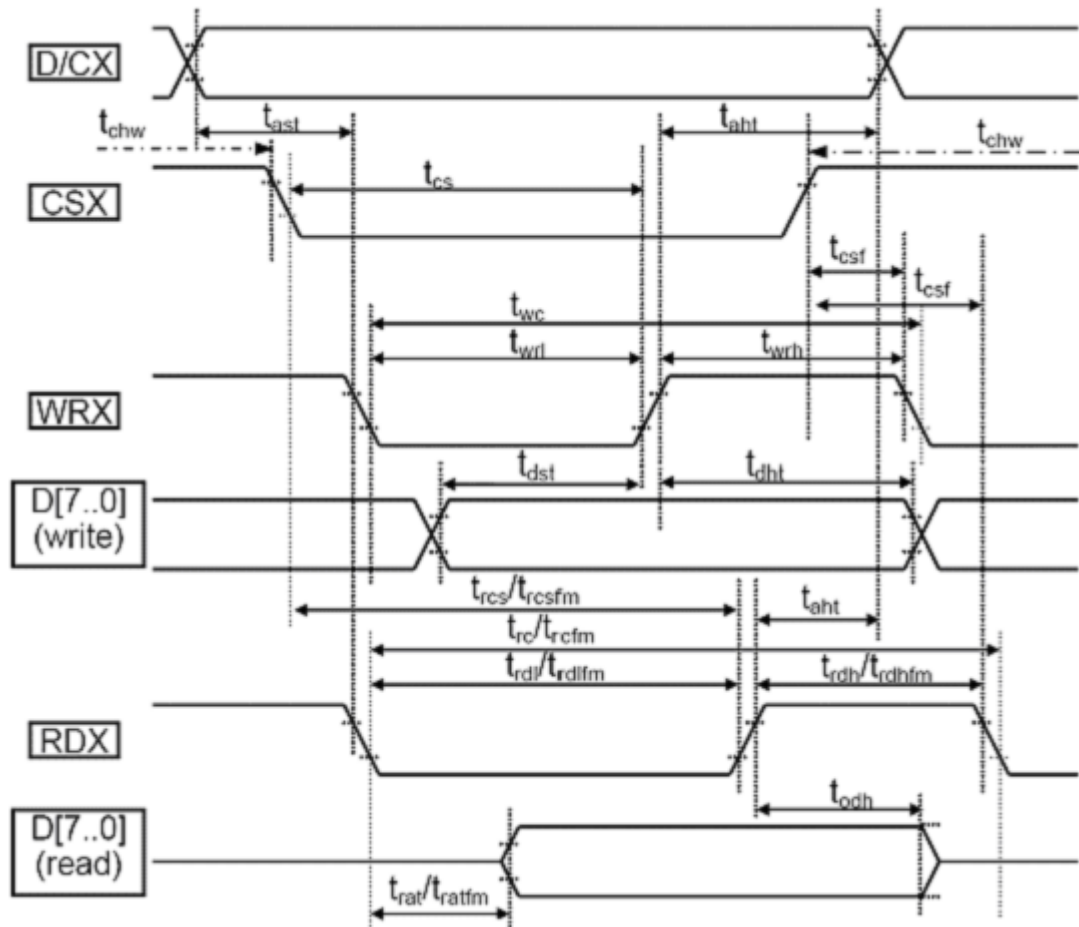


• **INTERFACE DESCRIPTION**

No.	Symbol	Function	Remark
1	GND	Ground	
2	IOVCC	Logic Power(1.8V)	
3	VCC	Analog Power(2.8V)	
4	CSB	Chip Select Signal	
5	RST	Reset Signal	
6	RS	Data/Command Signal	
7	WRB	Write signal	
8	RDB	Read signal	
9	DB0	Data bus	
10	DB1	Data bus	
11	DB2	Data bus	
12	DB3	Data bus	
13	DB4	Data bus	
14	DB5	Data bus	
15	DB6	Data bus	
16	DB7	Data bus	
17	BL_A	Led anode	
18	BL_K1	Led cathode	
19	BL_K2	Led cathode	
20	GND	Ground	



• **TIMING CHART and COMMAND TABLE**



Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

Signal	Symbol	Parameter	min	max	unit	description
D/CX	tast	Address setup time	0		ns	
	taht	Address hold time(Write/Read)	10		ns	
CSX	tchw	CSX"H" Pulse Width	0		ns	
	tcs	Chip Select setup time (Write)	10		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	Control pulse H duration	15		ns	
	twrl	Control pulse L duration	15		ns	
RDX	trc	Read cycle (ID)	160		ns	When read ID data
	trdh	Control pulse H duration(ID)	90		ns	
	trdl	Control pulse L duration(ID)	45		ns	
RDX	trcfm	Read cycle (FM)	450		ns	When read from frame memory
	trdhfm	Control pulse H duration (FM)	90		ns	
	trdlfm	Control pulse L duration (FM)	355		ns	
D[17..0]	tdst	Data setup time	10		ns	For maximum CL = 30pF
	tdht	Data hold time	10		ns	
	trat	Read access time (ID)		40	ns	For minimum CL = 8pF
	tratfm	Read access time (FM)		340	ns	
	todh	Output disable time	20	80	ns	

Note 1: VDDI 1.65 to 3.3V, VDD=2.6 to 3.3V, AGND=GND=0V, Ta=-30 to 70 °C (to +85°C no damage)

Note 2: This 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 VDDI for input signals

Hex Code	Command	Description	Number of Parameters	Display Architecture Implementation Requirement		
				Type 1	Type 2	Type 3
00h	nop	No Operation	0	Yes	Yes	Yes
01h	soft_reset	Software Reset	0	Yes	Yes	Yes
06h	get_red_channel	Get the red component of the pixel at (0, 0).	1	No	Yes	Yes
07h	get_green_channel	Get the green component of the pixel at (0, 0).	1	No	Yes	Yes
08h	get_blue_channel	Get the blue component of the pixel at (0, 0).	1	No	Yes	Yes
0Ch	get_pixel_format	Get the current pixel format.	1	Yes	Yes	Yes
0Ah	get_power_mode	Get the current power mode.	1	Yes	Yes	Yes
0Bh	get_address_mode	Get the frame memory to the display panel read order.	1	Yes	Yes	Yes
0Dh	get_display_mode	Get the current display mode from the peripheral.	1	Yes	Yes	Yes
0Eh	get_signal_mode	Get display module signaling mode.	1	Yes	Yes	Yes
0Fh	get_diagnostic_result	Get Peripheral Self-Diagnostic Result	1	Yes	Yes	Yes
10h	enter_sleep_mode	Power for the display panel is off.	0	Yes	Yes	Yes
11h	exit_sleep_mode	Power for the display panel is on.	0	Yes	Yes	Yes
12h	enter_partial_mode	Part of the display area is used for image display.	0	Yes	Yes	No
13h	enter_normal_mode	The whole display area is used for image display.	0	Yes	Yes	No
20h	exit_invert_mode	Displayed image colors are not inverted.	0	Yes	Yes	Yes
21h	enter_invert_mode	Displayed image colors are inverted.	0	Yes	Yes	Yes
26h	set_gamma_curve	Selects the gamma curve used by the display device.	1	Yes	Yes	Yes
28h	set_display_off	Blanks the display device.	0	Yes	Yes	Yes
29h	set_display_on	Show the image on the display device.	0	Yes	Yes	Yes
2Ah	set_column_address	Set the column extent.	4	Yes	Yes	No
2Bh	set_page_address	Set the page extent.	4	Yes	Yes	No
2Ch	write_memory_start	Transfer image data from the Host Processor to the peripheral starting at the location provided by set_column_address and set_page_address.	variable	Yes	Yes	No
2Dh	write_LUT	Fills the peripheral look-up table with the provided data.	variable	optional	No	No
2Eh	read_memory_start	Transfer image data from the peripheral to the Host Processor interface starting at the location provided by set_column_address and set_page_address.	variable	Yes	Yes	No
30h	set_partial_area	Defines the partial display area on the display device.	4	Yes	Yes	No
33h	set_scroll_area	Defines the vertical scrolling and fixed area on display device.	6	Yes	No	No
34h	set_tear_off	Synchronization information is not sent from the display module to the host processor.	0	Yes	No	No
35h	set_tear_on	Synchronization information is sent from the display module to the host processor at the start of VFP.	1	Yes	No	No

36h	set_address_mode	Set the read order from frame memory to the display panel.	1	Yes	Yes	Yes
37h	set_scroll_start	Defines the vertical scrolling starting point.	2	Yes	No	No
38h	exit_idle_mode	Full color depth is used on the display panel.	0	Yes	No	No
39h	enter_idle_mode	Reduced color depth is used on the display panel.	0	Yes	No	No
3Ah	set_pixel_format	Defines how many bits per pixel are used in the interface.	1	Yes	Yes	Yes
3Ch	write_memory_continue	Transfer image information from the Host Processor interface to the peripheral from the last written location.	variable	Yes	Yes	No
3Eh	read_memory_continue	Read image data from the peripheral continuing after the last read_memory_continue or read_memory_start.	variable	Yes	Yes	No
44h	set_tear_scanline	Synchronization information is sent from the display module to the host processor when the display device refresh reaches the provided scanline.	2	Yes	No	No
45h	get_scanline	Get the current scanline.	2	Yes	Yes	No
DAh	Read ID1					
DBh	Read ID2					
DCh	Read ID3					

Notes:

1. There will be no abnormal visible effects on the display when S/W or H/W Reset are applied.
2. After Powered-On Reset finishes within 10 μ s after both VDD & VDDI are applied.
3. Mode 1 means Tearing Effect Output Line consists of V-Blanking Information only.

• RELIABILITY TESTING

NO.	Item	Condition	Criteria
1	High Temperature Operating	70°C +/-2°C, 240Hrs	IEC60068-2-1, GB2423.2
2	Low Temperature Operating	-20°C +/-2°C, 240Hrs	IEC60068-2-1 GB2423.1
3	High Temperature Storage	80°C +/-2°C, 240Hrs	IEC60068-2-1 GB2423.2
4	Low Temperature Storage	-30°C +/-2°C, 240Hrs	IEC60068-2-1 GB2423.2
5	Hi Temperature & High Humidity Operation	60°C, 90%RH max, 240Hrs	IEC60068-2-78 GB/T2423.3
6	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
7	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
8	Thermal Shock (non operating)	-20°C to 30min to 70°C, 30min Change time: 5min, 100 cycles	Start with cold temperature, End with high temperature, IEC60068-2- 14:1984,GB2423.22
9	Drop Test (packaged)	Height:80 cm,1 corner, 3 edges, 6 surfaces	IEC60068-2-32 GB/T2423.8
10	Shock (non-operation)	80G 6ms, ±X,±Y,±Z 3 times for each direction	IEC60068-2-27 GB/T2423.5
11	ESD (operation)	C=150pF,R=330Ω, Air:±15Kv, Contact:±8Kv, 10times/terminal	IEC61000-4-2 GB/T17626.2

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 $>10\text{MW}$ should be used.
4. (a) In the case of a malfunction caused by ESD damage, if the LCM returns to its normal state after resetting, the item is considered to have passed the ESD test.
 (b) It is recommended to use an anti-static blower (ioniser) 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. EL backlights are exempt from the reliability testing with respect to temperature and humidity. Some defects may occur such as black spots or blemishes due to the inherent chemical reaction of humidity with fluorescent EL.
6. 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 $20\text{-}25^\circ\text{C}$ and normal humidity $60\pm 15\text{ RH}$.)
- Driving voltage - The V_{op} value from which the most optimal contrast can be obtained near the specified V_{op} in the specification (within $\pm 0.5\text{V}$ of the typical value at 25°C .)

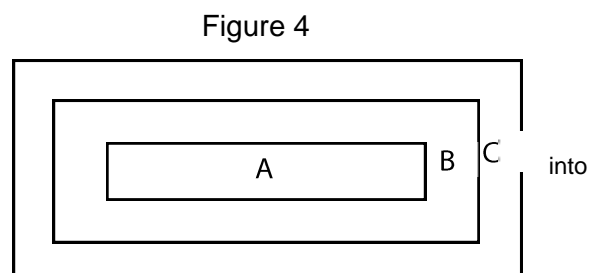
3. Definition of inspection zone in LCD.

Zone A : active pixel 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 inspection zones in an LCD



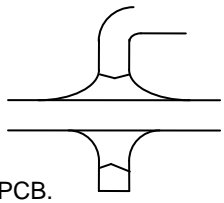
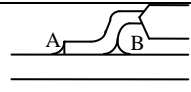
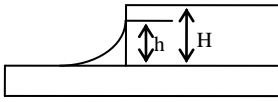
Note: As a general rule visual defects in Zone C are permissible when there is no visual effect once assembled into the customer's product.

● **INSPECTION STANDARD**

○ MAJOR CRITERIA

Item No	Item to be inspected	Inspection standard	Classification
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	
3	Outline dimension	Overall outline dimension beyond the drawing dimension is not allowed	

○ COSMETIC CRITERIA

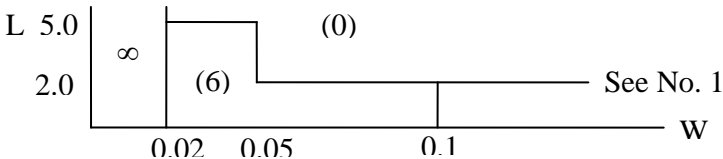
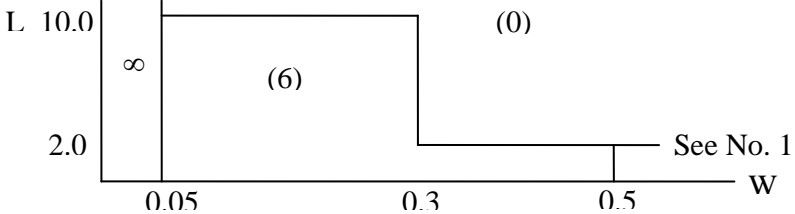
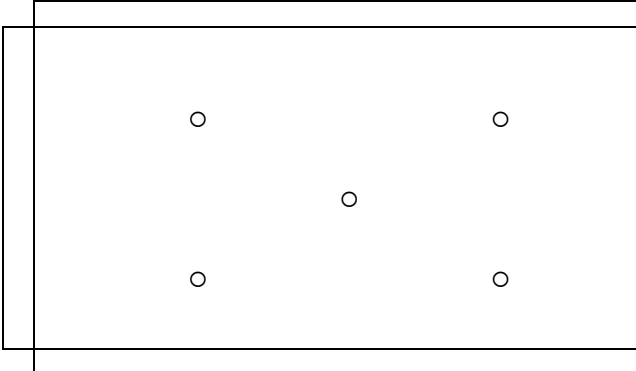
No.	Item	Judgment Criteria	Partition
1	Difference in Spec.	None allowed	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing No soldering bridge No cold soldering	Major Major Minor
4	Resist flaw on substrate	Invisible copper foil (Ø0.5mm or more) on substrate pattern	Minor
5	Accretion of metallic Foreign matter	No soldering dust No accretion of metallic foreign matters (Not exceed Ø0.2mm)	Minor Minor
6	Stain	No stain to spoil cosmetic badly	Minor
7	Plate discoloring	No plate fading, rusting and discoloring	Minor
8	Solder amount	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 'heel' (B) of the lead to be covered by 'Filet'. Lead form to be assume over solder. 	Minor
	3. Chips	$(3/2) H \geq h \geq (1/2) H$ 	Minor
9	Solder ball/solder splash	a) The spacing between solder ball and the conductor or solder pad $h \geq 0.13\text{mm}$. The diameter of the solder ball $d \leq 0.15\text{mm}$. b) The quantity of solder balls or solder splashes isn't more than 5 in 600mm ² . 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)

No.	Defect	Judgment Criteria	Classification										
1	Spots	In accordance with Screen Cosmetic Criteria (Operating) No.1.	Minor										
2	Lines	In accordance with Screen Cosmetic Criteria (Operating) No.2.	Minor										
3	Bubbles in polarizer	<table border="1"> <thead> <tr> <th>Size : d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>d ≤ 0.3</td> <td>Disregard</td> </tr> <tr> <td>0.3 < d ≤ 1.0</td> <td>3</td> </tr> <tr> <td>1.0 < d ≤ 1.5</td> <td>1</td> </tr> <tr> <td>1.5 < d</td> <td>0</td> </tr> </tbody> </table>	Size : d mm	Acceptable Qty in active area	d ≤ 0.3	Disregard	0.3 < d ≤ 1.0	3	1.0 < d ≤ 1.5	1	1.5 < d	0	Minor
Size : d mm	Acceptable Qty in active area												
d ≤ 0.3	Disregard												
0.3 < d ≤ 1.0	3												
1.0 < d ≤ 1.5	1												
1.5 < d	0												
4	Scratch	In accordance with spots and lines operating cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.	Minor										
5	Allowable density	Above defects should be separated more than 30mm each other.	Minor										
6	Coloration	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.	Minor										
7	Contamination	Not to be noticeable.	Minor										

○ COSMETIC CRITERIA (operating)

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

2	Lines	<p>A) Clear</p>  <p>Note : () - Acceptable Qty in active area L - Length (mm) W - Width (mm) ∞ - Disregard</p> <p>B) Unclear</p> 	Minor
3	Rubbing line	Not to be noticeable.	
4	Allowable density	Above defects should be separated more than 10mm each other.	Minor
5	Rainbow	Not to be noticeable.	Minor
6	Dot size	To be 95% ~ 105% of the dot size (Typ.) in drawing. Partial defects of each dot (ex. pin-hole) should be treated as 'spot'. (see Screen Cosmetic Criteria (Operating) No.1)	Minor
7	Uneven brightness (only back-lit type module)	<p>Uneven brightness must be $B_{MAX} / B_{MIN} \leq 2$</p> <ul style="list-style-type: none"> - BMAX : Max. value by measure in 5 points - BMIN : Min. value by measure in 5 points <p>Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure.</p>  <p>○ : Measuring points</p>	Minor

Note :

- (1) Size : $d = (\text{long length} + \text{short length}) / 2$
- (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 $\varnothing 5\text{mm}$.
- 10 or over defects in circle of $\varnothing 10\text{mm}$.
- 20 or over defects in circle of $\varnothing 20\text{mm}$.

• 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 module.
- 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).

○ Others

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 LCD MODULES

○ Liquid Crystal Display Modules

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. Polariser degradation, bubble generation or polariser peel-off may occur if exposed to high temperature and high humidity.
- (2) Do not touch, push or rub the exposed polarisers with anything harder than an HB pencil lead (no glass object, or metal objects such as pins, 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 in contact 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 the LCD glass is fragile, take care when handling especially on the edges.
- (11) Mounting Method – take care when handling in areas such as any PCB mounting holes, polarisers and any area on the perimeter of the LCM that can be easily damaged.
- (12) Caution against static charge - the LCD Module uses C-MOS LSI drivers, so we strongly recommend that you connect any unused input terminal to VDD or VSS, and DO NOT input any signal before power is turned on. Ensure to ground your body, any work/assembly table/area, and assembly equipment to protect against static electricity.

• PRECAUTIONS FOR SOLDERING LCD MODULES

	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.

- **Caution 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 colouration 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.