

深圳市阿美林电子科技有限公司 Shenzhen Amelin Electronic Technology Co. Ltd.		
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Specifications

TFT-LCD module

Model No: AML-FRD350H45030-A

For Customer's Acceptance	
Approved by	Comment

	Signature	Date
Prepared by		
Checked by		
Approved by		

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1 General Description

AML-FRD350H45030-A is a transmissive type a-Si TFT-LCD (amorphous silicon thin film transistor liquid crystal display) module, which is composed of a TFT-LCD panel, a driver circuit a backlight unit, The panel size is 3.5inch and the resolution is 320x480. High image quality a-Si TFT LCD module. Partial-screen display function is available. Sleep and Stand-by modes are available for power saving.

1.1 Features

No	Item	Specification	Remark
1	Display Mode	Normally White	
2	Screen Size	3.5inch (diagonal)	
3	Resolution	320XRGBX480	
4	Color Number	262K	
5	Color Arrangement	TFT Active matrix	
6	Driver IC	ILI9488	
7	Back Light	White LED1*6	
8	Viewing Direction	12:00 DIRECTION	
9	Interface	3spi-18bit RGB	
10	Surface Treatment	UV Cut	
11	touch panel	With CTP	
12	Touch driver	FT6336G	

1.2 Application

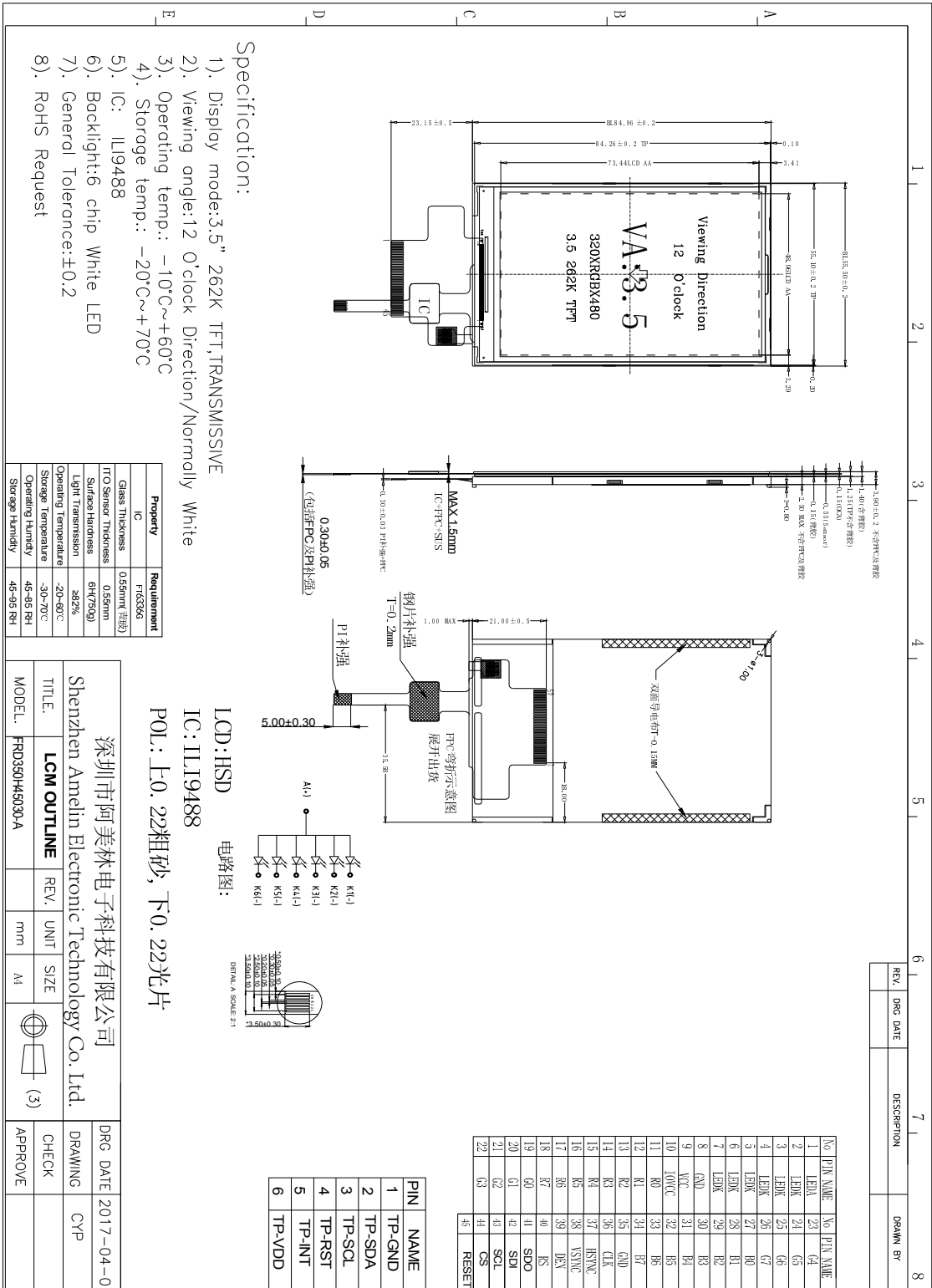
- ◆ Mobile phone.
- ◆ Portable multimedia device.

2 Outline Dimension

The mechanical detail is shown in Fig. 1 and summarized in Table 1 below.

Parameter	Specifications	Unit
Outline dimensions	55.50(W) x84.96(H) x 3.9(D) (LCM, not include FPC)	mm
Active area	48.96(W) x73.44(H)	mm
Resolution	320(H)RGBx 480(V) dots	-
Dot size	0.153(H) x 0.153(V)	mm

Figure 1: Module specification of the module



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3 Electrical Characteristics

3.1 TFT-LCD Module

Ta=25°C

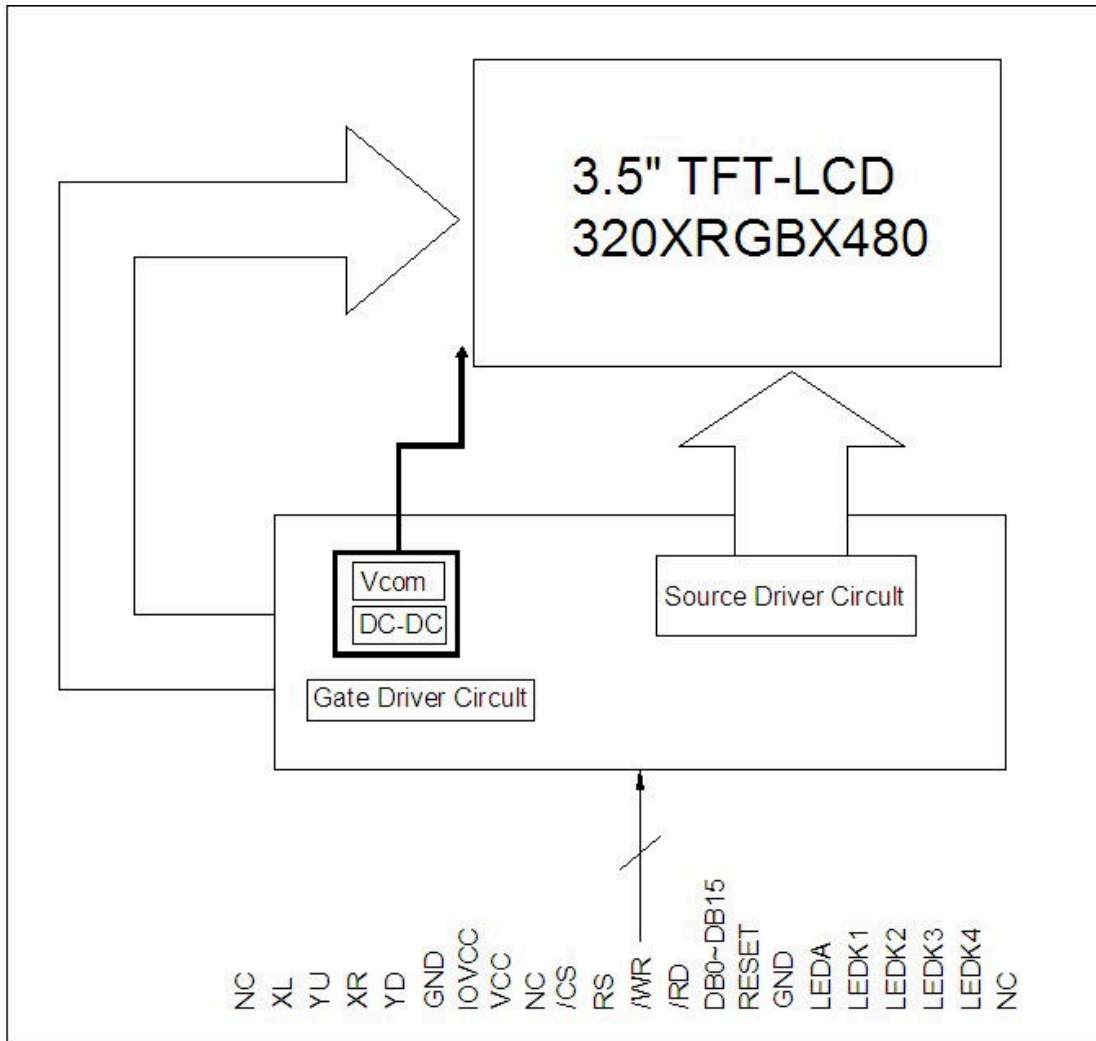
Item	Symbo	Value			Unit	Notes
		Min	Typ	Max		
Supply Voltage for logic	IOVCC	1.65	1.8	3.3	V	
	VCC	2.5	2.8	3.3		
Operating temperature	Top	-10		+60	°C	
Storage temperature	Tst	-20		+70	°C	

3.2 Back-Light Unit

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Current	IF	--	120	25	mA	IF=120mA VF=3.2V
Forward voltage	VF	-	3.2	-	V	
Chroma	X	-	TBD	-		
	Y	-	TBD	-		
Brightness	L	-	250		Cd/m2	
Uniformity	UBL	80			%	

- 6 LEDs used
- The luminous intensity of LED is strongly dependent on the driving current.
- It is recommended the input of backlight to be constant current rather than constant voltage.

4 Block Diagram



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5 TFT-LCM Interface Specification

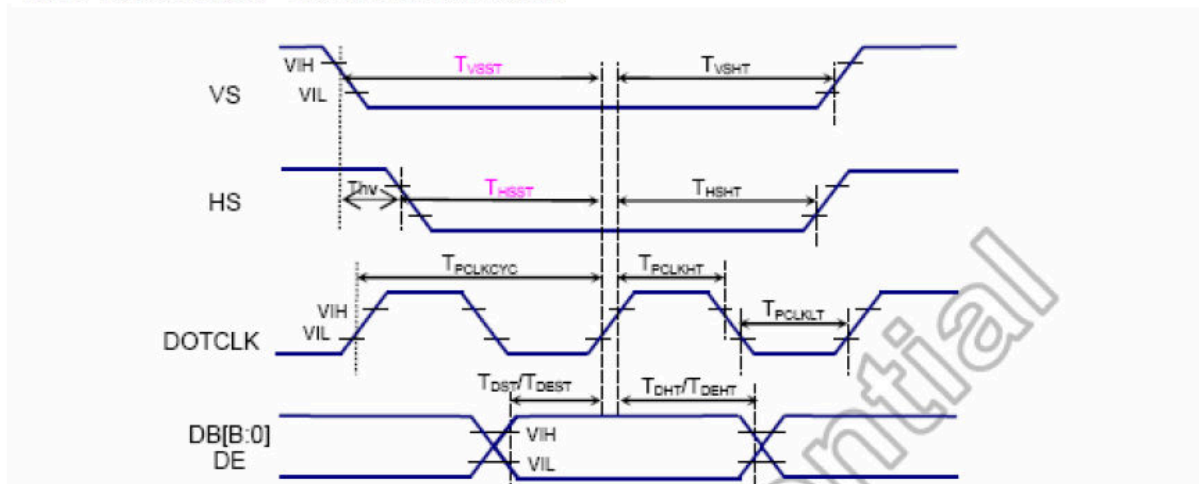
Pin No	Symbol	Description	Note
1	LEDA	Power supply Anode input for backlight	
2-7	LEDK	Power supply Cathode input for backlight	
8	GND	Ground	
9	VCC	Power supply input for LCM: 2.8	
10	IOVCC	Power supply input for I/O	
11-18	R0-R7	Red data bus	
19-26	G0-G7	Green data bus	
27-34	B0-B7	Blue data bus	
35	GND	Ground	
36	DOTCLK	High speed interface CLOCK differential signal input pins.	
37	HSYNC	Horizontal synchronizing signal in DPI interface. Let to open or connected to VSSD.	
38	VSYNC	Vertical synchronizing signal in DPI interface. Let to open or connected to VSSD	
39	DE	Data enable pin	
40	RS	Data or command select pin	
41	SDO		
42	SDA	serial data input/output bi-direction pin	
43	WRX/SCL	SCL pin as Serial Clock when operates in the serial interface	
44	CS	Chip select input signal	
45	/RESET	Reset signal input Pin	

CTP INTERFACE

Pin No	Symbol	Description	Note
1	GND	System Ground	
2	SDA(1.8V)	Serial data input signal	
3	SCL(1.8V)	Serial clock signal	
4	RESET(1.8V)	Reset Signal	
5	EINT(1.8V)	Interrupt signal	
6	VDD(2.8V)	Power supply input for CTP: 2.8V	

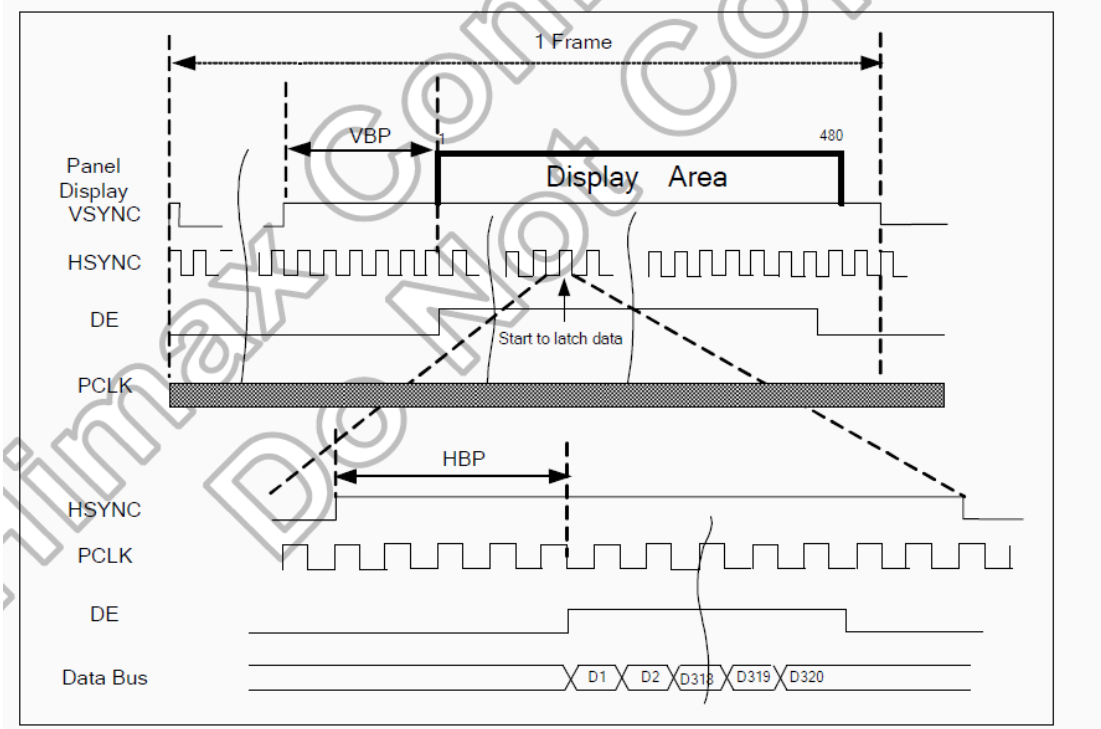
6 Description of Interface Signal

DPI interface characteristics

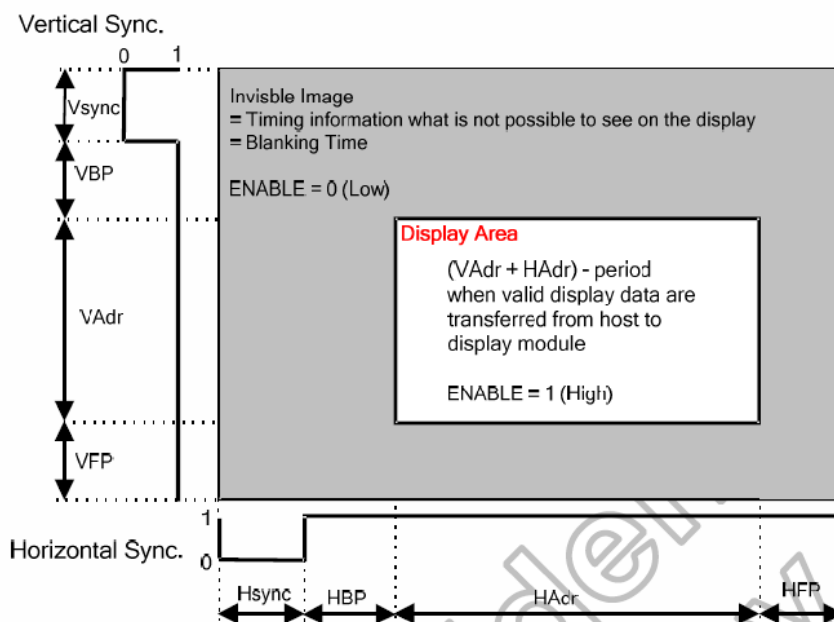


Item	Symbol	Condition	Spec.			Unit
			Min.	Typ.	Max.	
Pixel low pulse width	T_{CLKLT}		15	-	-	ns
Pixel high pulse width	T_{CLKHT}		15	-	-	ns
Vertical Sync. set-up time	T_{VSST}		15	-	-	ns
Vertical Sync. hold time	T_{VSHT}		15	-	-	ns
Horizontal Sync. set-up time	T_{HSST}		15	-	-	ns
Horizontal Sync. hold time	T_{HSHT}		15	-	-	ns
Data Enable set-up time	T_{DEST}		15	-	-	ns
Data Enable hold time	T_{DEHT}		15	-	-	ns
Data set-up time	T_{DST}		15	-	-	ns
Data hold time	T_{DHT}		15	-	-	ns
Phase difference of sync signal falling edge	Thv		0	-	320	Dotclk

DPI timing diagram



General timing diagram



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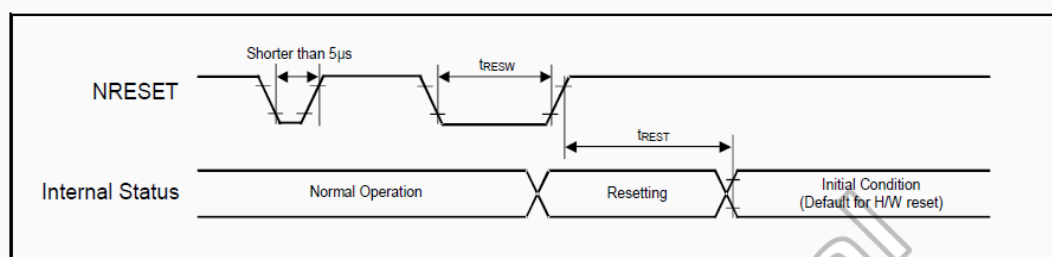
Power on/off sequence

Power source IOVCC, VCI can be applied and powered down in any order.
IOVCC, VCI can be powered down in any order.
During power off, if LCD is in the Sleep Out mode, IOVCC, VCI must be powered down minimum 120msec after NRESET has been released.
During power off, if LCD is in the Sleep In mode, IOVCC, VCI can be powered down minimum 0msec after NRESET has been released.
NCS can be applied at any timing or can be permanently grounded. NRESET has priority over NCS.

- Note:** (1) There will be no damage to the display module if the power sequences are not met.
(2) There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.
(3) There will be no abnormal visible effects on the display between end of Power on Sequence and before receiving Sleep Out command. Also between receiving Sleep In command and Power Off Sequence.
(4) If NRESET line is not held stable by host during Power on Sequence as defined in Sections 5.11.1.1 and 5.11.1.2, then it will be necessary to apply a Hardware Reset (NRESET) after Host Power on Sequence to ensure correct operation. Otherwise correct function is not guaranteed.

If NRESET line is not held stable by host during Power on Sequence as defined in Sections 5.9.1.1 and 5.9.1.2 then it will be necessary to apply a Hardware Reset (NRESET) after Host Power on Sequence is complete to ensure correct operation, otherwise correct functionality is not guaranteed. The power on/off sequence is illustrated as below

Reset Timing Characteristics



Symbol	Parameter	Related Pins	Spec.			Note	Unit
			Min.	Typ.	Max.		
tRESW	Reset low pulse width ⁽¹⁾	NRESET	10	-	-	-	µs
tREST	Reset complete time ⁽²⁾	-	5	-	-	When reset applied during SLPIN mode	ms
		-	120	-	-	When reset applied during SLPOUT mode	ms

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DC Characteristics (Vcc=2.4~ 3.3V, IOVcc=1.65-3.3V,Ta=-40 ~ 85°C)

Parameter	Symbol	Conditions	Spec.			Unit
			Min.	Typ.	Max.	
Power & Operating Voltages						
IO Operating voltage	IOVCC	I/O supply voltage	1.65	1.8	3.3	V
Driver Operating voltage	VCI	Operation voltage	2.5	2.8	3.3	
Source Drive Voltage	VSPROUT	Dual Pump				
	VSPROUT	Triple Pump				
	VSNROUT	Dual Pump				
	VSNROUT	Triple Pump				
Gate Drive High Voltage	VGH	VCI=2.8V Dual Pump (Typ:BT=001)				
		IVGH=80uA				
		IVGH=70uA				
		IVGH=60uA				
		IVGH=50uA				
Gate Drive Low Voltage	VGL	VCI=2.8V Dual Pump (Typ:BT=001)				
		IVGL=-80uA				
		IVGL=-70uA				
		IVGL=-60uA				
		IVGL=-50uA				
IVGL=-40uA						
Drive Supply Voltage	VGH-VGL	-	-	-	32	
Input / Output						
High level input voltage	VIH	-	0.7IOVCC	-	IOVCC	V
Low level input voltage	VIL	-	VSSD	-	0.3IOVCC	
High level output voltage	VOH	IOH = -1.0mA	0.8IOVCC	-	IOVCC	
Low level output voltage	VOL	IOL = +1.0mA	VSSD	-	0.2IOVCC	
Input leakage current	IIL	-	-1	-	1	μA
Oscillator frequency	fOSC	Frame rate at 60hz,default Vs and Hs setting Ta=25°C				MHz

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7.Optical Specification

Item	Symbol	Condition	Specification			Unit	Remark
			Min.	Typ.	Max.		
Response time (By Quick)	Tr+Tf	$\theta = 0^\circ$	-	20	40	ms	Note 5
Contrast ratio	CR	$\theta = 0^\circ$	-	500	-		Note 2,6
Viewing angle	Top	$CR \geq 10$	-	60	-	deg.	Note 2,6,7
	Bottom	$CR \geq 10$	-	60	-		
	Left	$CR \geq 10$	-	70	-		
	Right	$CR \geq 10$	-	70	-		
Color chromaticity (CF only with ITO, light source is C light, CIE 1931)	Wx	$\theta = 0^\circ$	0.292	0.307	0.322		Note 3
	Wy		0.312	0.327	0.342		
	Rx		0.609	0.624	0.639		
	Ry		0.316	0.331	0.346		
	Gx		0.281	0.296	0.311		
	Gy		0.562	0.577	0.592		
	Bx		0.128	0.143	0.158		
	By		0.094	0.109	0.124		
NTSC			57%	60%	-		Note 3
Cross talk	Ct		-	-	2%		Note 9
Transmittance	Trans		-	5.50%	-		Note 4

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Note 1: Ambient temperature = 25°C.

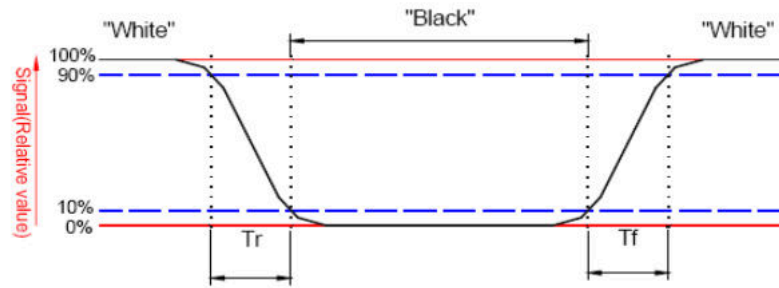
Note 2: To be measured with a viewing cone of 2° by Topcon luminance meter BM-5A.

Note 3: To be measured with Otsuta chromaticity meter LCF-2100M, CF only measure under C light simulation.

Note 4: CTC shipping status is cell without polarizer. Transmittance of Specification is cell with polarizer. The tolerance of Transmittance is $\pm 10\%$.

Note 5: Definition of response time:

The output signals of TRD-100 are measured when the input signals are changed to "White" (falling time) and from "White" to "Black" (rising time), respectively. The interval is between the 10% and 90% of amplitudes. Refer to figure as below.



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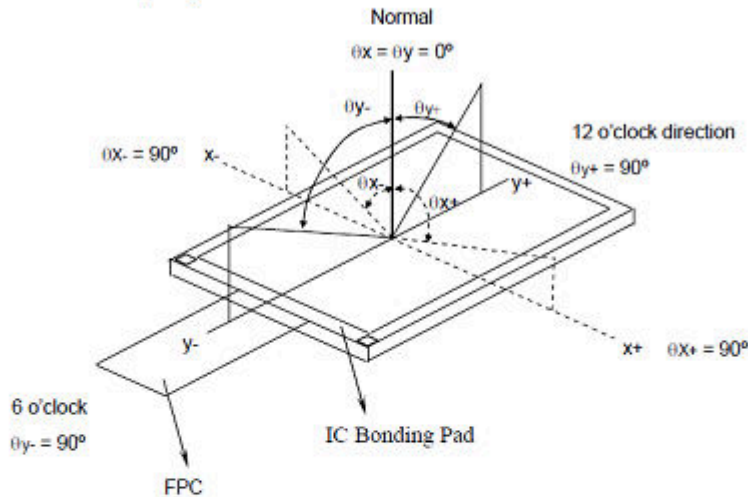
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Note 6: Definition of contrast ratio:

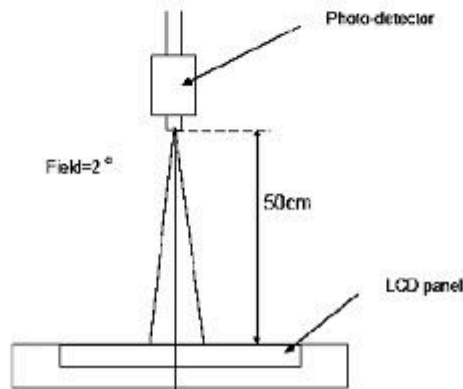
Contrast ratio is calculated by the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "white" state}}{\text{Brightness on the "black" state}}$$

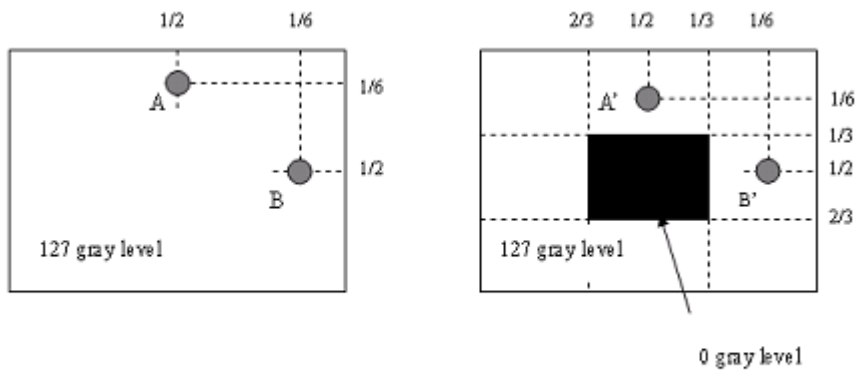
Note 7: Definition of viewing angle



Note 8: Optical characteristic measurement setup.



Note 9:



$|LA-LA'| / LA \times 100\% = 2\% \text{ max.}$, LA and LA' are brightness at location A and A'.

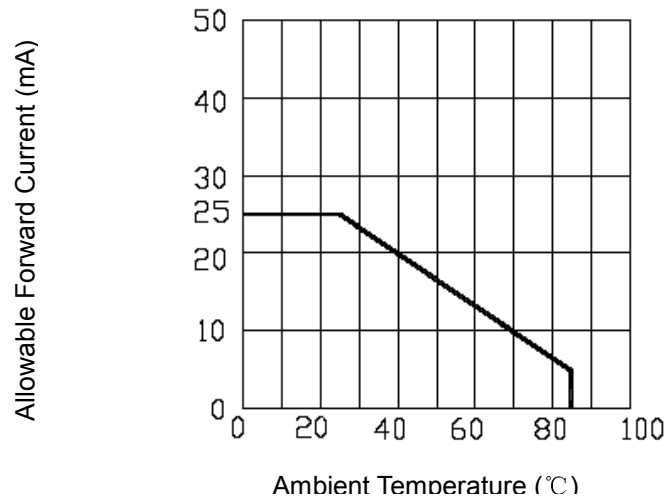
$|LB-LB'| / LB \times 100\% = 2\% \text{ max.}$, LB and LB' are brightness at location B and B'.

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8.Environment Absolute Maximum Ratings

Item	Symbol	Min	Max	Unit	Remark
Operation temperature range	Top	-20	70	°C	Ambient
Storage temperature range	Tst	-30	80	°C	Ambient

- Corrosive gas environment is not acceptable.
- TFT-LCD color will change slightly depending on environment temperature. This phenomenon is reversible. Current reduction rate of LED backlight is according to the graph indicated below:



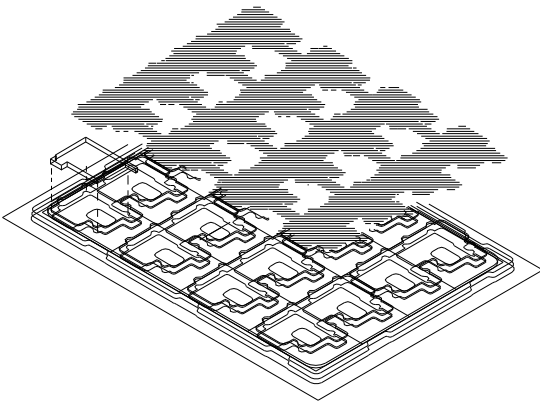
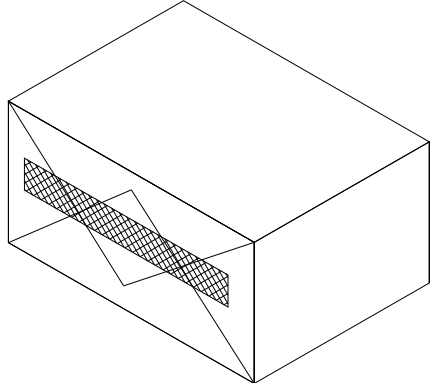
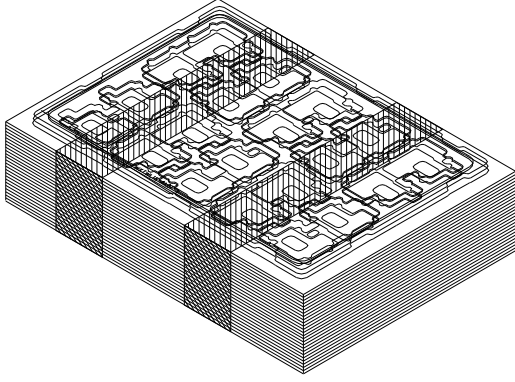
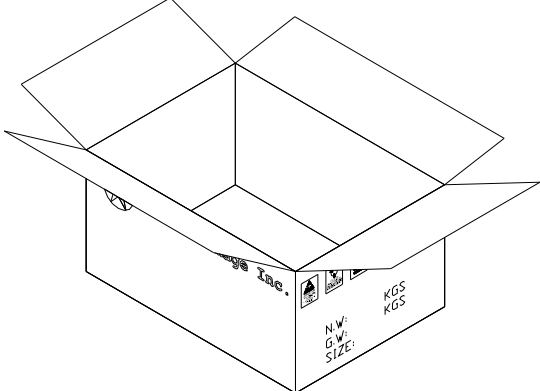
9.Reliability Test Items

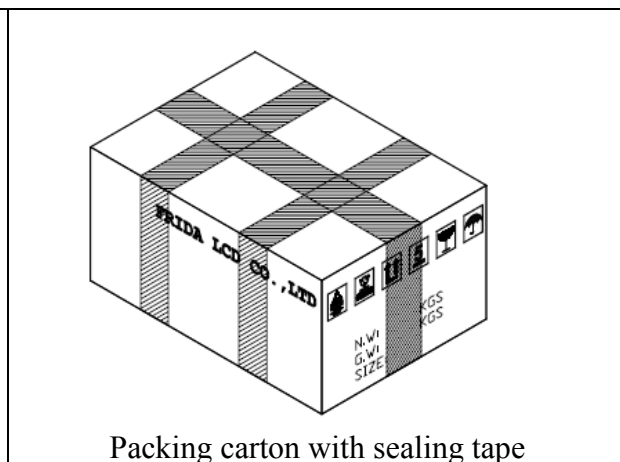
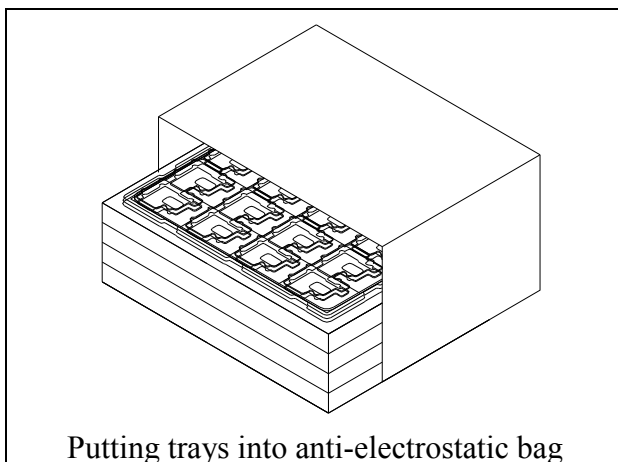
Item	Test Condition		Criterion
High Temperature Storage	80 °C, 120 hrs		There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.
Low Temperature Storage	-30 °C, 120 hrs		
High Temp. & High Humidity Storage	60 °C, 90% RH, 120 hrs		
Vibration Test (Non-operating)	Freq.:10~55~10 Hz, Amp.:1.5mm 1 hr for each direction of X, Y, Z		
Electrostatic Discharge Test (Non-operating)	Terminals	150 pF, 0 Ω, ±300 V, Contact	
	Panel	150 pF, 330 Ω, ±8 KV, Air	
Thermal Shock (Static)	-30°C, 30 min /80°C, 30 min, 20 cycles		
High Temperature Operation	70 °C, 120 hrs		

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Low temperature Operation	-20 °C, 120 hrs	
High Temperature & High Humidity (Operating)	50 °C, 90% RH, 120 hrs	
FPC Peeling Strength Test	Pull speed: 50 mm/min, +90°,	> 400gf/cm

10. Package

<p>1</p>  <p>16 pcs per tray + 1 cover (EPE)</p>	<p>4</p>  <p>Packing bag</p>
<p>2</p>  <p>25 trays + 1 dummy tray = 400 ps</p>	<p>5</p>  <p>Putting bag into carton Protected by 6 pieces of cushion EPE sheet</p>
<p>3</p>	<p>6</p>



11.Precautions

Please pay attentions to the followings as using the LCD module.

Handling

- (a) Do not apply strong mechanical stress like drop, shock or any force to LCD module. It may cause improper operation, even damage.
- (b) Because the polarizer is very fragile and easy to be damaged, do not hit, press or rub the display surface with hard materials.
- (c) Do not put heavy or hard material on the display surface, and do not stack LCD modules.
- (d) If the display surface is dirty, please wipe the surface softly with cotton swab or clean cloth.
- (e) Avoid using Ketone type materials (e.g. Acetone), Toluene, Ethyl acid or Methyl chloride to clean the display surface. It might damage the touch panel surface permanently. The recommended solvents are water and Isopropyl alcohol.
- (f) Wipe off water droplets or oil immediately.
- (g) Protect the LCD module from ESD. It will damage the LSI and the electronic circuit.
- (h) Do not touch the output pins directly with bare hands.
- (i) Do not disassemble the LCD module.
- (j) Do not lift the FPC of Touch Panel.

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Storage

- (a) Do not leave the LCD modules in high temperature, especially in high humidity for a long time.
- (b) Do not expose the LCD modules to sunlight directly.
- (c) The liquid crystal is deteriorated by ultraviolet. Do not leave it in strong ultraviolet ray for a long time.
- (d) Avoid condensation of water. It may cause improper operation.
- (e) Please stack only up to the number stated on carton box for storage and transportation. Excessive weight will cause deformation and damage of carton box.

Operation

- (a) When mounting or dismounting the LCD modules, turn the power off.
- (b) Protect the LCD modules from electric shock.
- (c) The Driver IC control algorithms stated above should always obeyed to avoid damaging the LSI and electronic circuit.
- (d) Be careful to avoid mixing up the polarity of power supply for backlight.
- (e) Absolute maximum rating specified above has to be always kept in any case. Exceeding it may cause non-recoverable damage of electronic components or, nevertheless, burning.
- (f) When a static image is displayed for a long time, remnant image is likely to occur.
- (g) Be sure to avoid bending the FPC to an acute shape, it might break FPC.
- (h) Most of the touch screens have air vent to equalize the inside air pressure to the outside one. The air vent must be open and liquid contact must be avoided as the liquid may be absorbed if the liquid is accumulated near the air vent.
- (i) For the fragility of ITO film, it should avoid to use too tapering pen as the input material.

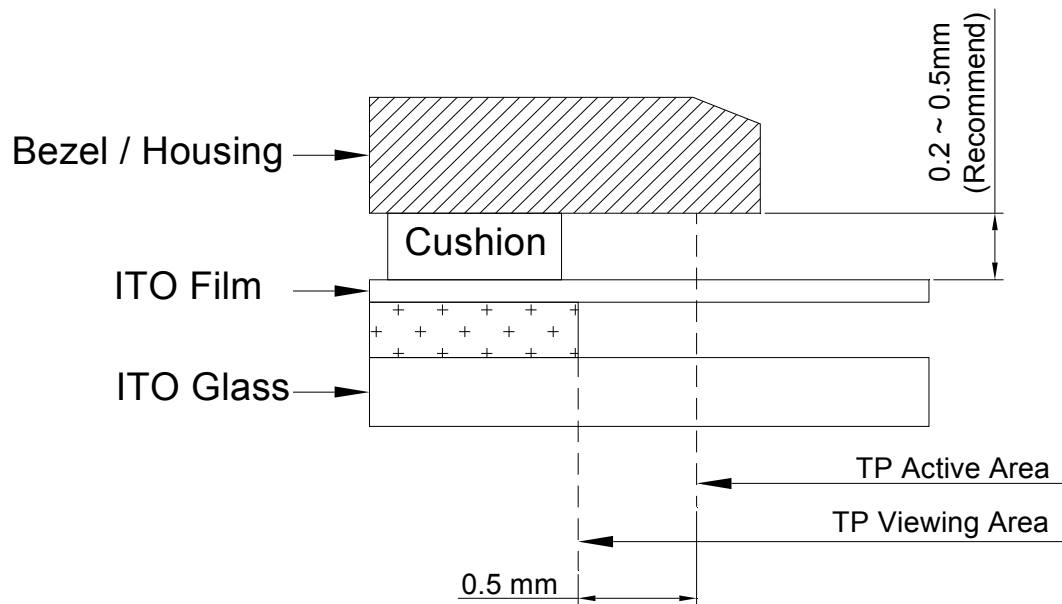
Touch Panel Mounting Notes

- (a) If a cushion is used between bezel/housing and film must be choose as free as enough to absorb the expansion and contraction to avoid the distortion of film.
- (b) The cushion must be placed out of the Viewing Area.
- (c) Bezel/Housing edge must be posited between Key Area and Viewing Area. The edge

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enters the Key Area may cause unexpected input if the gap is too narrow or foreign particles like dusts exist between Bezel/Housing and ITO film.

(d) Mounting example:



The corner part has conductivity. Do not touch any metal part after mounting.

Others

- If the liquid crystal leaks from the panel, it should be kept away from the eyes or mouth.
- For the fragility of polarizer, it is recommended to attach a transparent protective plate over the display surface.
- It is recommended to peel off the protection film on the polarizer slowly so that the electrostatic charge can be minimized.

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12. Incoming inspection standard

12.1 Description

These inspection standards shall be applied to 3.5TN (CTC panel) supplied by FRIDA co.,ltd

12.2 The environmental condition of inspection

The environmental condition and visual inspection shall be conducted as below

(1) Ambient temperature:15~25℃

(2) Humidity:25~75%RH

(3) External appearance inspection shall be conducted by using a single 20W fluorescent lamp or equivalent illumination.

Cell visual inspection on the operation condition for cosmetic shall be conducted at the distance 35cm or more between the LCD Cell and eyes of inspector. And, the visual inspection viewing angle should be with in the 45° to perpendicular line

Ambient Illumination: 400~600 Lux for external appearance inspection.

Ambient Illumination:100~200 Lux for light on inspection.

12.3 Inspection criteria

Definition of dot defect

Definition of defect

a) The definition of dot: The size of a defective dot over 1/2 of whole dot is regarded as one defective dot, and all brightness or dark dot defect must be visible through ND 5% filter

b) Bright dot: Dots appear bright and unchanged in size in which LCD Cell is displaying under black pattern.

c) Dark dot: Dots appear dark and unchanged in size in which LCD Cell is displaying under pure red, green, blue picture.

d) 2 dot adjacent=1pair=2dots



2 dot adjacent



2 dot adjacent



2 dot adjacent(vertical)

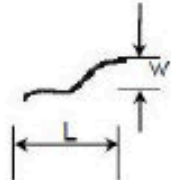
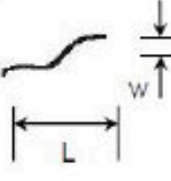


2 dot adjacent(slant)

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Light on display inspection criteria

01	Outline Dimension	In accord with drawing																									
02	Position-finding Dimension Assemble Dimension	In accord with drawing																									
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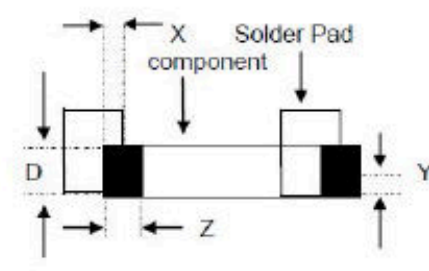
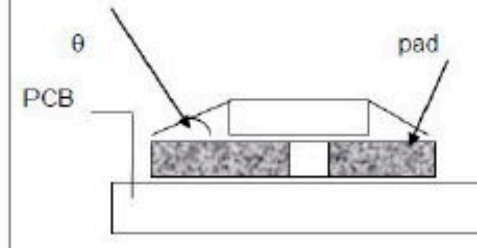
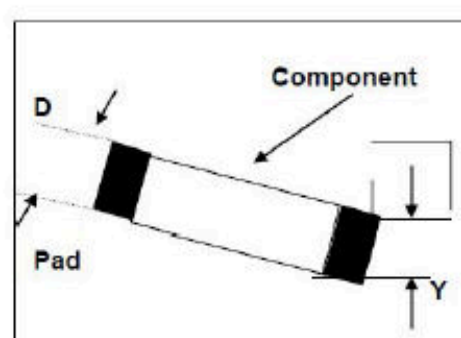
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-	$D > 0.05$	According to circle																						
			CSTN : If $W \geq 0.015$, unqualified Ignore beyond viewing area																					
05	LCD Scratch , Threadlike Fiber	Same to NO.3 circle sightline and surface of LCD is vertical (2)Same to NO.3 line style																						
06	POL	It is not admissible that POL is beyond the edge of glass, else, unqualified. It is essential that POL is over the 50 percent of width of frame , else ,unqualified. According to the drawing in case of special definition.																						
07	IC/FPC Bonding	Scratch	Reject																					

SPEC TITLE

DOCUMENT CONTROL SPECIFICATION

EFFECTIVE DATE : 2017-07-12

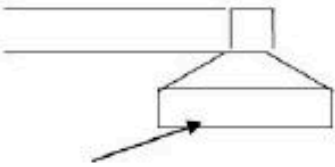
		Intensity Of Adhesion	If lower than specification, reject	
		Gold Fold Twist	Reject	
07	IC/FPC Bonding	Silicon	According to outline, no gold outside, seal can not be higher than LCD	
		FPC Gold Sever	Reject	
08	SMT	Lack of Component, Polarity Inverse	If exist, reject	
		Leak Solder, Virtual Solder	If exist, reject	
		Short Circuit In Solder Point	If exist, reject	
		Tin Ball	If exist, reject	
		Tin Acumination	If visual, reject	
		Height Solder Point	If higher 0.5mm than component. reject	
		Height of component	Either side higher 0.5mm than component, reject	

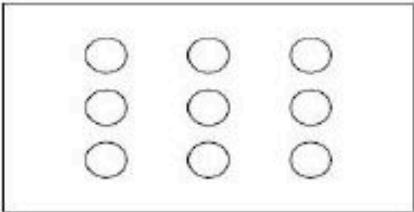
		Component Shift	 <p>$X < 3/4Z$ reject $y > 1/3D$ reject</p>
		Few Tin	 <p>If $\theta \leq 20^\circ$ reject</p>
08	SMT	Component Deflection	 <p>If $Y > 1/3D$ reject</p>
		Component Carcass Sideways	Reject

SPEC TITLE

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		Component Carcass Sideways	If exist with visual inspection , reject
		Lot Tin	A: Tin accrete the solder side completely , hollowly ,Ok B: Tin accrete the solder side completely , full circle arc , ok C: Jointing include whole solder side, height of tin>50 percent of height of component, reject
		Few Tin	A: Tin accrete the solder side completely , hollowly ,Ok B: height of tin > 1/3 of solder side of component , ok C: height of tin ≤ 1/3 of solder side of component, reject
08	SMT	<p style="text-align: center;">Normal</p>  <p style="text-align: center;">Jointing side</p>	
		Short circuit 、 Open circuit	Forbid
09	Light	Quality of CSTN Display	1、 Rolling strake with visual inspection, forbid 2、 Differentness of color in viewing area with visual inspection (full white、 red、 green、 blue), forbid 3 、 Display change with visual inspection , forbid

10	Color Of CIE Coordinate		x	y	Drive LCD under normal condition, 25℃ Φ=0 Θ=0 Test white, red, green blue with DMS Record
		white	±0.05	±0.05	
		Red	±0.05	±0.05	
		Green	±0.05	±0.05	
		Blue	±0.05	±0.05	
According to the specification or sample customer have approved					
11	Brightness	In accord with product specification	Drive condition is according to specification Measure location is in Follow Picture 3、 Adjust brightness instrument to zero , burrow against the surface of LCD , press "measure" , record when the display is steady. (YOKOGAWA-3298)		
			 <p style="text-align: center;">Measure location</p>		
12	CR (Max)	According to specification	According to product specification Measure instrument (DMS-501)		
13	Response time	According to specification	According to product specification Measure instrument (DMS-501)		
14	Viewing angle	According to specification	According to product specification Measure instrument (DMS-501)		
15	Vibration、 Ring	Compare with the sample customer supply	Compare with the sample customer supply when assemble		
16	Frequency Of FPC Bend	According to the use of product (main FPC of foldaway cell phone ≥6 thousand)	Measure instrument Bend angle : 150° Fix FPC in the casement when customer supply		

