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The LCD(M) Specialist

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PART NO. : PTG20AW-TCLWU
FOR MESSRS. : _____

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ACCEPTED BY : _____

PROPOSED BY : _____

■ GENERAL INFORMATION

Item	Contents	Unit
LCD type	TFT TRANSMISSIVE	/
Viewing direction	12:00	O' Clock
Glass area (W × H)	35.90 × 49.20	mm ²
Viewing area (W×H)	33.90 × 42.10	mm ²
Active area (W×H)	31.68 × 39.59	mm ²
Number of Dots	176 (RGB) × 220	/
Pixel size	0.18×0.18	mm ²
Driver IC	LGDP4524	/
Colors	262K	/
Backlight Type	LED	/
Module Power consumption	210	mw
Interface Type	System parallel interface	/
Input voltage	2.8	V

■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Supply voltage for logic	V _{DD}	-0.3	4.2	V
Input voltage	V _{IN}	-0.3	4.2	V
Operating temperature	T _{OP}	-20	70	°C
Storage temperature	T _{ST}	-30	80	°C
Humidity	RH		90%(Max60°C)	RH

■ ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage for logic	V _{DD} -V _{SS}	2.7	2.8	2.9	V
Input Current	I _{dd}	-	3.7	7.4	mA
Input voltage 'H' level	V _{IH}	0.8V _{DD}	-	V _{DD}	V
Input voltage 'L' level	V _{IL}	-0.3	-	0.2V _{DD}	V
Output voltage 'H' level	V _{OH}	0.8V _{DD}	-	-	V
Output voltage 'L' level	V _{OL}	-	-	0.2V _{DD}	V

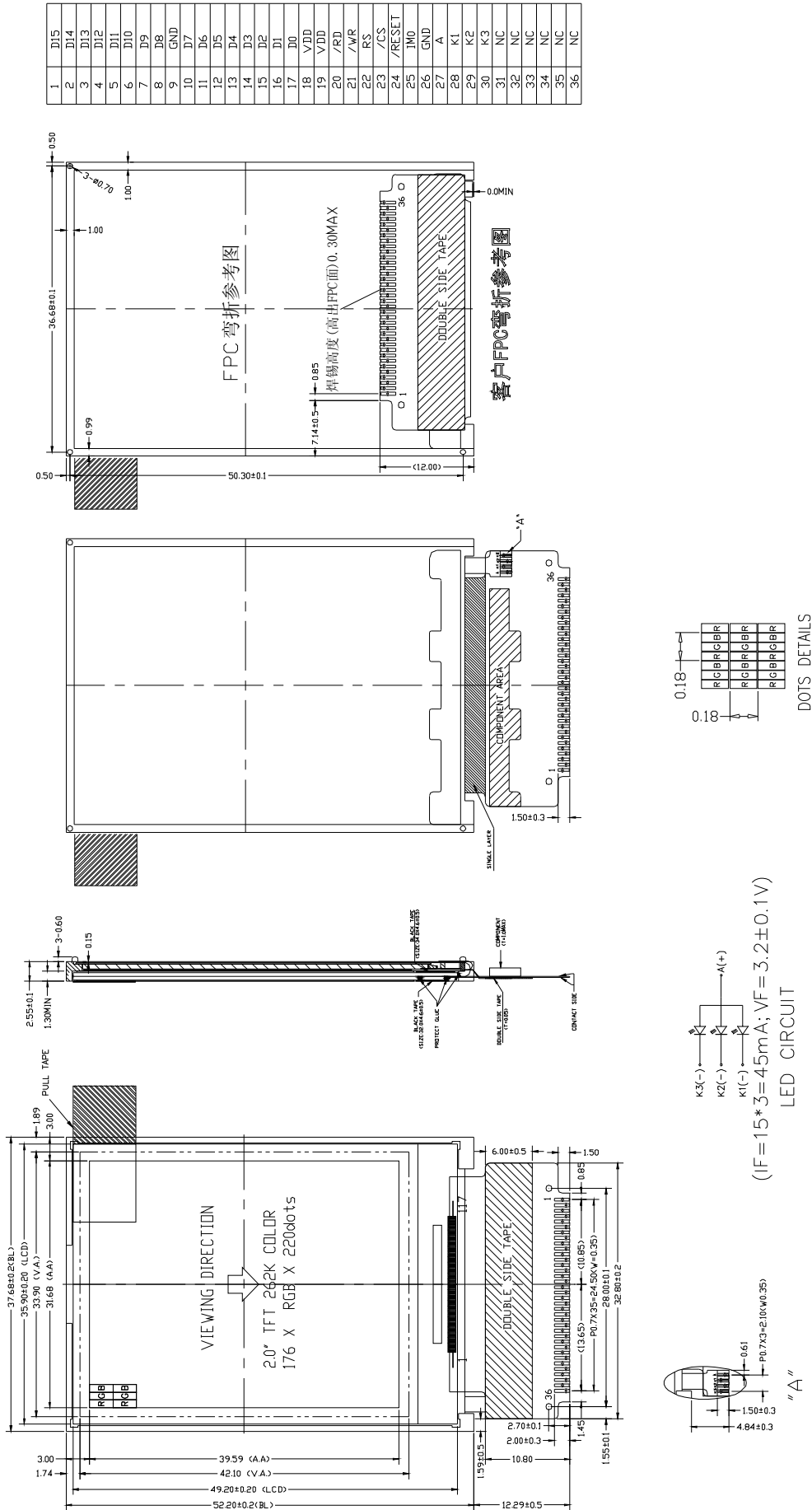
■ TIMING OF POWER SUPPLY

PLEASE REFER TO THE DRIVER IC SPECIFICATION.

■ BACKLIGHT CHARACTERISTICS

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Forward voltage	V _f	3.0	3.2	3.4	V	If= 45 mA
Luminance	L _v	2800	3300	3800	cd/m ²	
Number of LED	-	3			Piece	-
Connection mode	P	parallel			-	-

EXTERNAL DIMENSIONS



■ELECTRO-OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time	Tr+ Tf	$\theta=0^\circ$ $\phi=0^\circ$ $T_a=25^\circ\text{C}$	---	26	40	ms	FIG 1.	4
Contrast ratio	Cr		190	380	---	---	FIG 2.	1
Luminance uniformity	δ WHITE		81	90	---	%	FIG 2.	3
Surface Luminance	Lv		190	237	---	cd/m ²	FIG 2.	2
Viewing angle range	θ	$\phi = 90^\circ$	70	80	---	deg	FIG 3.	6
		$\phi = 270^\circ$	11	21	---	deg	FIG 3.	
		$\phi = 0^\circ$	33	43	---	deg	FIG 3.	
		$\phi = 180^\circ$	32	42	---	deg	FIG 3.	
CIE (x, y) chromaticity	Red	x	0.509	0.559	0.609	FIG 2.	5	5
		y	0.282	0.332	0.382			
	Green	x	0.310	0.360	0.410			
		y	0.489	0.539	0.589			
	Blue	x	0.104	0.154	0.204			
		y	0.079	0.129	0.179			
	White	x	0.254	0.314	0.374			
		y	0.257	0.317	0.377			

Note 1. Contrast Ratio(CR) is defined mathematically as For more information see FIG 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 FIG 2.

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

Note 3. The uniformity in surface luminance, δ WHITE is determined by measuring luminance at each test position 1 through 5, and then dividing the maximum luminance of 5 points luminance by minimum luminance of 5 points luminance. For more information see FIG 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 Time, Tf). For additional information see FIG 1. The test equipment is Autronic-Melchers's ConoScope. Series.

Note 5. CIE (x, y) chromaticity, The x, y value is determined by measuring luminance at each test position 1 through 5, and then make average value.

Note 6. Viewing angle is the angle at which the contrast ratio is greater than 2. For 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 which is normal to the LCD surface. For more information see FIG 3.

Note 7. For Viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope. Series Instruments For contrast ratio, Surface Luminance, Luminance uniformity, CIE The test data is base on TOPCON's BM-5 photo detector.

FIG. 1 The definition of Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".

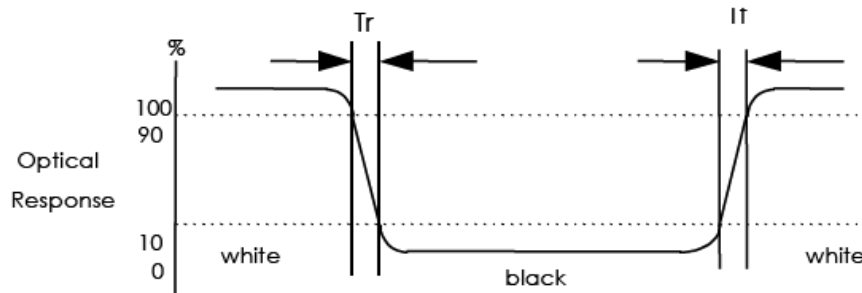


FIG. 2 Measuring method for Contrast ratio, surface luminance, Luminance uniformity , CIE (x, y) chromaticity

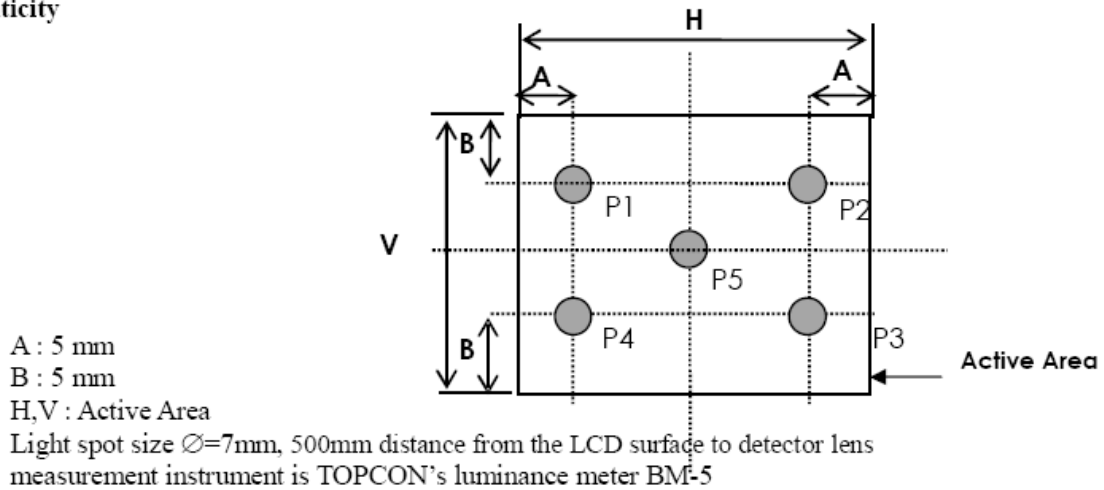
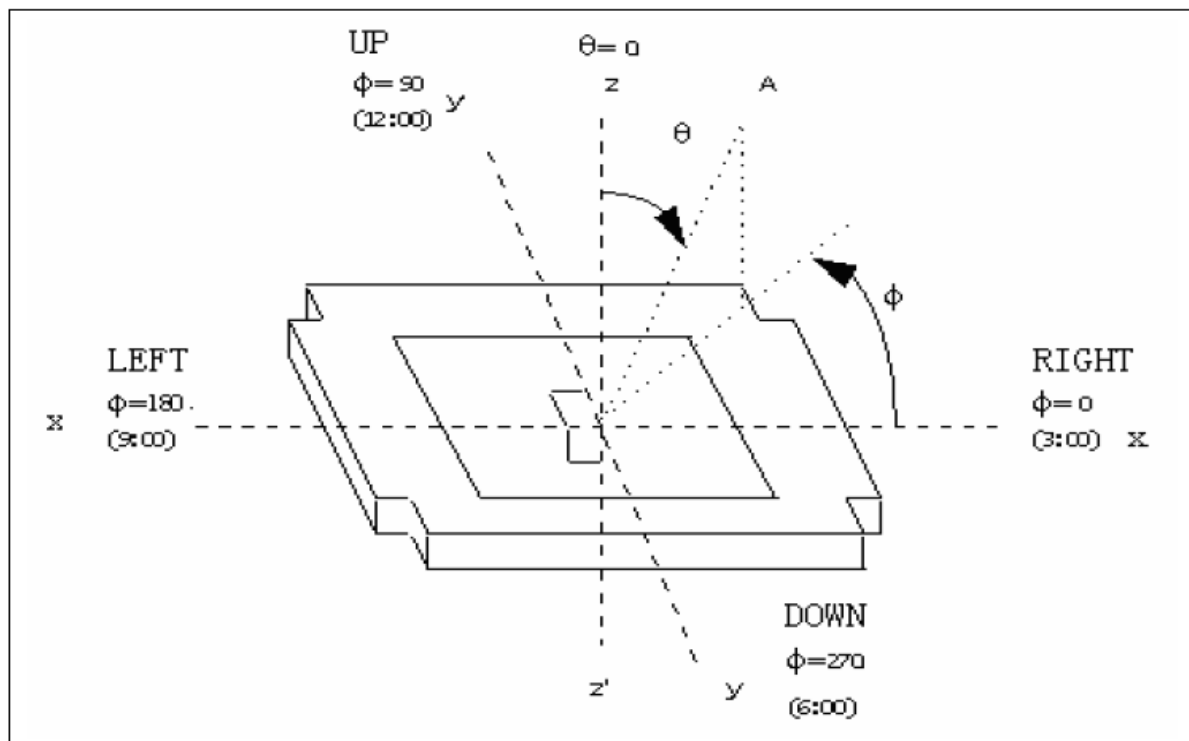


FIG. 3 The definition of viewing angle



■ INTERFACE DESCRIPTION

Pin No.	Symbol	Level	Description												
1~8	D15~ D8	H/L	Data bus.												
9	GND	0V	Ground.												
10~17	D7~ D0	H/L	Data bus.												
18~19	VDD	2.8V	power supply.												
20	/RD	H/L	Read strobe (active low) in 80-system bus interface mode.												
21	/WR	H/L	Write strobe (active low) in 80-system bus interface mode.												
22	RS	H/L	Register select signal. Low: selects the index/status register. High: selects a control register.												
23	/CS	H/L	Chip select signal (active low). Low: LGDP4524 is selected and accessible. High: LGDP4524 is not selected and not accessible. Fix to the GND level when not in use.												
24	/RESET	H/L	Reset pin. Resets if set to LOW.												
25	IM0	H/L	<table border="1"> <thead> <tr> <th>IM0</th> <th>Interface Mode</th> <th>DB Pin</th> <th>Colors</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>80-system 16-bit interface</td> <td>D15-D0</td> <td>262,144</td> </tr> <tr> <td>1</td> <td>80-system 8-bit interface</td> <td>D15-D8</td> <td>262,144</td> </tr> </tbody> </table>	IM0	Interface Mode	DB Pin	Colors	0	80-system 16-bit interface	D15-D0	262,144	1	80-system 8-bit interface	D15-D8	262,144
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			0	80-system 16-bit interface	D15-D0	262,144									
1	80-system 8-bit interface	D15-D8	262,144												
26	GND	0V	Ground.												
27	A	-	LED light anode.												
28	K1	-	LED light cathode.												
29	K2	-	LED light cathode.												
30	K3	-	LED light cathode.												
31~36	NC	-	No connection.												

■ APPLICATION CIRCUIT

Please consult our technical department for detail information.

■ INITIAL CODE

Please consult our technical department for detail information.

■ RELIABILITY TEST

No.	Test Item	Test Condition	Inspection after test
1	High Temperature Storage	80±2°C/200 hours	Inspection after 2~4 hours storage at room temperature, the sample shall be free from defects: 1.Airbubble in the LCD; 2.Sealleak; 3.Non-display; 4.missing segments; 5.Glass crack; 6.Current Idd is twice higher than initial value.
2	Low Temperature Storage	-30±2°C/200 hours	
3	High Temperature Operating	70±2°C/120 hours	
4	Low Temperature Operating	-20±2°C/120 hours	
5	Temperature Cycle	-20±2°C~25~70±2°C × 10cycles (30min.) (5min.) (30min.)	
6	Damp Proof Test	50°C ± 5°C × 90%RH/120 hours	
7	Vibration Test	Frequency: 10Hz~55Hz~10Hz Amplitude: 1.5mm, X, Y, Z direction for total 3hours (Packing condition)	
8	Drooping test	Drop to the ground from 1m height, one time, every side of carton. (Packing condition)	
9	ESD test	Voltage: ± 8KV R: 330 Ω C: 150pF Air discharge, 10time	

Remark:

- 1.The test samples should be applied to only one test item.
- 2.Sample size for each test item is 5~10pcs.
- 3.For Damp Proof Test, Pure water(Resistance>10MΩ) should be used.
- 4.In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.
Using ionizer(an antistatic blower) is recommended at working area in order to reduce electro-static voltage.
When removing protection film from LCM panel, peel off the tag slowly(recommended more than one second) while blowing with ionizer toward the peeling face to minimize ESD which may damage electrical circuit..
- 5.EL evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
- 6.Please use automatic switch menu(or roll menu) testing mode when test operating mode.

INSPECTION CRITERION

This specification is made to be used as the standard acceptance/rejection criteria for Color mobile phone LCM.

1 Sample plan

Sampling method shall be in accordance with MIL-STD-105D, inspection level II and based on:

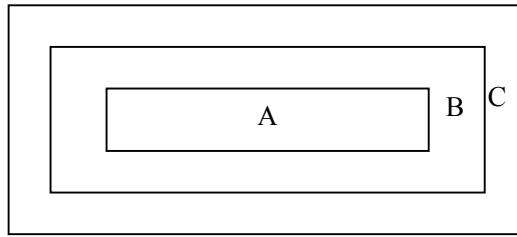
Major defect: AQL 0.65

Minor defect: AQL 1.5

2. Inspection condition

Viewing distance for cosmetic inspection is about 30cm with bare eyes, and under an environment of 20~40W light intensity, all directions for inspecting the sample should be within 45 ° against perpendicular line.

3. Definition of inspection zone in LCD.



Zone A: character/Digit area

Zone B: viewing area except Zone A (ZoneA+ZoneB=minimum Viewing area)

Zone C: Outside viewing area (invisible area after assembly in customer s product)

Fig.1 Inspection zones in an LCD.

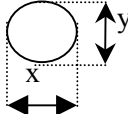
Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer s product.

4. Inspection standards

4.1 Major Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects
4.1.1	All functional defects	1) No display 2) Display abnormally 3) Missing vertical , horizontal segment 4) Short circuit 5) Back-light no lighting, flickering and abnormal lighting.	Major
4.1.2	Missing	Missing component	
4.1.3	Outline dimension	Overall outline dimension beyond the drawing is not allowed.	

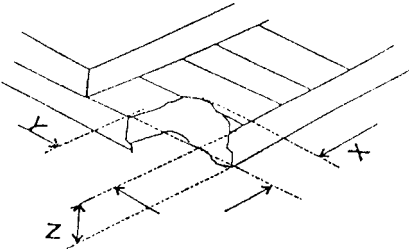
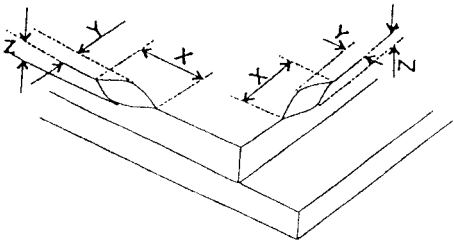
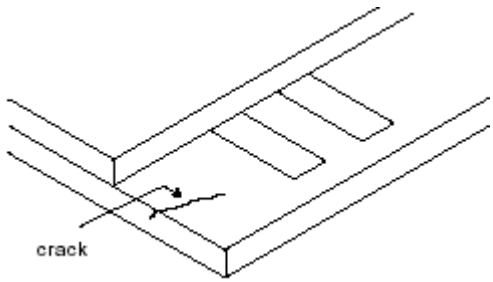
4.2 Cosmetic Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects																							
4.2.1	Clear Spots	For dark/white spot, size is defined as $= \frac{(x+y)}{2}$ 	Minor																							
	Black and white Spot defect Pinhole, Foreign Particle, Dirt under polarizer	1. <table border="1"> <thead> <tr> <th rowspan="2">Size(mm) \ Zone</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>0.1</td> <td colspan="3">Ignore</td> </tr> <tr> <td>0.10 < 0.2</td> <td colspan="3">3</td> </tr> <tr> <td>0.2 < 0.3</td> <td colspan="3">2</td> </tr> <tr> <td>> 0.3</td> <td colspan="3">0</td> </tr> </tbody> </table>		Size(mm) \ Zone	Acceptable Qty			A	B	C	0.1	Ignore			0.10 < 0.2	3			0.2 < 0.3	2			> 0.3	0		
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	Dim Spots Circle shaped and dim edged defects	2. <table border="1"> <thead> <tr> <th rowspan="2">2. Zone \ Size(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>0.2</td> <td colspan="3">Ignore</td> </tr> <tr> <td>0.20 < 0.40</td> <td colspan="3">2</td> </tr> <tr> <td>0.40 < 0.60</td> <td colspan="3">1</td> </tr> <tr> <td>0.60 <</td> <td colspan="3">0</td> </tr> </tbody> </table>	2. Zone \ Size(mm)	Acceptable Qty			A	B	C	0.2	Ignore			0.20 < 0.40	2			0.40 < 0.60	1			0.60 <	0			Minor
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4.2. Cosmetic Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects																																	
4.2.2	Line defect Black line, White line, Foreign material under polarizer,	<table border="1"> <thead> <tr> <th colspan="2">Size(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th rowspan="2">L(Length)</th> <th rowspan="2">W(Width)</th> <th colspan="3">Zone</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>Ignore</td> <td>W 0.02</td> <td colspan="3">Ignore</td> </tr> <tr> <td>L 3.0</td> <td>0.02 < W 0.03</td> <td colspan="3">2</td> </tr> <tr> <td>L 2.0</td> <td>0.03 < W 0.05</td> <td colspan="3">1</td> </tr> <tr> <td></td> <td>0.05 < W</td> <td colspan="3">Define as spot defect</td> </tr> </tbody> </table>	Size(mm)		Acceptable Qty			L(Length)	W(Width)	Zone			A	B	C	Ignore	W 0.02	Ignore			L 3.0	0.02 < W 0.03	2			L 2.0	0.03 < W 0.05	1				0.05 < W	Define as spot defect			Minor
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4.2.3	Polarizer scratch	<p>If the Polarizer scratch can be seen after mobile phone cover assembling or in the operating condition, judge by the line defect of 4.2.2.</p> <p>If the Polarizer scratch can be seen only in non-operating condition or some special angle, judge by the following.</p> <table border="1"> <thead> <tr> <th colspan="2">Size(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th rowspan="2">L(Length)</th> <th rowspan="2">W(Width)</th> <th colspan="3">Zone</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>Ignore</td> <td>W 0.03</td> <td colspan="3">Ignore</td> </tr> <tr> <td>5.0 < L 10.0</td> <td>0.03 < W 0.05</td> <td colspan="3">2</td> </tr> <tr> <td>L 5.0</td> <td>0.05 < W 0.08</td> <td colspan="3">1</td> </tr> <tr> <td></td> <td>0.08 < W</td> <td colspan="3">0</td> </tr> </tbody> </table>	Size(mm)		Acceptable Qty			L(Length)	W(Width)	Zone			A	B	C	Ignore	W 0.03	Ignore			5.0 < L 10.0	0.03 < W 0.05	2			L 5.0	0.05 < W 0.08	1				0.08 < W	0			Minor
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4.2.4	Polarize Air bubble	<p>Air bubbles between glass & polarizer</p> <table border="1"> <thead> <tr> <th rowspan="2">2. Zone Size(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>0.2</td> <td colspan="3">Ignore</td> </tr> <tr> <td>0.20 < 0.30</td> <td colspan="3">2</td> </tr> <tr> <td>0.30 < 0.50</td> <td colspan="3">1</td> </tr> <tr> <td>0.50 <</td> <td colspan="3">0</td> </tr> </tbody> </table>	2. Zone Size(mm)	Acceptable Qty			A	B	C	0.2	Ignore			0.20 < 0.30	2			0.30 < 0.50	1			0.50 <	0			Minor										
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4.3. Cosmetic Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects						
4.3.5	Glass defect	<p>(i) Chips on corner</p>  <table border="1" data-bbox="475 528 1109 627"> <tr> <td>X</td> <td>Y</td> <td>Z</td> </tr> <tr> <td>2.0</td> <td>S</td> <td>Disregard</td> </tr> </table> <p>Notes: S=contact pad length Chips on the corner of terminal shall not be allowed to extend into the ITO pad or expose perimeter seal.</p>	X	Y	Z	2.0	S	Disregard	Minor
		X	Y	Z					
		2.0	S	Disregard					
<p>(ii) Usual surface cracks</p>  <table border="1" data-bbox="451 1061 1129 1160"> <tr> <td>X</td> <td>Y</td> <td>Z</td> </tr> <tr> <td>3.0</td> <td><Inner border line of the seal</td> <td>Disregard</td> </tr> </table>	X	Y	Z	3.0	<Inner border line of the seal	Disregard	Minor		
X	Y	Z							
3.0	<Inner border line of the seal	Disregard							
<p>(iii) Crack Cracks tend to break are not allowed.</p> 	Major								
4.3.6	Parts alignment	<p>1) Not allow IC and FPC/heat-seal lead width is more than 50% beyond lead pattern. 2) Not allow chip or solder component is off center more than 50% of the pad outline.</p>	Minor						
4.3.7	SMT	According to the <Acceptability of electronic assemblies> IPC-A-610C class 2 standard. Component missing or function defect are Major defect, the others are Minor defect.							

PRECAUTIONS FOR USING LCD MODULES

Handling Precautions

(1) The display panel is made of glass and polarizer. As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring. 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. Do not touch the display with bare hands. This will stain the display area and degraded insulation between terminals (some cosmetics are determined to the polarizer).

(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully. Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.). Do not put or attach anything on the display area to avoid leaving marks on. Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizer. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.

(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

Do not scrub hard to avoid damaging the display surface.

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

- Water
- Ketone
- Aromatic solvents

Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading. Avoid contacting oil and fats.

(7) 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.

(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) Electro-Static Discharge Control , Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential. Be sure to ground the body when handling the LCD modules.

- Tools required for assembling, such as soldering irons, must be properly grounded. make certain the AC power source for the soldering iron does not leak. When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.

- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions. To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended. As far as possible make the electric potential of your work clothes and that of the work bench the ground potential

- 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

(13) Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

- Do not alter, modify or change the shape of the tab on the metal frame.
 - Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
 - Do not damage or modify the pattern writing on the printed circuit board.
 - Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
 - Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
 - Do not drop, bend or twist LCM.

Storage Precautions

When storing the LCD modules, the following precaution is necessary.

- (1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for the dessicant.
- (2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C.
- (3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped).

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.

Precautions for Operation

(1) Viewing angle varies with the change of liquid crystal driving voltage (VLCD). Adjust VLCD to show the best contrast.

(2) It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage than the limit causes the shorter LCD life. An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.

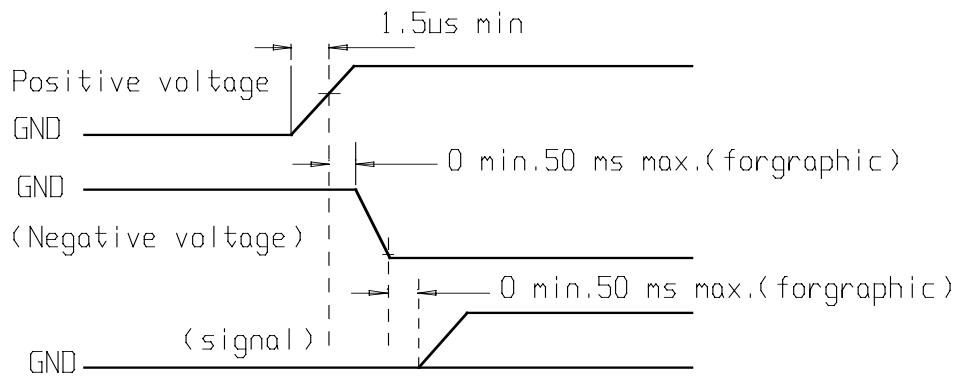
(3) Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operating temperature.

(4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.

(5) A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Usage under the maximum operating temperature, 50%RH or less is required.

(6) Input each signal after the positive/negative voltage becomes stable.

(7) 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.



Safety

(1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

(2) If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

Limited Warranty

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