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5. Maximum rating

[VSS=0V]

Item	Symbol	Min.	Max.	Unit
Supply voltage	VCC	-0.3	4.6	V
Supply voltage	IOVCC	-0.3	4.6	V
Input voltage	VI	-0.3	IOVCC + 0.3	V
Operating temperature	T _{OP}	-20	70	°C
Storage temperature	T _{STG}	-30	80	°C
Humidity	---	---	90	%RH

Note 1: Temp. > 60°C , 90% RH MAX

Temp. > 60°C , Absolute humidity shall be less than 90% RH at 60

Note 2: If the LSI is used above these absolute maximum ratings, it may become permanently damaged.

6. Electrical characteristics

6-1. TFT-LCD Module Electrical characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Input voltage range	VCI	2.5	2.8	3.3	V	-
Input voltage "H" level	VIH	0.7* IOVCC	-	IOVCC	V	-
Input voltage "L" level	VIL	0.0	-	0.3* IOVCC		-
output voltage "H" level	VOH	0.8* IOVCC	-	IOVCC		IOH=-0.1mA
output voltage "L" level	VOL	0	-	0.2* IOVCC		IOL=1.0mA
Current 1	VI1	-	-	-		mA
Current 2	VI2	-	-	-	mA	Sleep mode

Note:

1、Test Condition: IOVCC = 1.65 ~ 3.3V

6-2. Back-Light Electrical characteristics

The backlight system is an edge-lighting type with Four white LED (Light Emitting Diode).

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I _f	-	80	-	mA	-
Forward Voltage	V _f	3.0	3.2	3.4	V	I _f =80mA

Note (1): Four LEDs in parallel type.

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7. Electro-optical characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (2).

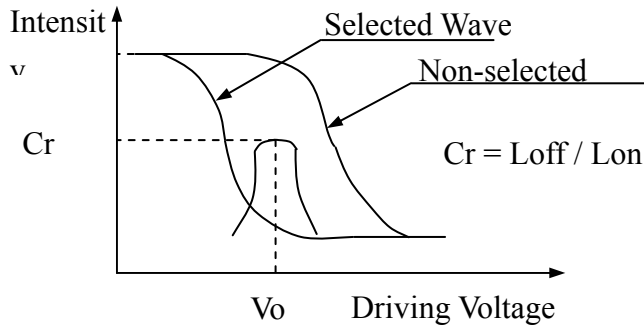
Measuring equipment: LCD-7200, BM-5A, PR-650, EZ-Contrast

(Ta = 25 ± 2°C, Reference only)

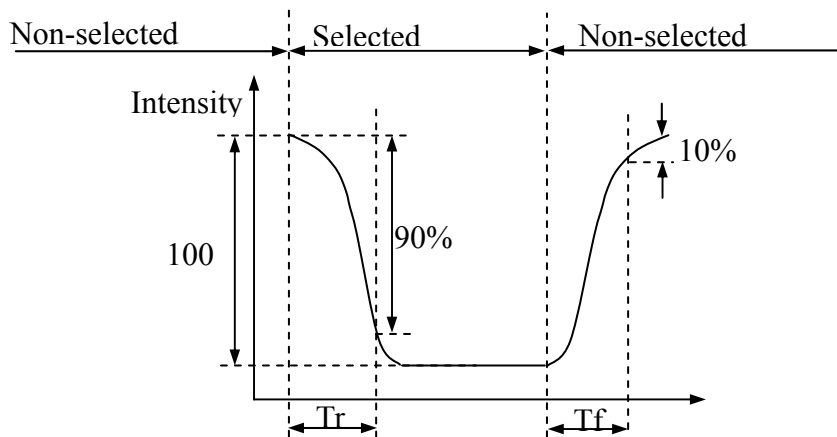
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Brightness		YL	$\theta = \phi = 0^\circ$	200	250	-	nits	
Contrast ratio (Center point)		C/R		-	300	-	-	Note(4)
Response time	Rising: Tr	Tr		-	10	-	msec	Note(2)
	Falling: Tf	Tf		-	15	-		
Color Chromaticity (CIE 1931)	White	Wx		0.278	0.308	0.338	-	C light
		Wy		0.309	0.339	0.369		
	Red	Rx		0.622	0.652	0.682		
		Ry		0.301	0.331	0.361		
	Green	Gx		0.284	0.314	0.344		
		Gy		0.545	0.575	0.605		
	Blue	Bx	0.108	0.138	0.168			
		By	0.102	0.132	0.162			
Viewing angle		$\theta F(D)$	C/R ≥ 10	-	-	-	Degrees	Note(3)
		$\theta B(U)$		-	-	-		
		ϕR		-	-	-		
		ϕL		-	-	-		

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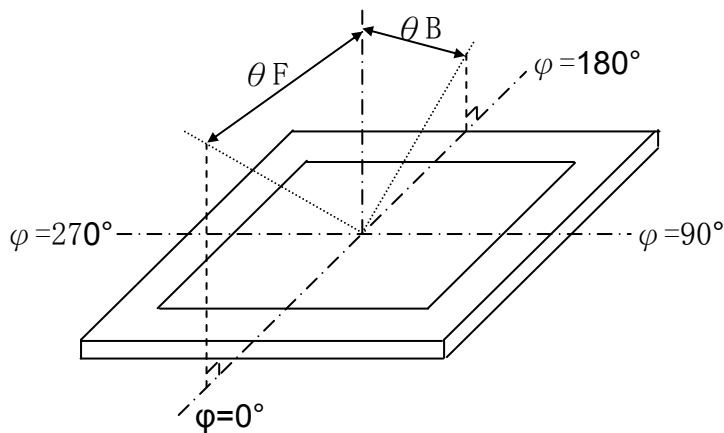
Note1: Definition of Operation Voltage (Vop)



Note2: Definition of Response Time (Tr, Tf)



Note3: Definition of Viewing Angle



Note4: Definition of Contrast Ratio:

$$CR = \text{White Luminance (ON)} / \text{Black Luminance (OFF)}$$

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8. I/O terminal

8-1. I/O connection

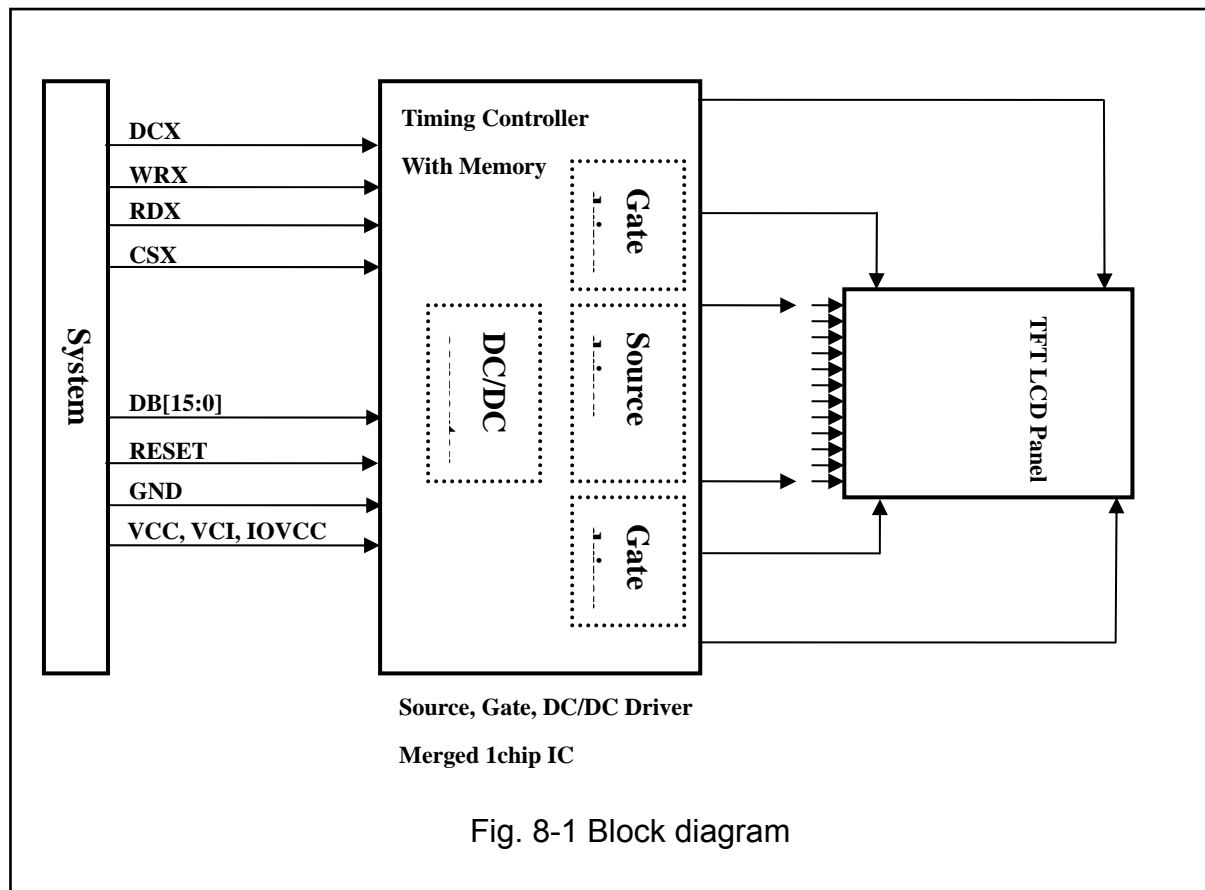
PIN NO.	PIN NAME	DESCRIPTION
1	DB0	Data bus
2	DB1	
3	DB2	
4	DB3	
5	GND	Power ground
6	IOVCC	I/O Power supply
7	CSX	Chip select signal input terminal, Active at 'L'
8	DCX	Register select signal input terminal: RS='H': control register; RS='L': index or status register.
9	WRX	Write signal input terminal, Active at 'L'.
10	RDX	Read signal input terminal, Active at 'L'.
11	IM0	8/16 bit select pin
12	NC	No Connect
13	NC	
14	NC	
15	NC	
16	LEDA	LED backlight anode (+)
17	LEDK1	LED backlight cathode (-)
18	LEDK2	
19	LEDK3	
20	LEDK4	
21	NC	No Connect
22	DB4	Data bus
23	DB8	
24	DB9	
25	DB10	
26	DB11	
27	DB12	
28	DB13	
29	DB14	

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30	DB15	
31	/RESET	Reset signal input terminal, active at 'L'
32	VCI	Power supply.
33	VCC	Power supply.
34	GND	Power ground
35	DB5	Data bus
36	DB6	
37	DB7	

8-2. Circuit block diagram

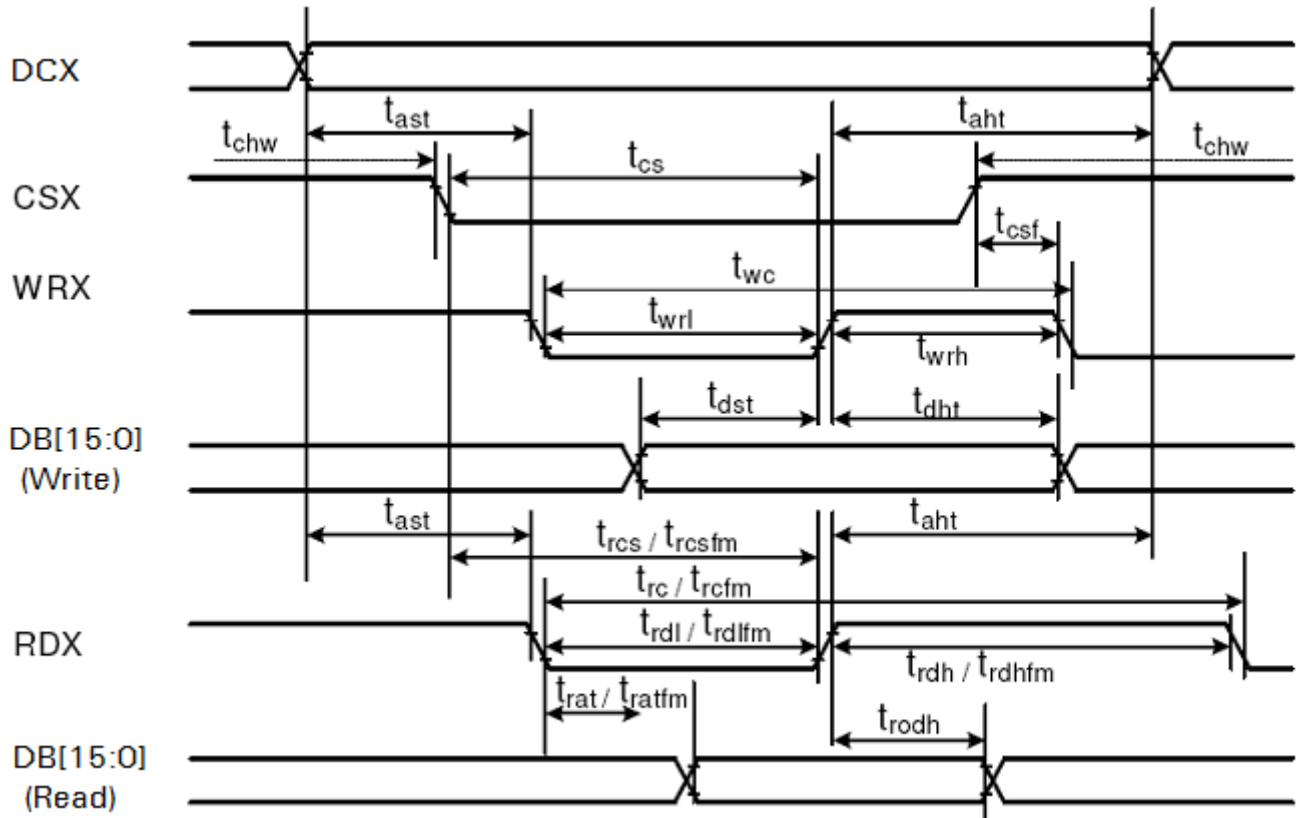
The circuit block diagram is shown in fig. 8-1.



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8-3. AC_CHARACTERISTICS

80 Parallel Write Interface Characteristics



Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	0	-	ns	
CSX	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
WRX	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
	twc	Write cycle	66	-	ns	
	twrh	Write Control pulse H duration	15	-	ns	
WRX	twrh	Write Control pulse H duration	15	-	ns	
	twrh	Write Control pulse L duration	15	-	ns	
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
DB[15:0] DB[8:0] DB[7:0]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

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9. Quality level

9-1. Inspection conditions

9-1-1. The environmental conditions for inspection shall be as follows.

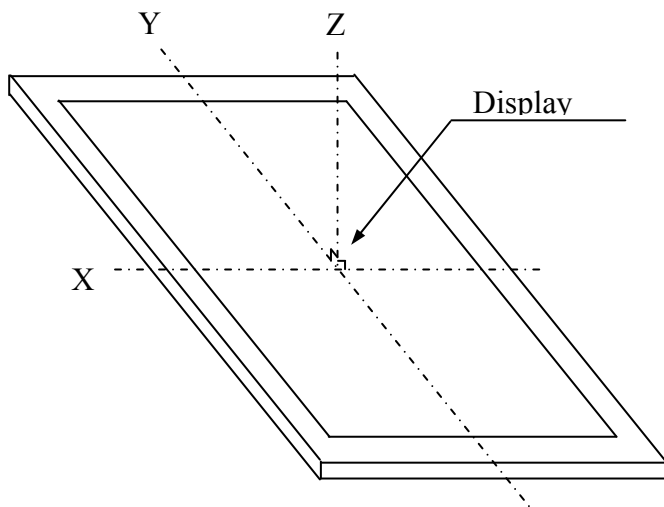
Room temperature : $20\pm 3^{\circ}\text{C}$

Humidity : $65\pm 20\% \text{RH}$

9-1-2. The external visual inspection

The inspection shall be performed by using a single 20W fluorescent lamp for illumination and the distance from LCD to eyes of the inspector should be 30cm or more.

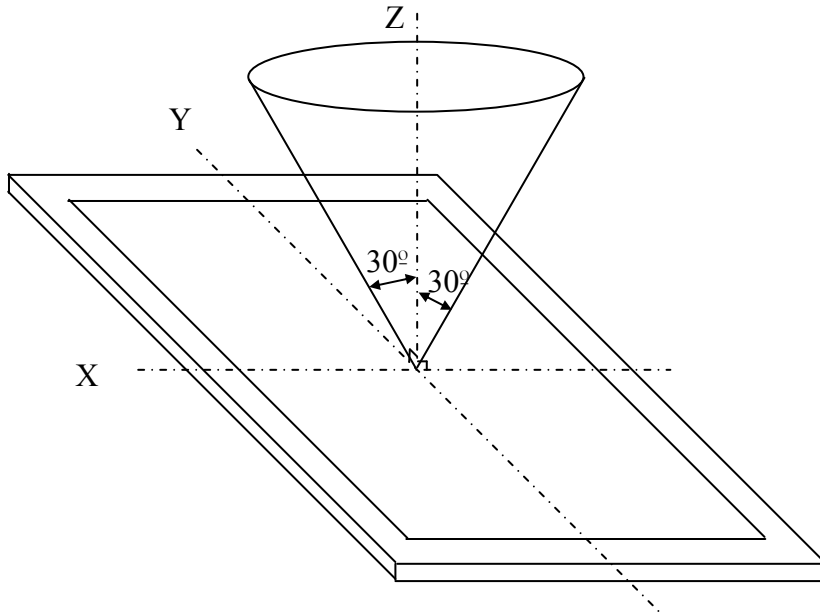
9-1-3. (1) Light method



Fluorescent lamp set the

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(2) Inspection distance and angle



Inspection should be performed within ϕ (ϕ is usually 30 degree) from Z axis to each X and Y axis. Inspection distance of any direction within ϕ must be kept $30\pm 5\text{cm}$ to the display surface.

9-2. Sampling procedures for each item's acceptance level table.

Defect type.	Sampling procedures	AQL
Major defect	MIL-STD-105E Inspection level 1 Normal inspection Single sample inspection	0.65
Minor defect	MIL-STD-105E Inspection level 1 Normal inspection Single sample inspection	1.5

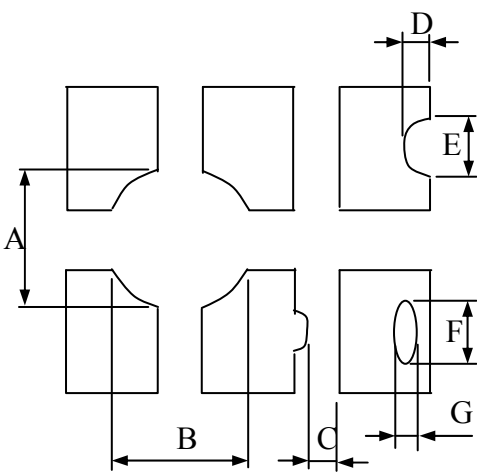
9-3. Classification of defects

9-3-1. Major defects: A major defect refers to a defect that is not considered to substantially degrade usability for product applications.

9-3-2. Minor defect: A minor defect refers to a defect which is not considered to substantially degrade product application or a defect which deviates from existing standards almost unrelated to the effective use of the product or it's operation.

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9-4. Incoming Inspection standards

Item	Criterion for defects	Defect type		
1) Display on inspection	(1) Non display (2) Vertical line is deficient (3) Horizontal line is deficient (4) Cross line is deficient	Major		
2) Black/White spot	Size \varnothing (mm)	Acceptable number	Minor	
	$\varnothing \leq 0.20$	Ignore (note)		
	$0.20 < \varnothing \leq 0.30$	3		
	$0.30 < \varnothing$	0		
Note: NG if four or more spot crowd together				
3) Black/White line	Length(mm)	Width(mm)	Acceptable number	Minor
	$L < 10$	$W < 0.05$	Ignore	
	$L < 10$	$0.05 \leq W < 0.1$	1	
	$L < 10$	$0.10 \leq W$	0	
	$L \geq 10$		0	
Defects separate at interval if 30mm each other				
Item	Criterion for defects	Defect type		
4) Display pattern		Minor		
	<table border="1" data-bbox="539 1758 1173 1803"> <tr> <td>$(A+B)/2 \leq 0.3$</td> <td>$0 < C$</td> <td>$(D+E)/2 \leq 0.15$</td> </tr> </table> <p>Note:</p> <ol style="list-style-type: none"> Up to 5 damages acceptable. NG if there're two or more pinholes per digit <p>[Unit: mm]</p>		$(A+B)/2 \leq 0.3$	$0 < C$
$(A+B)/2 \leq 0.3$	$0 < C$	$(D+E)/2 \leq 0.15$		

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5) Spot-like contrast irregularity	Size Ø (mm)	Acceptable number	Minor
	Ø≤0.2	Ignore (note)	
	0.2 <Ø≤0.4	3	
	0.4<Ø0.6	2	
	0.6<Ø	0	
Note: 1) Conformed to limit samples. 2) Defects separate at intervals of 50mm each other			
6) Bubble in polarizer	Size Ø (mm)	Acceptable number	Minor
	Ø≤0.2	Ignore (note)	
	0.2 <Ø≤0.4	3	
	0.4<Ø0.6	2	
	0.6<Ø	0	
Note: 1) Conformed to limit samples. 2) Defects separate at intervals of 50mm each			
7) Scratches and dent on the polarizer	Scratches and dent on the polarizer shall be in the accordance with. 1) Black/White spot. 2) Black/White line.		Minor
8) Stains on LCD panel surface	Stains which cannot be removed even when wiped lightly with a soft cloth or similar cleaning too		Minor
9) Rainbow color	The rainbow color of limited sample is allowed in the optimum contrast on state within the active area		Minor
10) Threshold voltage coloration	Non-uniform brightness at optimum contrast is not allowed and the criterion abides by standard samples		Minor
11) Viewing area encroachment	Polarizer edge or line is visible in the opening viewing area due to polarizer shortness or sealing line.		Minor

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12) Bezel appearance	Rust and deep damage which are visible in the bezel is retable.	Minor
13) Defect or land surface contact (Poor soldering)	(1) Failure to mount parts (2) Parts not in the specifications are mounted (3) Polarity for example is reversed	Major
15) Parts alignment	(1) LSI, IC lead width is more then 50% beyond pad outline.	Minor
	(2) Chip component is off center and more then 50% of the leads is off the pad outline.	Minor
16) Conductive foreign matter (Solder ball Solder chips)	(1) $0.45 < \varnothing \quad N \geq 1$	Major
	(2) $0.30 < \varnothing \leq 0.45 \quad N \geq 1$ \varnothing : Average diameter of solder ball (unit :mm)	Minor
	(3) $0.50 < L \quad N \geq 1$ L : Average length of solder ship (unit :mm)	Minor
17) PWB pattern damage	(1) Deep damage is found on copper foil and the pattern is nearly broken.	Minor
	(2) Damage on copper foil other than (1) above.	Minor
18) Faulty PWB correction	(1) Due to PWB copper foil pattern burnout, the pattern is connected, using a jumper wire for repair; 2 or more places are corrected per PWB.	Minor
	(2) Short circuited part is cut, and no resist coating has been performed.	Minor
19) Bezel claw	Bezel claw missing or not bent	Minor
20) Indication of name plate (sampling indication label)	(1) Failure to stamp or label error, or not legible. (all acceptable if legible) (2) The separation is more than 1/3 for indication discoloration In which the characters can be checked.	Minor

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10. Reliability

10-1. Life time

50,000 Hrs (25°C in the room without ray of sun)

10-2. Items of reliability

Item	Condition	Criterion
1) High temperature operating	60°C 96 hrs	No cosmetic failure is allowable. Contrast ratio should be between initial value $\pm 10\%$ Total current consumption should be below double of initial value.
2) Low temperature operating	-20°C 96 hrs	
3) Humidity	40°C, 90%RH, 96 hrs	No cosmetic failure is allowable. Contrast ratio should be between initial value $\pm 20\%$ Total current consumption should be below double of initial value.
4) High temperature storage	70°C 96 hrs	
5) Low temperature storage	-30°C 96 hrs	
6) Thermal shock storage	25°C→-30°C→25°C→80°C 5(min) 30(min) 5(min) 30(min) 5 cycle, 55~60%RH	
7) Vibration	10~55~10hz Amplitude: 1.5mm 2hrs for each direction (X,Y,Z)	No defect in cosmetic and operational function is allowable. Total current consumption should be below double of initial value.

Note: 1) No cosmetic failure' means there must be no permanent cosmetic defect and does not include any recoverable defect after 24 hours.

Note: 2) After any reliability test which is stated above, let it alone unpowered for 24 hours or more in a room temperature and check the criterion.

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11. Handling precautions

11-1. Mounting method

The LCD panel of ACROWISE Technology LCD module consists of two thin glass plates with polarizes which easily get damaged and the module is so constructed as to be fixed by utilizing fitting holes in the plastic cases. Extreme care should be used when handling the LCD modules.

11-2. Caution of LCD handling and cleaning

When cleaning the display surface, use soft cloth with solvent [recommended below] and wipe lightly

- ◆ Isopropyl alcohol
- ◆ Ethyl alcohol
- ◆ Trichlorotrifluoroethane

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

Do not use the following solvent:

- ◆ Water
- ◆ Ketone
- ◆ Aromatic

11-3. Caution against static charge

The LCD module use CMOS LSI drivers, so we recommended that you; Connect any unused input terminal to VCC or GND, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

11-4. Packing

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

11-5. Caution for operation

- ◆ It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit cause the shorter LCD life.

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An electrochemical reaction due to direct current drive should be avoided.

- ◆ 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.

- ◆ If the display area is pushed hard during operation. Some font will be abnormally displayed but it resumes normal condition after turning off once.
- ◆ As light dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

Usage under the relative condition of 40°C, 50%RH or less is required.

11-6. Storage

In the case of storing for a long period of time [for instance, for years] for the purpose or replacement use the following ways are recommended.

- ◆ Storage in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it. And with no desiccant.
- ◆ Placing in a dark place where neither exposure to direct sunlight nor light is, keeping the storage temperature.
- ◆ Storing with no touch on polarizer surface by anything else.

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

11-7. Safety

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

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12. Precaution for use

12-1. A limit sample should be provided by the both parties on an occasion when the both parties agreed its necessity.

Judgement by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

12-2. On the following occasions, The handling of problem should be decided through discussion and agreement between responsible of the both parties.

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

13. Revision History

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