LIQUID CRYSTAL DISPLAY MODULE

Product Specification

CUSTOMER	**Standard**
CUSTOMER PART NUMBER	
PRODUCT NUMBER	**DET28QVF1H-A**

Product Mgr	Design Eng
Bruno Recaldini	**Luo Luo**
Date: 28-Jun-13	Date: 28-Jun-13

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REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECN no.
0.1	05-Feb-13			Preliminary	
1.0	23-May-13			Production Release	
1.1	28-Jun-13	4,6	1,2.2	IC part number ILI9341→ILI9341V	
1.2	06-Mar-14	16 26	4.1 7.1	Updated colour coordinates Updated reliability tests conditions	

1 MAIN FEATURES

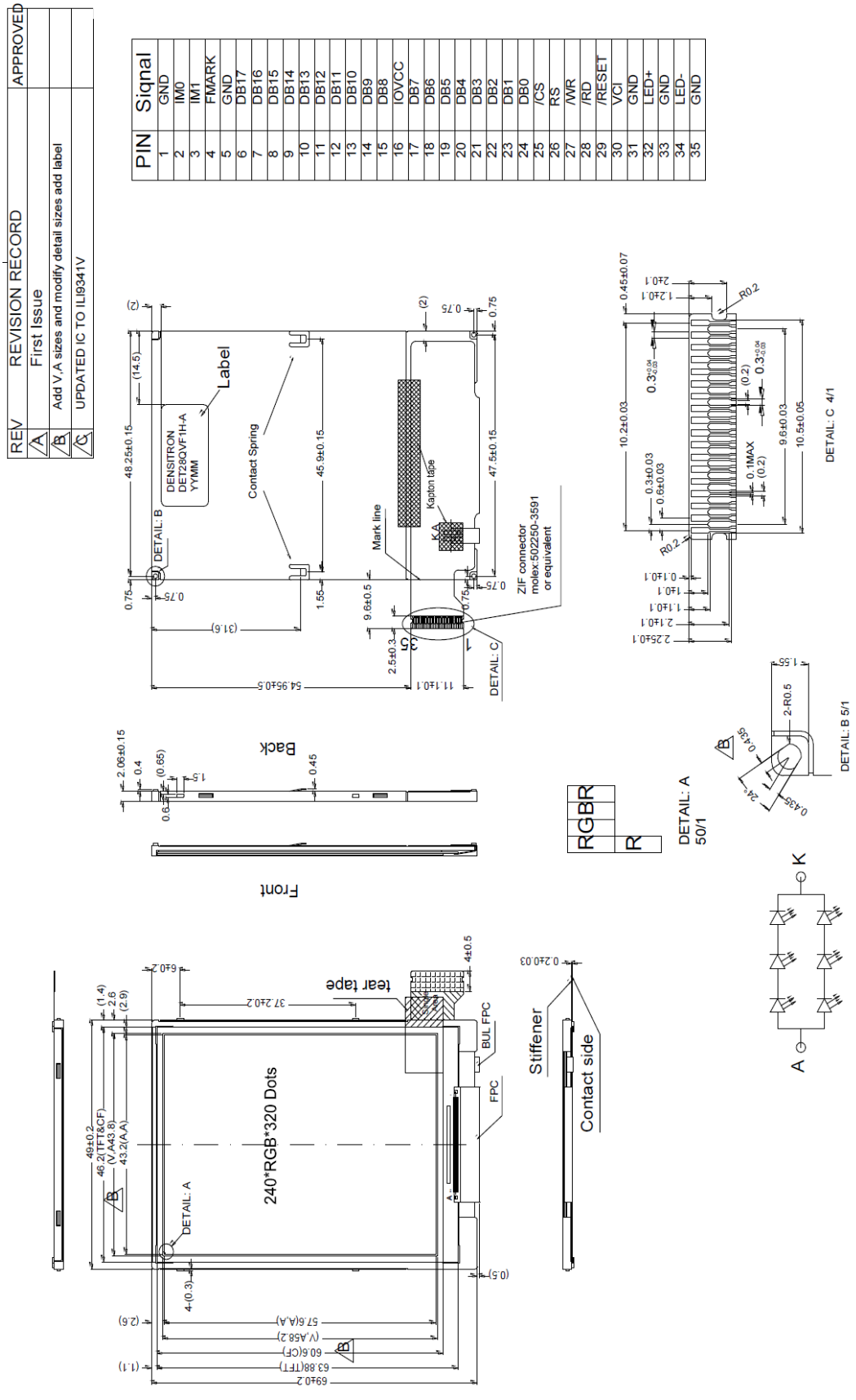
ITEM	CONTENTS
Screen Size	2.8” Diagonal
Display Format	240 x RGB x 320 Dots
N° of Colour	262K
Overall Dimensions	49 mm (H) x 69 mm (V) x 2.06 mm (D)
Active Area	43.2 mm (H) x 57.6 mm (V)
LCD Type	TFT
Mode	MVA Transmissive / Normally White
Viewing Direction	Full view
Interface	80-series CPU 8/9/16/18 bit selectable
Driver IC	ILI9341V or equivalent
Backlight Type	LED
Operating Temperature	-20°C ~ +70°C
Storage Temperature	-30°C ~ +80°C
RoHS compliant	Yes

2 MECHANICAL SPECIFICATION

2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	240 x RGB x 320 Dots	Dots
Overall Dimensions	49 mm (H) x 69 mm (V) x 2.06 mm (D)	mm
Viewing Area	43.8 (H) x 58.2 (V)	mm
Active Area	43.2 mm (H) x 57.6 mm (V)	mm
Dot Pitch	180 (H) x RGB x 180 (V)	µm
Weight	13	g

2.2 MECHANICAL DRAWING



3 ELECTRICAL SPECIFICATION

3.1 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit	Note
Power Supply Voltage	IOVCC, VCI	Ta=25˚C	-0.3	4.6	V	
Operating Temperature	TOP		-20	70	°C	1
Storage Temperature	TST		-30	80	°C	1,2,3

Note 1. 90 % RH Max for Ta<50 °C, and 60% RH for Ta≥50°C.
Note 2. In case of below 0°C, the response time of liquid crystal (LC) becomes slower and the colour of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's characteristic.
Note 3. Only operation is guaranteed at operating temperature. Contrast, response time, another display quality are evaluated at +25°C.

3.2 ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply Voltage	VCI		2.5	2.8	3.3	V	
	IOVCC		1.65	2.8	3.3	V	
Input Voltage for Logic	VIH		0.7xIOVCC	-	IOVCC	V	
	VIL		0	-	0.3xIOVCC	V	
Output Voltage for Logic	VOH		0.8xIOVCC	-	IOVCC	V	
	VOL		0	-	0.2xIOVCC	V	
Current Consumption	ICC		-	9		mA	1

Note 1: The specified power consumption is under the conditions of IOVCC=VCI=2.8V, FV=60Hz, whereas a Power dissipation check pattern below is displayed.

Black pattern

Active Area

3.3 INTERFACE PIN ASSIGNMENT

3.3.1 LCM PIN ASSIGNMENT

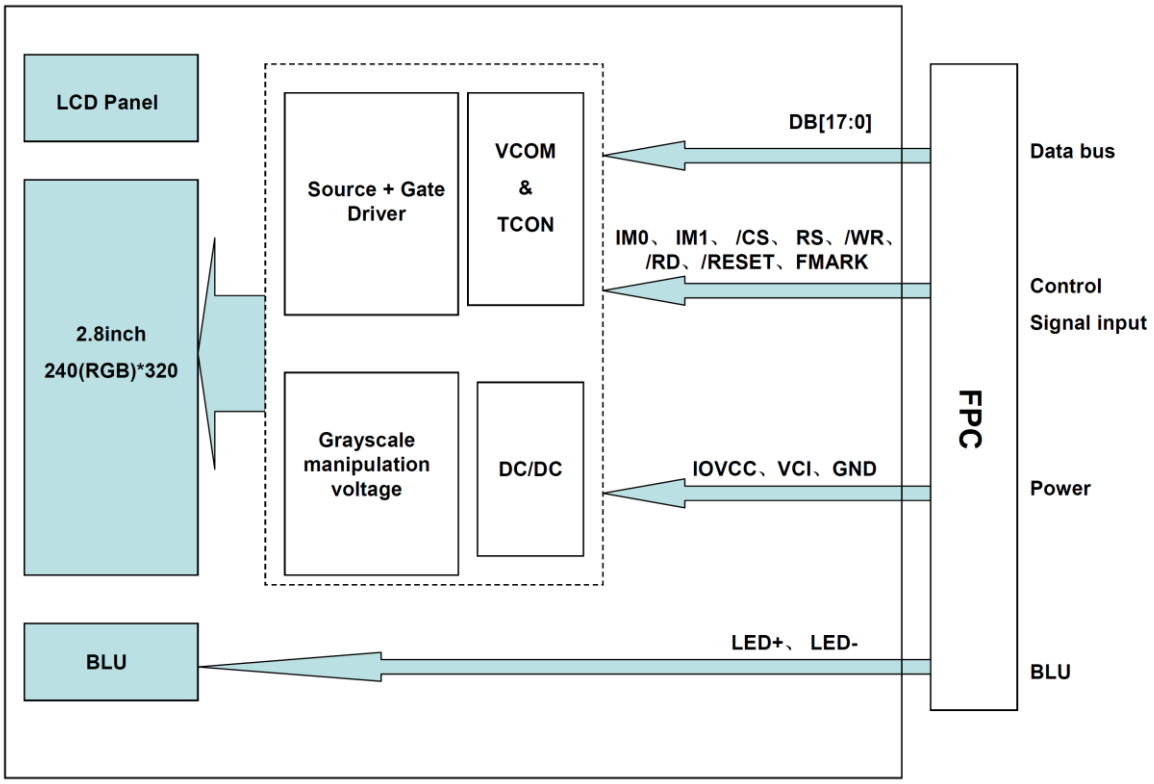
Recommended connector: Molex 502250-3591

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Function</th></tr>
<tr><td>1</td><td>GND</td><td>Ground</td></tr>
<tr><td>2
3</td><td>IM0
IM1</td><td>
<table>
<tr><th rowspan="2">IM1</th><th rowspan="2">IM0</th><th rowspan="2">Interface mode 80-series</th><th colspan="2">DB Pin in use</th></tr>
<tr><th>Register/Content</th><th>GRAM</th></tr>
<tr><td>0</td><td>0</td><td>CPU 16-bit Interface II</td><td>D[8:1]</td><td>D[17:10]
D[8:1]</td></tr>
<tr><td>0</td><td>1</td><td>CPU 8-bit I/F II</td><td>D[17:10]</td><td>D[17:10]</td></tr>
<tr><td>1</td><td>0</td><td>CPU 18-bit I/F II</td><td>D[8:1]</td><td>D[17-0]</td></tr>
<tr><td>1</td><td>1</td><td>CPU 9 bit I/F II</td><td>D[17:10]</td><td>D[17:9]</td></tr>
</table>
</td></tr>
<tr><td>4</td><td>FMARK (TE)</td><td>Frame head pulse signal (leave it Open if not used)</td></tr>
<tr><td>5</td><td>GND</td><td>Ground</td></tr>
<tr><td>6
7
8
9
10
11
12
13
14
15</td><td>DB17
DB16
DB15
DB14
DB13
DB12
DB11
DB10
DB9
DB8</td><td>Data bus

(connect unused pin(s) to VSS)</td></tr>
<tr><td>16</td><td>IOVCC</td><td>Digital power supply</td></tr>
<tr><td>17
18
19
20
21
22
23
24</td><td>DB7
DB6
DB5
DB4
DB3
DB2
DB1
DB0</td><td>Data bus

(connect unused pin(s) to VSS)</td></tr>
<tr><td>25</td><td>/CS (CSX)</td><td>Chip select signal active low</td></tr>
<tr><td>26</td><td>RS (DCX)</td><td>Display data (RS=H) / Command selection (RS=L)</td></tr>
<tr><td>27</td><td>/WR (WRX)</td><td>Write signal active low</td></tr>
<tr><td>28</td><td>/RD (RDX)</td><td>Read signal active low</td></tr>
<tr><td>29</td><td>/RESET (RESX)</td><td>Reset signal active low</td></tr>
<tr><td>30</td><td>VCI</td><td>Analogue power supply</td></tr>
<tr><td>31</td><td>GND</td><td>Ground</td></tr>
<tr><td>32</td><td>LED+</td><td>LED power supply (+)</td></tr>
<tr><td>33</td><td>GND</td><td>Ground</td></tr>
<tr><td>34</td><td>LED-</td><td>LED power supply (-)</td></tr>
<tr><td>35</td><td>GND</td><td>Ground</td></tr>
</table>

3.4 BLOCK DIAGRAM

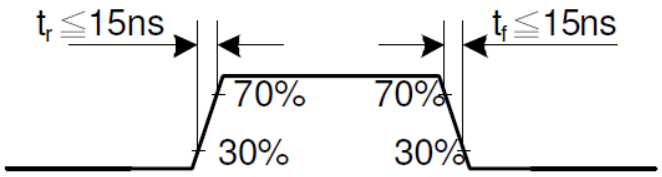


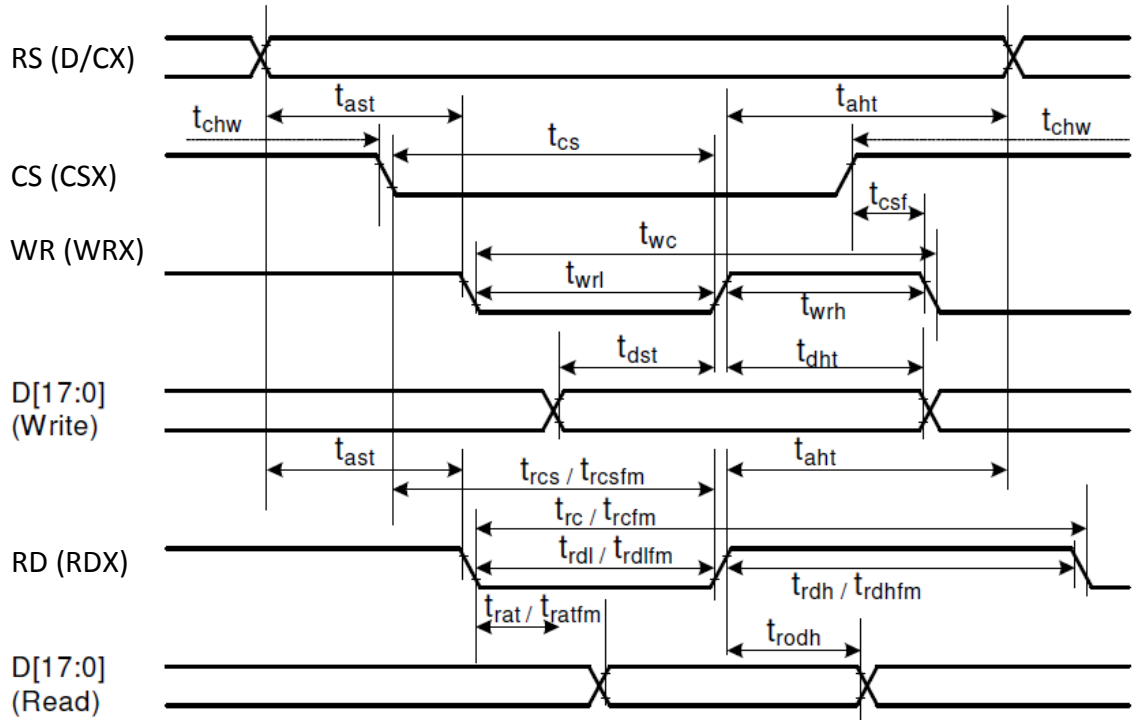
3.5 TIMING CHARACTERISTICS

Please refer to Ilitech IC ILI9341V datasheet for more information

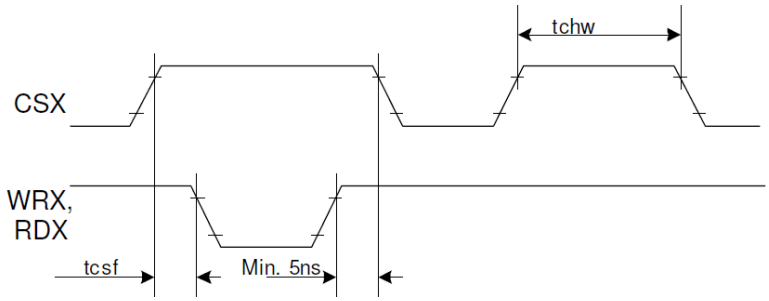
3.5.1 CPU 80-series Timing Characteristics (Interface II)

Item	Symbol		MIN	MAX	Unit	Remark
Address setup time	RS(DCX)	tast	0	-	Ns	
Address hold time (Write/Read)		taht	0	-	ns	
Chip select "H" pulse width	CS(CSX)	tchw	0	-	ns	
Chip select setup time (write)		tcs	15	-	ns	
Chip select setup time (Read ID)		trcs	45	-	ns	
Chip select setup time (Read FM)		trcsfm	355	-	ns	
Chip select Wait time (Write/Read)		tcsf	10	-	ns	
Write cycle	WR(WRX)	twc	66	-	ns	
Write Control pulse H duration		twrh	15	-	ns	
Write Control pulse L duration		twrl	15	-	ns	
Read cycle (FM)	RD(RDX (FM))	trcfm	450	-	ns	
Read Control H duration (FM)		trdhfm	90	-	ns	
Read Control L duration (FM)		trdlfm	355	-	ns	
Read cycle (ID)	RD(RDX (ID))	trc	160	-	ns	
Read Control H duration		trdh	90	-	ns	
Read Control L duration		trdl	45	-	ns	
Write data setup time	D[17:0], D[17:10] & D[8:1], D[17:10], D[17:9]	tdst	10	-	ns	For max CL=30pF
Write data hold time		tdht	10	-	ns	
Read access time		trat	-	40	ns	For min CL=8pF
Read access time (FM)		tratfm	-	340	ns	
Read output disable time		trod	20	80	ns	

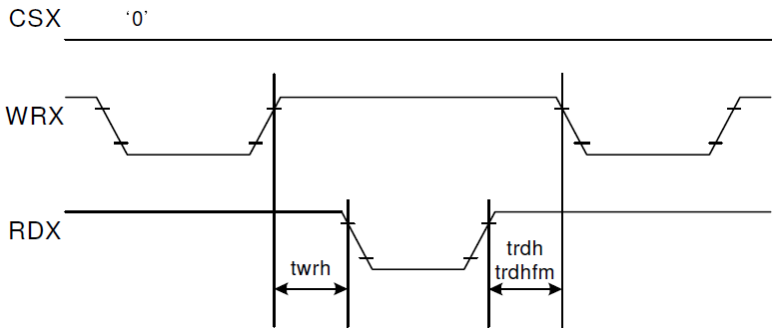




CS (CSX) timing:



Write to read or read to write timings [WR (WRX), RD (RDX)]:



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

3.6 COMMAND TABLE

Operational Code (HEX)	Function	Read/Write / Command	Number of Parameter	Parameters
00	No Operation	C	0	-
01	Software Reset	C	0	-
04	Read Display Identification Information	R	3	
09	Read Display Status	R	4	
0A	Read Display Power Mode	R	1	
0B	Read display MADCTL	R	1	
0C	Read Display Pixel Format	R	1	
0D	Read Display Image Mode	R	1	
0E	Read Display Signal Mode	R	1	
0F	Read Display Self Diagnostic Result	R	1	
10	Sleep In	C	0	-
11	Sleep Out	C	0	-
12	Partial Mode On	C	0	-
13	Normal Display Mode On	C	0	-
20	Display Inversion Off	C	0	-
21	Display Inversion On	C	0	-
26	Gamma Set	W	1	format: 1byte for curve selection
28	Display Off	C	0	-
29	Display On	C	0	-
2A	Column Address Set	W	4	format: 2 byte for leftmost Column counter 2 byte for rightmost Column counter
2B	Page Address Set	W	4	format: 2 byte for top line pointer 2 byte for bottom line pointer
2C	Memory Write	W	Any length	Successive video data stream Format in all colour modes
2E	Memory Read	R	Any length	Successive video data stream Format in all colour modes
30	Partial Area	W	4	format: 2 byte for top line pointer 2 byte for bottom line pointer

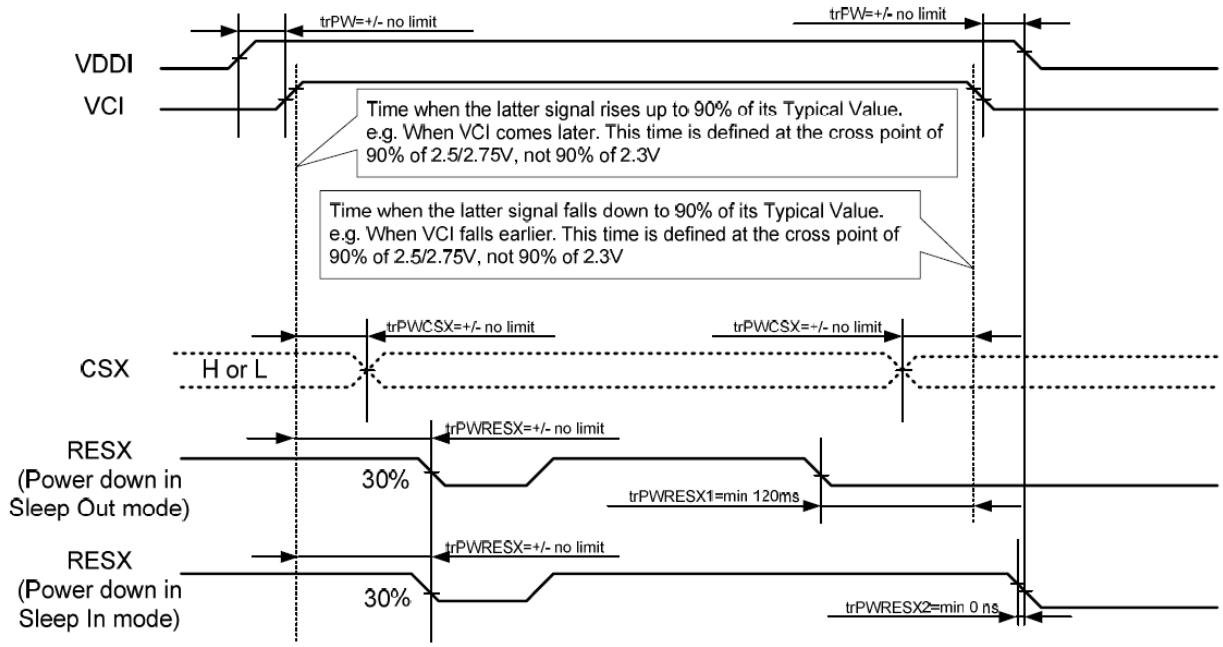
Operational Code (HEX)	Function	Read/Write / Command	Number of Parameter	Parameters
33	Vertical Scrolling Definition	W	6	format: 2 byte for fixed area top line pointer 2 byte for scrolling area height 2 byte for fixed area bottom line pointer
34	Tearing Effect Line Off	C	0	
35	Tearing Effect Line On	W	1	1 byte for Tearing Effect Line Mode selection
36	Memory Data Access Control	W	1	1 byte for memory scan direction
37	Vertical Scrolling Start Address	W	2	2 byte for line pointer
38	Idle Mode Off	C	0	-
39	Idle Mode On	C	0	-
3A	Interface Pixel Format	W	1	Refer to ILI9341V datasheet
DA	Read ID1	R	(1)	
DB	Read ID2	R	(1)	
DC	Read ID3	R	(1)	

3.7 POWER SEQUENCE

IOVCC and VCI can be applied in any order.
VCI and IOVCC can be powered down in any order.
During power off, if LCD is in the Sleep Out mode, VCI and IOVCC must be powered down minimum 120msec after RESET has been released.
During power off, if LCD is in the Sleep In mode, IOVCC or VCI can be powered down minimum 0msec after RESET has been released.
CS can be applied at any timing or can be permanently grounded. RESET has priority over CS.
Note 1: There will be no damage to the display module if the power sequences are not met.
Note 2: There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.
Note 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.
Note 4: If RESET line is not held stable by host during Power On Sequence as defined in Sections 3.7.1 and 3.7.2, then it will be necessary to apply a Hardware Reset (RESET) after Host Power On Sequence is complete to ensure correct operation. Otherwise function is not guaranteed.

3.7.1 Case 1 – RESET line is held High or Unstable by Host at Power ON

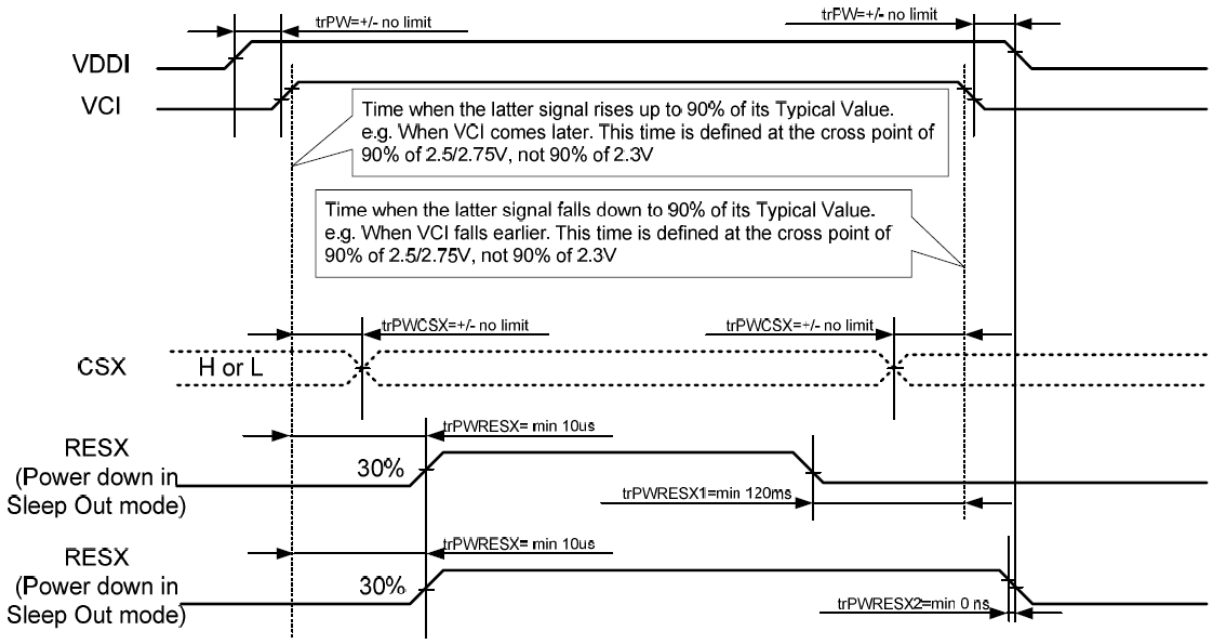
If RESET (RESX) line is held High or unstable by the host during Power On, then a Hardware Reset must be applied after both VCI and IOVCC have been applied – otherwise correct functionality is not guaranteed. There is no timing restriction upon this hardware reset.



trPWRESX1 is applied to RESET (RESX) falling in the Sleep Out Mode
trPWRESX2 is applied to RESET (RESX) falling in the Sleep In Mode

3.7.2 Case 2 – RESET line is held Low by Host at Power ON

If RESET (RESX) line is held Low (and stable) by the host during Power On, then the RESET must be held low for minimum 10µsec after both VCI and IOVCC have been applied.



trPWRESX1 is applied to RESET (RESX) falling in the Sleep Out Mode
trPWRESX2 is applied to RESET (RESX) falling in the Sleep In Mode

3.7.3 Uncontrolled Power Off

The uncontrolled power off means a situation when e.g. there is removed a battery without the controlled power off sequence. There will not be any damages for the display module or the display module will not cause any damages for the host or lines of the interface. At an uncontrolled power off event, ILI9341V will force the display to blank and will not be any abnormal visible effects within 1 second on the display and remains blank until “Power On Sequence” actives.

For other settings and details please refer to ILI9341V data sheet.

4 OPTICAL SPECIFICATION

4.1 OPTICAL CHARACTERISTICS

Measuring instruments: LCD-5100, Eldim, Topcon BM-7
Driving condition: IOVCC = VCI = 2.8V, VSS = 0V
Backlight: IF=40mA
Measured temperature: Ta ＝ 25° C

Item		Symbol	Condition	MIN	TYP	MAX	Unit	Note
Response Time		TR+TF	θ=Φ=0° Normal Viewing Angle	-	25	30	ms	2
Contrast Ratio		CR		400	500	-		3
Viewing Angle	Left	θL	CR ≥ 10	60	75	-	deg	4
	Right	θR		60	75	-	deg	
	Up	ϕU		60	75	-	deg	
	Down	ϕD		60	75	-	deg	
Colour Chromaticity	Red	Rx	CR ≥ 10	0.599	0.649	0.699	-	5
		Ry		0.281	0.331	0.381	-	
	Green	Gx		0.274	0.324	0.374	-	
		Gy		0.586	0.636	0.686	-	
	Blue	Bx		0.092	0.142	0.192	-	
		By		0.043	0.093	0.143	-	
	White	Wx		0.257	0.307	0.357	-	
		Wy		0.291	0.341	0.391	-	
Centre Brightness				280	350	-	cd/m²	6
Brightness Distribution				70	-	-	%	7

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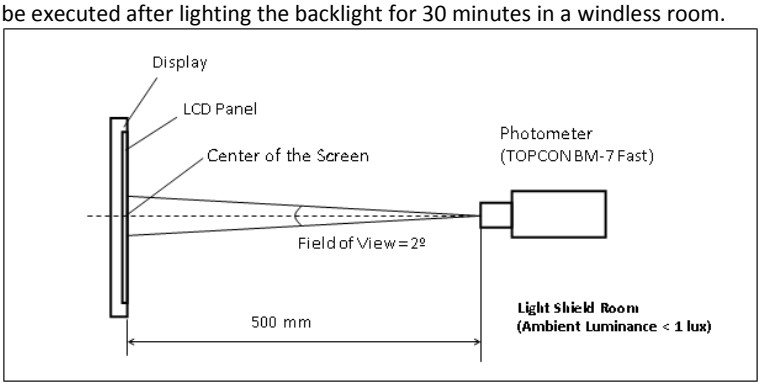
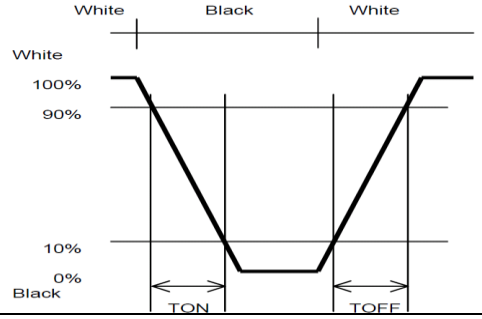
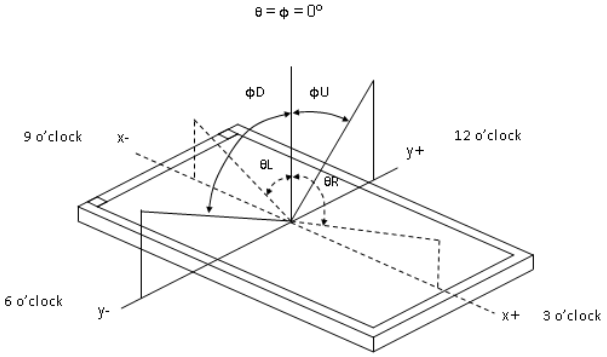
4.1.1 Test Method

Note	Item	Test method
1	Setup	The display should be stabilised at a given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilise the luminance, measurements should be executed after lighting the backlight for 30 minutes in a windless room. 
2	Response time	Measure output signal waveform by the luminance meter when raster of window pattern is changed from white to black and from black to white. 
3	Contrast ratio	Measure maximum brightness and minimum brightness at the centre of the screen by displaying raster or window pattern. Then calculate the ratio between these two values. Contrast Ratio (CR) = Brightness of unselected position (white) / Brightness of selected position (black)
4	Viewing angle Horizontal θ Vertical Ø	Move the luminance meter from right to left and up and down and determinate the angles where contrast ratio is 10 
5	Colour chromaticity	Measure chromaticity coordinates x and y of CIE1931 colorimetric system
6	Centre brightness	Measure the brightness at the centre of the screen
7	Brightness distribution	(Brightness distribution)= 100 x B/A % A: max. brightness of the 9 points B: min. brightness of the 9 points

5 BACKLIGHT SPECIFICATION

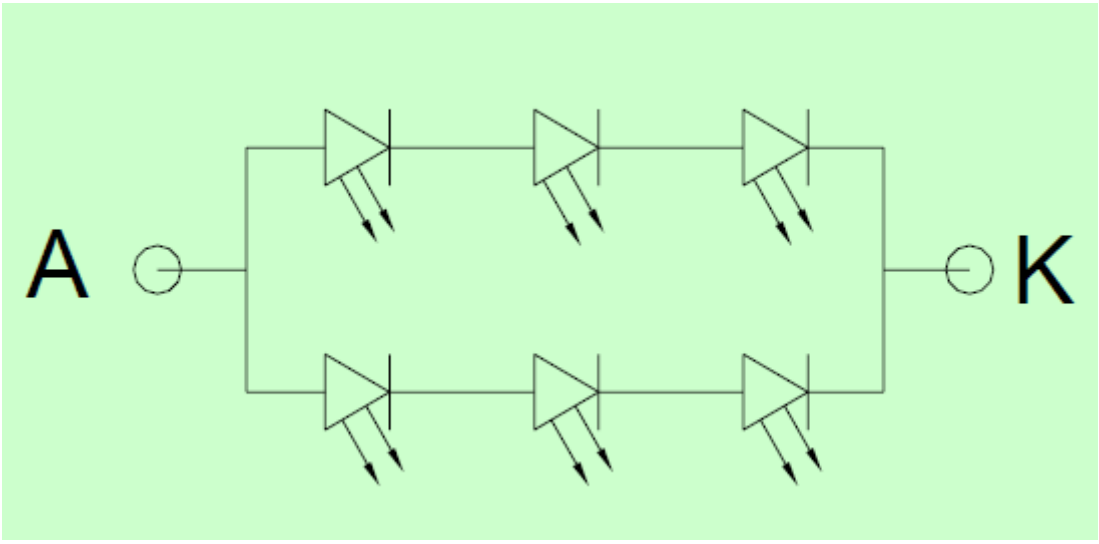
5.1 LED DRIVING CONDITIONS

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Current	IF	Ta=25 °C, VF=3.2V/LED	-	20*2	-	mA
Forward Voltage	VF	Ta= 25°C, IF= 20mA/LED	3.0*3	3.2*3	3.4*3	V
Power Consumption	PBL	Ta= 25°C, IL= 40mA	-	384	-	mW
Estimated Life of LED	LL	Ta= 25°C, IF= 40mA Note	(20000)	-	-	Hr
LED configuration	6 white LEDs (3 LEDs in one string and 2 groups in parallel)					

Note:

- The lifetime of the LED is defined as a period till the brightness of the LED decreases to the half of its initial value.
- This figure is given as a reference purpose only, and not a guarantee.
- This figure is estimated for an LED operating alone.
  The performance of an LED may differ when assembled as a monitor together with a TFT panel due to different environmental temperature.
- Estimated lifetime could vary on a different temperature and usually higher temperature could reduce the life significantly.

5.2 LED CIRCUIT

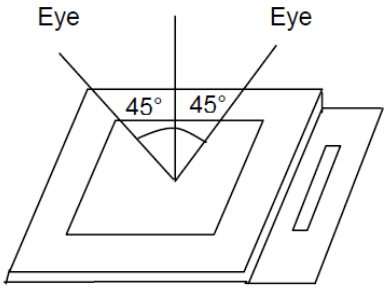


6 QUALITY ASSURANCE SPECIFICATION

6.1 DELIVERY INSPECTION STANDARDS

6.1.1 Inspection Conditions

Inspection distance: 30 cm ± 2 cm
Viewing angle: ±45°



6.1.2 Environmental Conditions

Ambient temperature: 23°C ±5°C
Ambient humidity: 55±10% RH
Ambient illumination: 1000~1500 lux

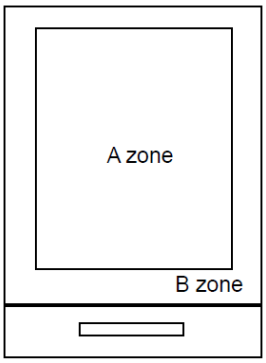
6.1.3 Sampling Conditions

1. Lot size: quantity of shipment lot per model
2. Sampling method:

Sampling Plan		ANSI / ASQC Z1.4-1993
		Normal inspection, Single Sampling
AQL	Major Defect	0.65%
	Minor Defect	1.5%

6.1.4 Definition of Area

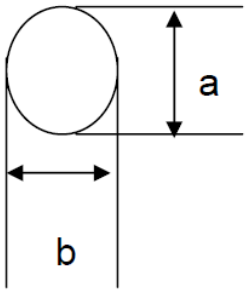
A zone: active area
B zone: viewing area

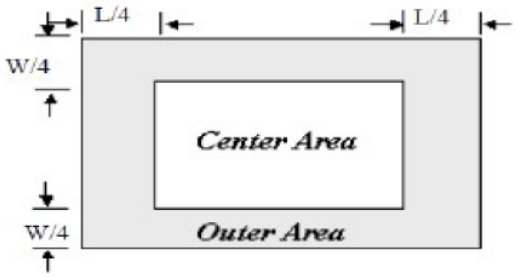


6.1.5 Basic Principle

A set of sample to indicate the limit of acceptable quality level shall be discussed should a dispute occur.

6.1.6 Inspection Criteria

<table>
<tr><th>No.</th><th>Item</th><th>Criteria (Unit: mm)</th></tr>
<tr><td>01</td><td>Black / White spot
Foreign material
(Round type)
Pinholes
Stain
Particles inside cell.
(Minor defect)</td><td>


φ= (a + b) /2
<table>
<tr><th>Area / Size</th><th>Acc. Qty</th></tr>
<tr><td>φ≤0.10</td><td>Ignore</td></tr>
<tr><td>0.10<φ≤0.15</td><td>2</td></tr>
<tr><td>0.15<φ≤0.25</td><td>1</td></tr>
<tr><td>0.25<φ</td><td>0</td></tr>
<tr><td>Total</td><td>2 no include
φ≤ 0.10</td></tr>
</table>
Distance between 2 defects should more than 3mm apart.
</td></tr>
<tr><td>02</td><td>Inactive Area
(Minor defect)</td><td>Line Criteria: L≦1mm, W≦0.1mm,
Dot Criteria: Please refer to Note 1,2&3
Note 1: Definition of Area


</td></tr>
</table>

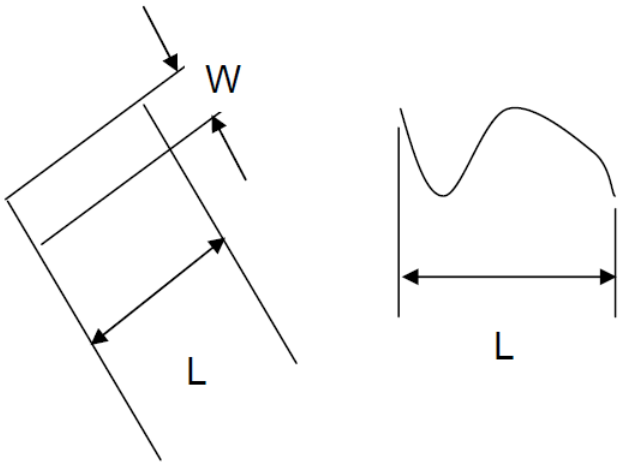
Note 2 :

Size	Inactive dot	Center	Outer	Total	Remark
All	Ø<0.2mm;	Is not counted			
≦5"	0.2≦Ø≦0.3mm; L≦1mm,W≦0.1mm	N≦1	N≦5	N≦6	
5~8"	0.2≦Ø≦0.5mm; L≦1mm,W≦0.1mm	N≦2	N≦5	N≦7	0.4≦Ø≦0.5mm,N≦1 is allowed at outer.)
8.1"~10.1"	0.2≦Ø≦0.5mm; L≦1mm,W≦0.1mm	N≦2	N≦10	N≦12	(0.4≦Ø≦0.5mm,N≦2 is allowed at outer.)

Note 3: Inactive area D < 0.2 mm is not counted without appearance observation.

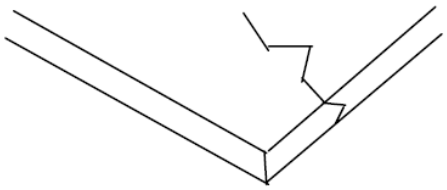
03

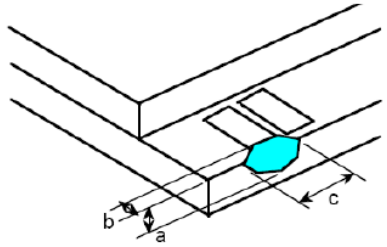
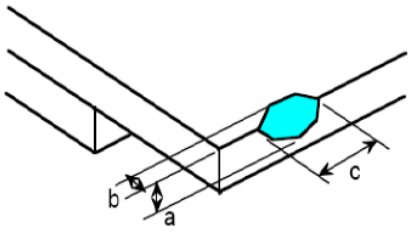
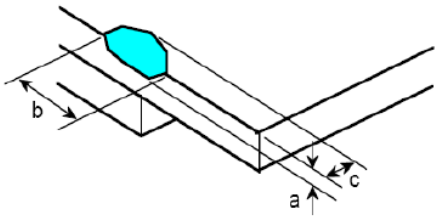
Black and White line
Scratch
Foreign material
(Line type)
(Minor defect)

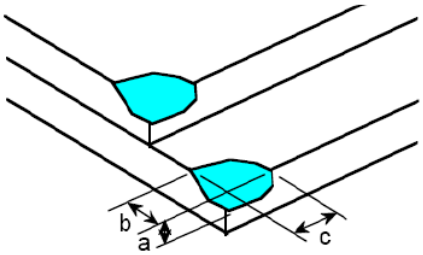
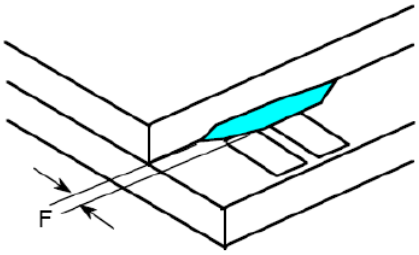


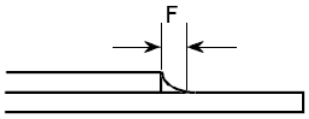
Length	Width	Acc. Qty
/	W ≦ 0.03	Ignore
L ≦ 2.5	0.03 < W ≦ 0.05	3
L ≦ 2.5	0.05 < W ≦ 0.10	2
/	0.1 < W	0
Total		3

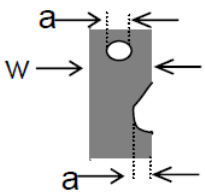
Distance between 2 defects should more than 3mm apart. Scratches not viewable through the back of the display are acceptable.

04	Glass Crack (Minor defect)	 Crack is potential to enlarge, any type is not allowed.

05	Glass Chipping Pad Area: (Minor defect) 	Length and Width / Acc. Qty c > 3.0, b< 1.0 / 1 c< 3.0, b< 1.0 / 3 a<Glass Thickness
06	Glass Chipping Rear of Pad Area: (Minor defect) 	Length and Width / Acc. Qty c > 3.0, b< 1.0 / 1 c< 3.0, b< 1.0 / 2 c< 3.0, b< 0.5 / 4 a<Glass Thickness
07	Glass Chipping Except Pad Area: (Minor defect) 	Length and Width / Acc. Qty c > 3.0, b< 1.0 / 1 c< 3.0, b< 1.0 / 2 c< 3.0, b< 0.5 / 4 a<Glass Thickness

<table>
<tr>
<td>08</td>
<td>Glass Corner Chipping:
(Minor defect)
 
</td>
<td><table>
<tr><th>Length and Width</th><th>Acc. Qty</th></tr>
<tr><td>c < 3.0, b< 3.0</td><td>Ignore</td></tr>
<tr><td colspan="2">a<Glass Thickness</td></tr>
</table></td>
</tr>
<tr>
<td>09</td>
<td>Glass Burr:
(Minor defect)
 



 </td>
<td><table>
<tr><th>Length</th><th>Acc. Qty</th></tr>
<tr><td>F < 1.0</td><td>Ignore</td></tr>
</table>
Glass burr don't affect assemble and module dimension.</td>
</tr>
<tr>
<td>10</td>
<td>FPC Defect:
(Minor defect)
 
</td>
<td>9.1 Dent, pinhole width a<w/3.
(w: circuitry width.)
9.2 Open circuit is unacceptable.
9.3 No oxidation, contamination and distortion.</td>
</tr>
</table>

<table>
<tr><td>11</td><td>Bubble on Polarizer
(Minor defect)</td><td><table><tr><th>Diameter</th><th>Acc. Qty</th></tr><tr><td>φ≤0.20</td><td>Ignore</td></tr><tr><td>0.20 <φ≤0.30</td><td>4</td></tr><tr><td>0.30 < φ</td><td>None</td></tr></table></td></tr>
<tr><td>12</td><td>Dent on Polarizer
(Minor defect)</td><td><table><tr><th>Diameter</th><th>Acc. Qty</th></tr><tr><td>φ≤0.20</td><td>Ignore</td></tr><tr><td>0.20 <φ≤0.30</td><td>4</td></tr><tr><td>0.30 < φ</td><td>None</td></tr></table></td></tr>
<tr><td>13</td><td>Bezel</td><td>12.1 No rust, distortion on the Bezel.
12.2 No visible fingerprints, stains or other contamination.</td></tr>
<tr><td>14</td><td>Touch Panel</td><td>D: Diameter W: width L: length
13.1 Spot: D<0.25 is acceptable
0.25≤D≤0.4
2dots are acceptable and the distance between defects should more than 10 mm.
D>0.4 is unacceptable
13.2 Dent: D>0.40 is unacceptable
13.3 Scratch: W≤0.03, L≤10 is acceptable,
0.03<W≤0.10, L≤10 is acceptable
Distance between 2 defects should more than 10 mm.
W>0.10 is unacceptable.</td></tr>
<tr><td>15</td><td>PCB</td><td>14.1 No distortion or contamination on PCB terminals.
14.2 All components on PCB must same as documented on the BOM/component layout.
14.3 Follow IPC-A-600F.</td></tr>
<tr><td>16</td><td>Soldering</td><td>Follow IPC-A-610C standard</td></tr>
<tr><td>17</td><td>Electrical Defect
(Major defect)</td><td>The below defects must be rejected.
16.1 Missing vertical / horizontal segment,
16.2 Abnormal Display.
16.3 No function or no display.
16.4 Current exceeds product specifications.
16.5 LCD viewing angle defect.
16.6 No Backlight.
16.7 Dark Backlight.
16.8 Touch Panel no function.</td></tr>
</table>

		16.9 Dark Dot –one Allowed. 16.10 Bright Dot – one Allowed. Remark: 1. A pixel defect is acceptable if one color is none functional and causes a bright dot. The display may have one case where one color is out and cause a dark dot. 2. Bright dot caused by scratch and foreign object accords to item 1.

Remark: LCD Panel Broken shall be rejected. Defect out of LCD viewing area is acceptable.

6.1.7 Classification of Defects

Visual defects (except no or wrong label) are treated as minor defects, while electrical defects are treated as major defects.
Two minor defects are equal to one major defect in lot sampling inspection.

6.1.8 Identification / marking criteria

Any unit with illegible / wrong / double or no marking / label shall be rejected.

6.2 DEALING WITH CUSTOMER COMPLAINTS

6.2.1 Non-conforming analysis

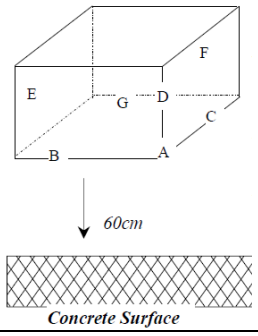
Purchaser should supply Densitron with detailed data of non-conforming sample.
After accepting it, Densitron should complete the analysis in two weeks from receiving the sample.
If the analysis cannot be completed on time, Densitron must inform the purchaser.

6.2.2 Handling of non-conforming displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.
Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.
Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

7 RELIABILITY SPECIFICATION

7.1 RELIABILITY TESTS

Test Item		Test Condition
Durability Test	High Temperature Storage	Ta= 80˚C 96h
	Low Temperature Storage	Ta=-30˚C 96h
	Temperature Cycle Storage	-30°C for 30 min, then 80°C for 30 min, 10 cycles
	High Temperature Operation	Tp= 70°C 96h
	Low Temperature Operation	Tp= -20°C 96h
	High Temperature & Humidity Operation	Tp= 60°C RH= 90% 96h Non condensing
	Packaging vibration	Frequency range: 10Hz ~ 55Hz Amplitude of vibration: 1.5 mm Sweep time: 12 minutes X,Y,Z 2 hours in each direction
	Electrical Static Discharge	Air: ±4kV 150pF / 330Ω 5 times
		Contact: ±2kV 150pF / 330Ω 5 times
	Drop Test	To be measured after dropping from 60cm high on concrete surface in packing state.  Corner dropping A corner: once Edge dropping B, C, D edge: once Face dropping E, F, G face: once

Note: Ta=ambient temperature Tp= Panel temperature

Notes:
1. No dew condensation to be observed.
2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
3. No cosmetic or functional defects should be allowed.
4. Total current consumption should be less than twice the initial value.

8 HANDLING PRECAUTIONS

Safety
If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Mounting and Design
Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface.
When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean.
Design the system so that no input signal is given unless the power supply voltage is applied.

Caution during LCD cleaning
Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotriflorothane.
Do not wipe the display surface with dry or hard materials that will damage the polariser surface.
Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

Caution against static charge
As the display uses C-MOS LSI drivers, connect any unused input terminal to VDD or VSS. Do not input any signals before power is turned on. Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

Packaging
Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height. To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

Caution during operation
It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life. Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation. Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged. If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once. Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

Storage
Store the display in a dark place where the temperature is 25°C ± 10°C and the humidity below 50%RH.Store the display in a clean environment, free from dust, organic solvents and corrosive gases.
Do not crash, shake or jolt the display (including accessories).