

# LIQUID CRYSTAL DISPLAY MODULE

## Product Specification

<b>PRODUCT NUMBER</b>	<b>84-0189-000T</b>
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INTERNAL APPROVALS		
Product Manager	Engineering	Document Control
Date:	Date:	Date:

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**REVISION RECORD**

<b>Rev.</b>	<b>Date</b>	<b>Page</b>	<b>Par.</b>	<b>Comment</b>	<b>ECN no.</b>
A	4/24/13	--	--	Preliminary DCA Release	E4791
B	5/17/13	15~17	--	Added jumper settings	E4805
C	5/28/13	4,9	--	Thickness and brightness spec updated.	E4807
D	5/7/14	5	--	Recommended mating screw added.	E4968

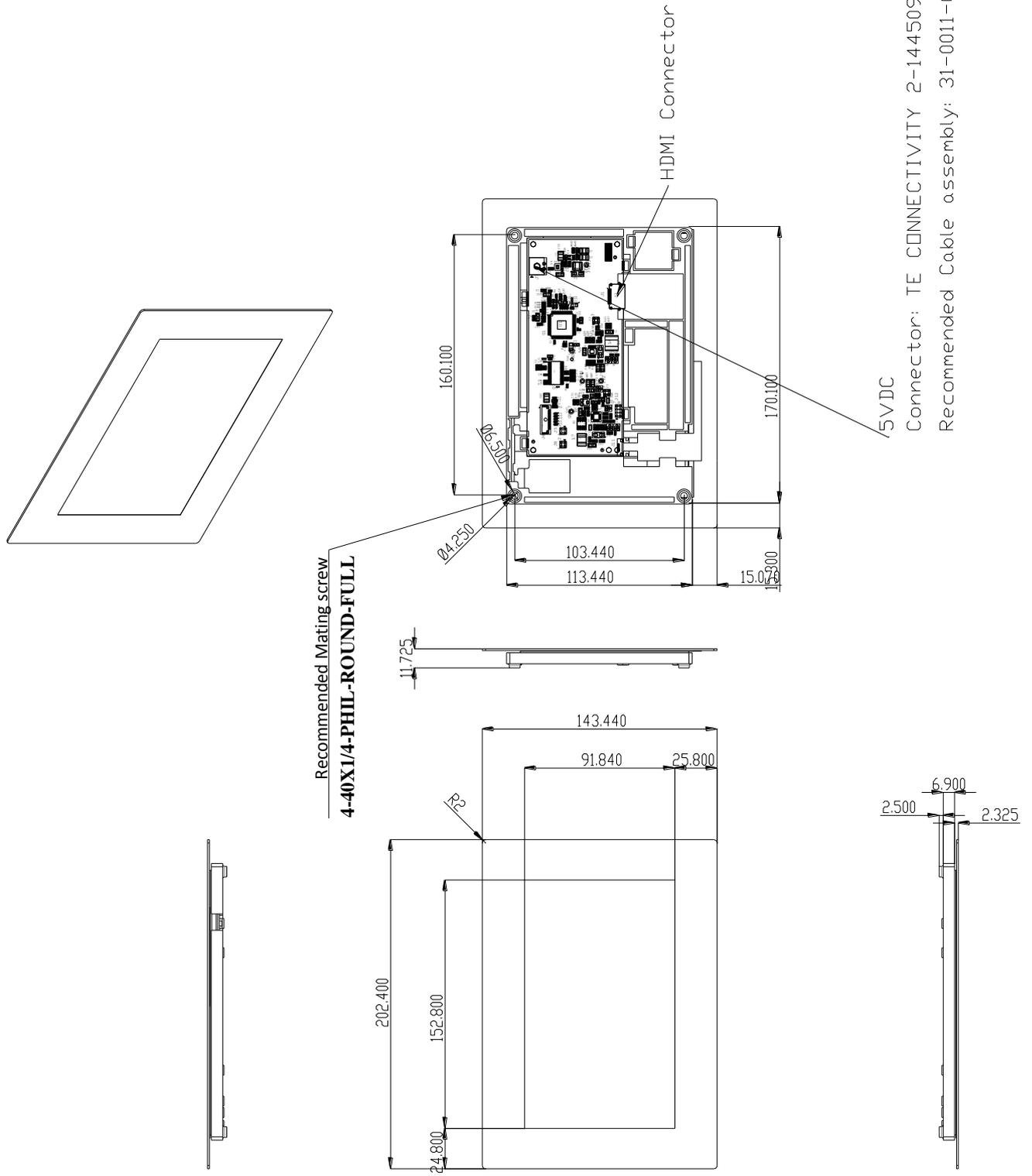
## 1 GENERAL SPECIFICATIONS

ITEM	DESCRIPTION	UNIT
Module Outline Dimensions	202.4 (H) x 143.44(V) x 11.725 (T) (Not including cable)	mm
Active Display Area	153.6(H) x 90.0 (V)	mm
Pixel Configuration Format / Resolution	1024 (H) x 600 (V)	pixels
LCD Type	Transmissive / Normally Black	--
Backlight Type	LED	--
Weight	TBD	gram
Interface	HDMI	--
Luminance, White	352 cd/m2	
Dot Pitch	0.050mm x 0.150mm	mm
Color Depth	6-bit + 2-bit FRC, 16.7M Colors	--
RoHS Compliant	Yes	--
Surface Treatment	Clear coating, 7H	--

## 2 FEATURES

- The display module is a 7" diagonal WSVGA supported TFT-LCD and can display 16.7M colors (Hi FRC).
- Glass-film-film PCT, with I2C interface.
- HDMI interface
- Solidworks model available with Densitron NDA on file.

### 3 MECHANICAL DRAWING



Connector: TE CONNECTIVITY 2-1445098-2  
Recommended Cable assembly: 31-0011-000

## 4 ABSOLUTE MAXIMUM RATINGS

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 1. ABSOLUTE MAXIMUM RATINGS

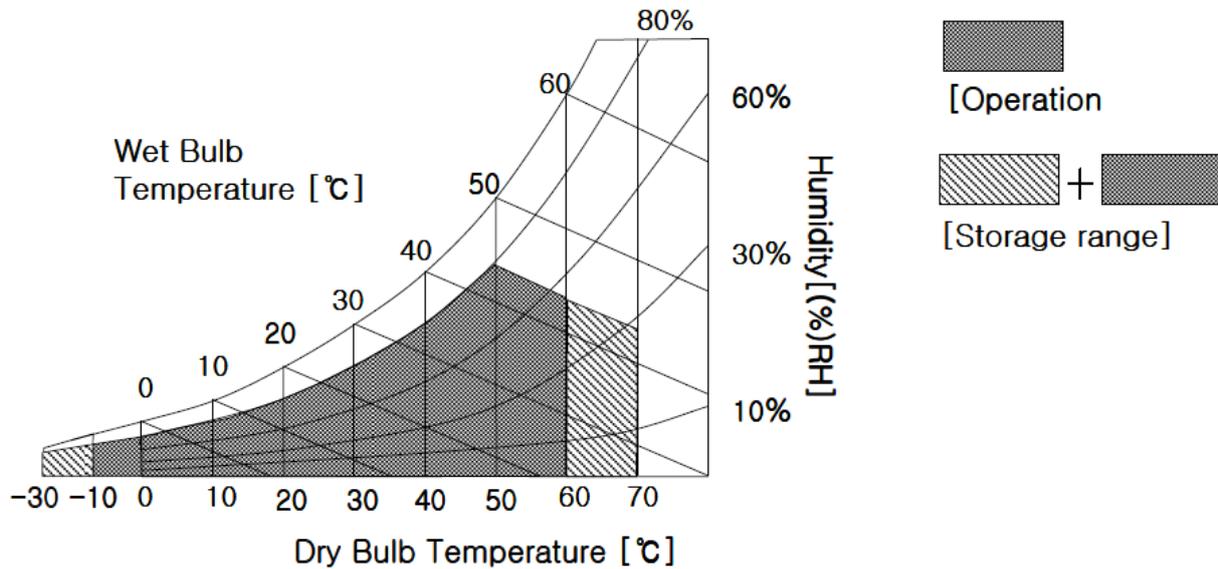
Parameter	Symbol	Values		Units	Notes
		Min	Max		
Power Input Voltage	VCC	-0.5	5.0	Vdc	at 25 ± 5°C
Operating Temperature	TOP	-20	60	°C	[Note 2-1,2,3,4]
Storage Temperature	HST	-30	70	°C	[Note 2-1,2]

[Note 2-1] This rating applies to all parts of the module and should not be exceeded.

[Note 2-2] Maximum wet-bulb temperature is 46°C. Condensation of dew must be avoided as electrical current leaks will occur, causing a degradation of performance specifications.

[Note 2-3] The operating temperature only guarantees operation of the circuit and doesn't guarantee all the contents of Electro-optical specification.

[Note 2-4] Ambient temperature when the backlight is lit (reference value).



## 5 ELECTRICAL CHARACTERISTICS

The 84-0169-000 requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input which powers the LED, is typically generated by an LED Driver. The LCD don't include LED Driver.

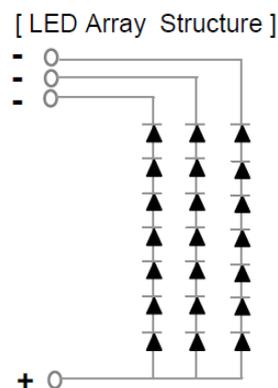
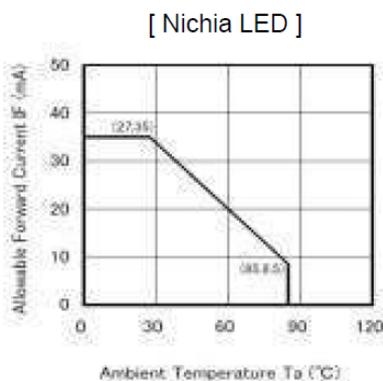
Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
LCD :						
Power Supply Input Voltage	VCC	3.0	3.3	3.6	V <sub>DC</sub>	
Input High-Level Voltage	V <sub>IH</sub>	0.7VCC	-	VCC	V <sub>DC</sub>	
Input Low-Level Voltage	V <sub>IL</sub>	0	-	0.3VCC	V <sub>DC</sub>	
Power Supply Input Current	I <sub>CC</sub>	-	212	250	mA	[Note 1]
Power Consumption	P <sub>c</sub>	-	0.7	0.9	Watt	[Note 1]

[Note 1] The specified current and power consumption are under the Vcc = 3.3V , 25°C, fv = 60Hz condition whereas "Mosaic Pattern" is displayed and fv is the frame frequency.

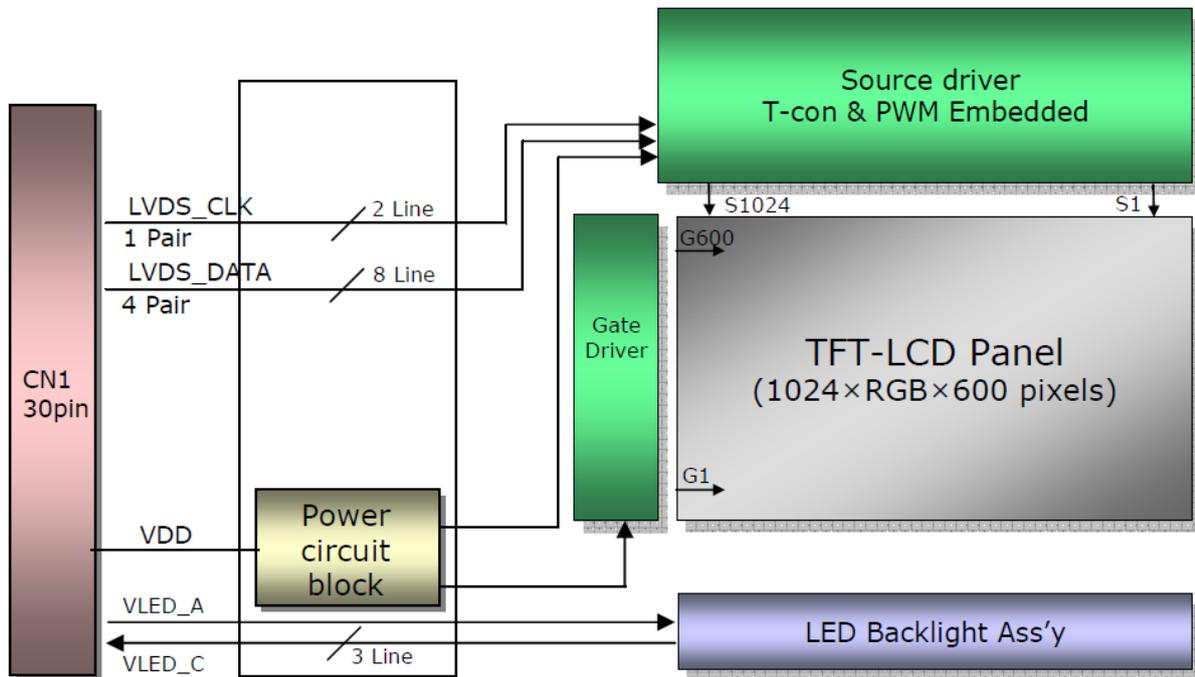
## 6 BACKLIGHT CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
LED forward Current	I <sub>f</sub>	-	20	21	mA	Ta=25°C (per chain)
LED forward Voltage	V <sub>f</sub>	-	21	23.1	V	Ta=25°C (@ 20mA)
Power Consumption	P <sub>BL</sub>	-	1,260	1,386	mW	Ta=25°C (@ 20mA)

[Note 1] The permissible forward current of LED vary with environmental temperature.



## 7 BLOCK DIAGRAM



## 8 ELECTRO-OPTICAL CHARACTERISTICS

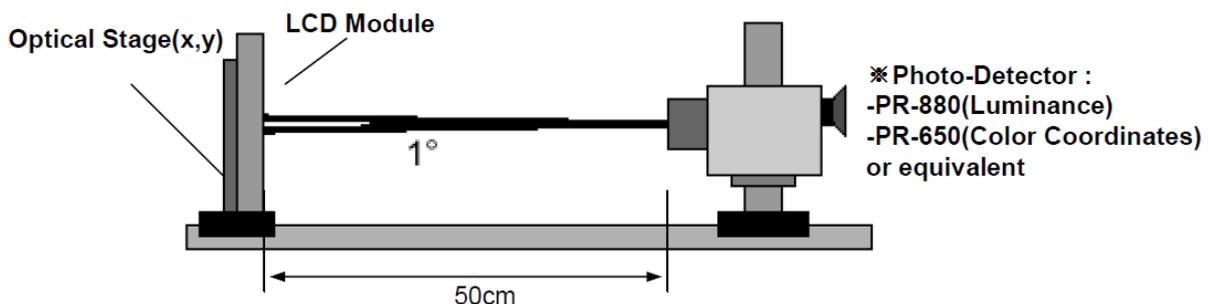
Ta=25°C, VCC=3.3V, fv=60Hz, fCLK= 51.2MHz

Parameter	Symbol	Values			Units	Notes
		Min	Typ	Max		
Contrast Ratio	CR	640	800	-		1
Surface Luminance, white	L <sub>WH</sub>	-	352	-	cd/m <sup>2</sup>	@20mA, 2
Luminance Variation	δ <sub>WHITE</sub>	-	1.18	1.34		3
Response Time(Rise Time + Decay Time)	T <sub>R</sub> + T <sub>D</sub>	-	-	40	ms	4
Color Coordinates						2
: Red	RX	0.572	0.607	0.642		
: Green	GX	0.294	0.329	0.364		
: Blue	BX	0.121	0.156	0.191		
: White	WX	0.270	0.310	0.350		
: Y-axis	WY	0.300	0.340	0.380		
Viewing Angle						5
: x axis, right(Φ=0°)	θ <sub>r</sub>	75	85	-	degree	3 o'clock
: x axis, left (Φ=180°)	θ <sub>l</sub>	75	85	-	degree	9 o'clock
: y axis, up (Φ=90°)	θ <sub>u</sub>	75	85	-	degree	12 o'clock
: y axis, down (Φ=270°)	θ <sub>d</sub>	75	85	-	degree	6 o'clock

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 5 minutes in a dark environment at 25°C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0°.

FIG. 1 presents additional information concerning the measurement equipment and method.

FIG. 1 Optical Characteristic Measurement Equipment and Method



[Note 4-1] Contrast Ratio(CR) is defined mathematically as

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

[Note 4-2] Surface luminance is measured at the center point(L<sub>1</sub>) of the LCD with all pixels displaying white at the distance of 50cm by PR-880. Color Coordinates are measured at the center point(L<sub>1</sub>) of the LCD with all pixels displaying red, green, blue and white at the distance of 50cm by PR-650. For more information, refer to the FIG 1 and FIG 2.

[Note 4-3] Luminance uniformity is measured for 9 point For more information see FIG 2.

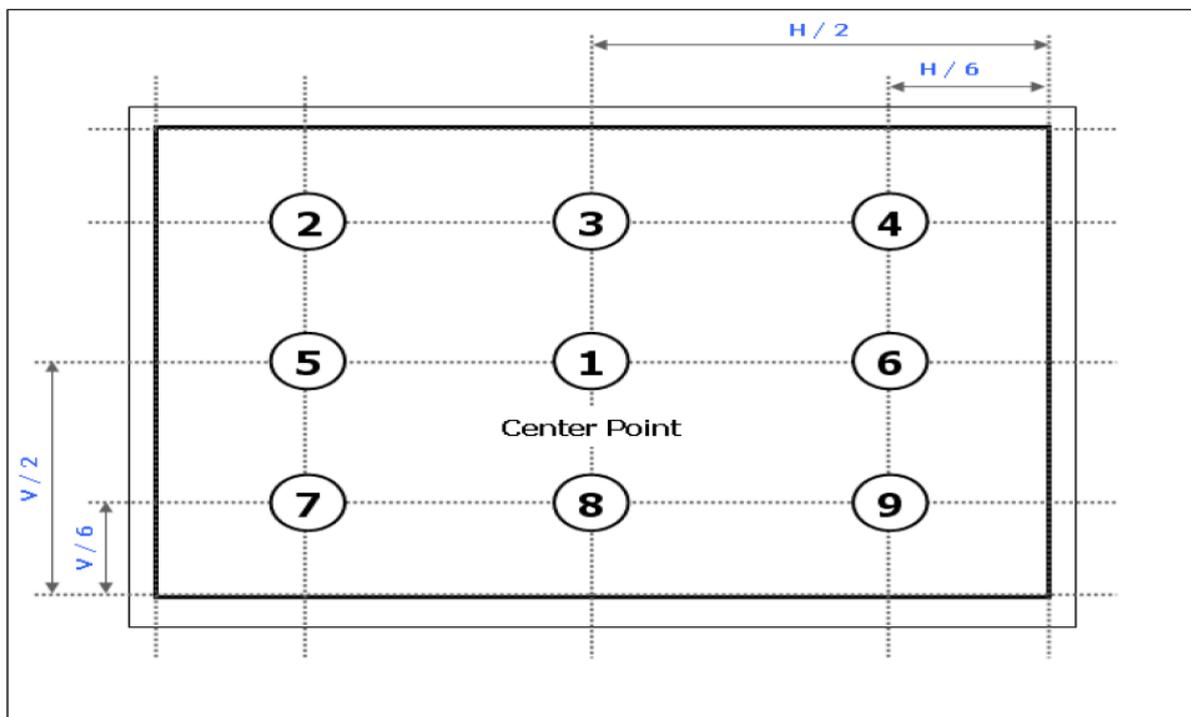
$$\delta_{\text{WHITE}} = \text{Maximum}(L_1, L_2, \dots, L_9) \div \text{Minimum}(L_1, L_2, \dots, L_9)$$

[Note 4-4] Response time is the time required for the display to transition from white to black (Rise Time, Tr<sub>R</sub>) and from black to white(Decay Time, Tr<sub>D</sub>). For additional information see FIG 3.

[Note 4-5] Viewing angle is the angle at which 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 4.

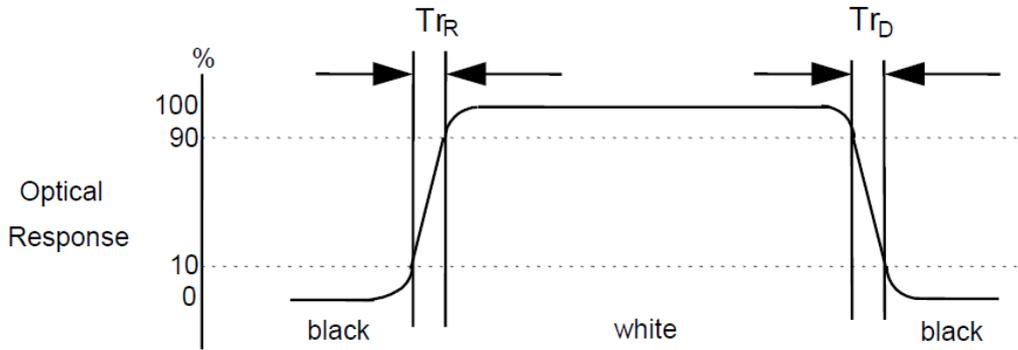
**FIG. 2 Luminance**

<measuring point for surface luminance & measuring point for luminance variation>

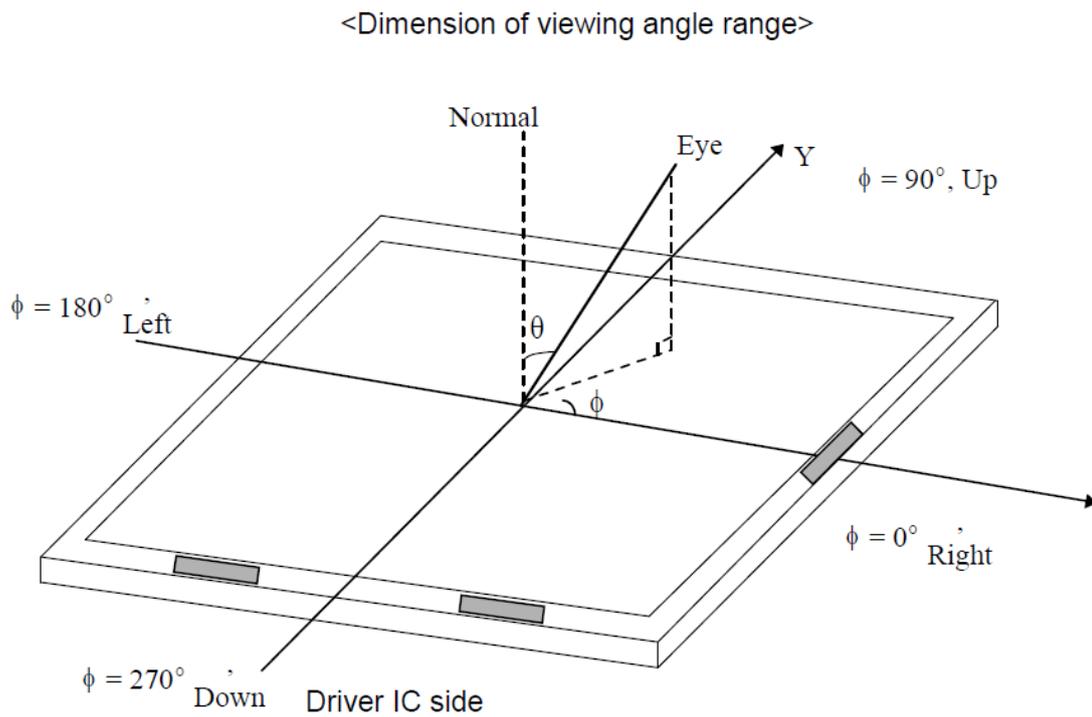


**FIG. 3 Response Time**

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



**FIG. 4 Viewing angle**



## 9 CONNECTORS, JUMPER SETTINGS AND TEST POINTS

### 9.1 Power Supply Connector (J1)

Pin	Name	Description
1	5V	5V 2A DC
2	GND	Ground

### 9.2 LCD Connector (J2)

Pin	Name	Description
1	GND	Ground
2	NC	No Connection
3-4	VCC	3.3V 2A DC
5-6	VCC	3.3V 2A DC
7	GND	Ground
8	Y0M	Negative LVDS Differential 0th Data
9	Y0P	Positive LVDS Differential 0th Data
10	GND	Ground
11	Y1M	Negative LVDS Differential 1st Data
12	Y1P	Positive LVDS Differential 1st Data
13	GND	Ground
14	Y2M	Negative LVDS Differential 2nd Data
15	Y2P	Positive LVDS Differential 2nd Data
16	GND	Ground
17	CLKM	Negative LVDS Differential CLK Data
18	CLKP	Positive LVDS Differential CLK Data
19	GND	Ground
20	Y3M	Negative LVDS Differential 3rd Data
21	Y3P	Positive LVDS Differential 3rd Data
22	GND	Ground
23	NC	No Connection
24-25-26	BL_LED+	Back-Light LED Positive Terminal END
27	NC	No Connection
28-29-30	BL_LED-	Back-Light LED Negative Terminal END

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### 9.3 PIC Controller Output (J3)

Not installed on production version.

### 9.4 PIC Controller Programming (J4)

Not installed on production version.

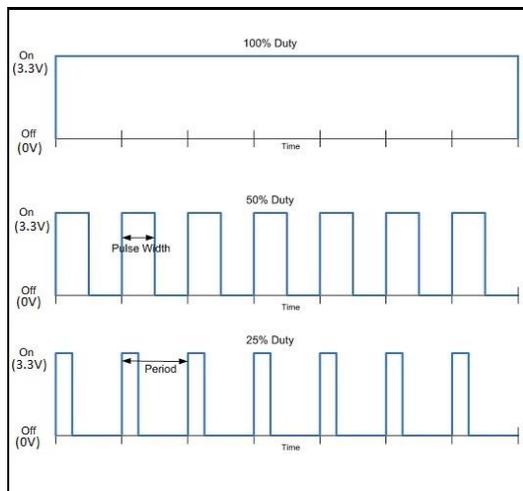
### 9.5 EEPROM Programming (J5)

Pin	Name	Description
1	SCL	EEPROM SCL
2	TEST	EEPROM Test
3	SDA	EEPROM SDA
4	GND	Ground

### 9.6 External PWM and Enable Control (J6)

Pin	Name	Description
1	VCC	3.3V for host system, it uses this power
2	PWM	PWM signal to controller backlight. It is approximated 32 KHz frequency. By default, constant 3.3V voltage provides the 100% duty cycle for maximum brightness.
3	GND	Ground
4	EN	Active high enable signal to on(3.3V)/off(0V) backlight. To turn back light off, supply 0V. By default it is high to turn on back light.

If you want to control the brightness of a LED you will need PWM. The image shows PWM being used to control the brightness. Duty cycles describes the proportion of ON state of the backlight. 0% duty cycle turns off the back light. 100% duty cycle gives maximum brightness.



### 9.7 External USB Touch Connector (J7)

Pin	Name	Description
1	5V	5V power
2	D-	Data differential pair minus
3	D+	Data differential pair plus
4	ID	On the Go Identification
5	GND	Ground

### 9.8 HDMI Connector (J8)

Pin	Name	Description
1	VCC	5V/3.3V 2A DC
2	NC	No Connection
3	NC	No Connection
4	GND	Ground
5	TS_INT	GPIO Interrupt Signal
6	TS_RESET	GPIO Reset Signal
7	TS_SDA	I2C Data Signal
8	TS_SCL	I2C Clock Signal
9	GND	Ground
10	RxC+	Digital Data Clock True
11	GND	Ground
12	RxC-	Digital Data Clock Complement
13-14	NC	No Connection
15-16	NC	No Connection
17	GND	Ground
18-19	NC	No Connection

### 9.9 External I2C Touch Connector (J9)

Pin	Name	Description
1	VCC	3.3/5V 2A DC
2	TS_INT	GPIO Interrupt Signal
3	NC	No connection
4	TS_RESET	GPIO Reset Signal
5	NC	No connection
6	TS_SDA	I2C Data Signal

7	GND	Ground
8	TS_SCL	I2C Clock Signal

### 9.10 Jumpers Configuration - Touch Interface Voltage Selection (J10)

This jumper used to set the Touch Panel operating voltage selection.

Pin	Description
1-2	USB 5V, for USB touch interface voltage
3-4	I2C 3.3V, for I2C touch interface voltage

### 9.11 Touch Pad Connector (J11)

Pin	Name	Description
1	VCC	5V/3.3V 2A DC
2	NC	No Connection
3	NC	No Connection
4	GND	Ground
5	TS_INT	GPIO Interrupt Signal
6	TS_RESET	GPIO Reset Signal
7	TS_SDA	I2C Data Signal
8	TS_SCL	I2C Clock Signal
9	GND	Ground

### 9.12 Test-Points

Test-Point	Description
TP1	5V input Voltage Test-Point
TP2	Test point for Ground Reference
TP3	Test point for Ground Reference
TP4	+ve Test Point to check the Back-light LED Voltage
TP5	Test Point to determine the Output 3.3V from the Voltage Regulator LMR10515XMF
TP6	Test Point to Track the Back-light-Clock Out Pulse Signals
TP7	-ve Test Point to check the Back-light LED Voltage
TP8	For testing Back-light PWM signal Amplitude, Duty cycle, frequency, time and Voltage waveforms for the desired Output

## 10 RELIABILITY TEST

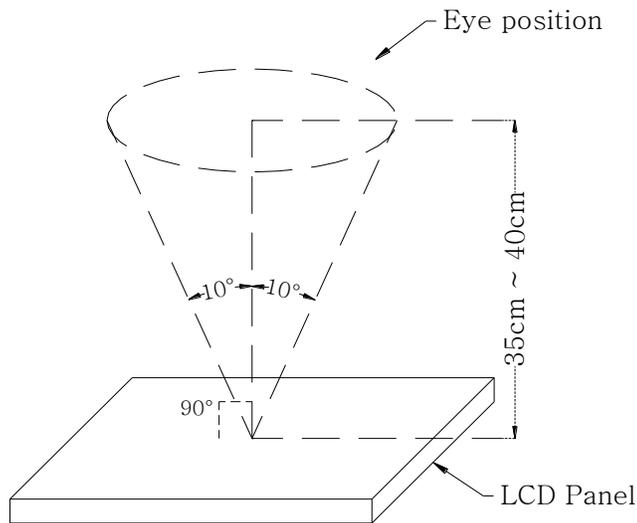
No.	Test Item	Test Condition
1	High Temperature Storage	70 ± 2 °C / 240 hours
2	Low Temperature Storage	-30 ± 2 °C / 240 hours
3	High Temperature Operation	60 ± 2 °C / 240 hours
4	Low Temperature Operation	-10 ± 2 °C / 240 hours
5	Temperature Cycle	-30 ± 2 °C ~ 70 °C (0.5hr.) X 50 Cycles
6	Proof against Dampness	50 ± 5 °C X 90% RH / 120 hours; Pure Water Used (Resistance > 10 MΩ)
7	Vibration Test	Frequency: 10 Hz ~ 55 Hz ~ 10 Hz Amplitude: 1.5 mm X,Y & Z directions for a total of 3 hours
8	Dropping Test	Dropped to the ground from 1 m height, one time and test ed on all sides of the carton when packed.
9	ESD Test	-Panel Surface/Top Case : 150pF, 150Ω (Air: ±15kV, Contact: ±8kV) -FPC input terminal: 100pF ±200V 0Ω
<b>Inspection after Test</b>		The sample is tested for the following defects after 2 ~ 4 hours of storage at room temperature: <ul style="list-style-type: none"> <li>1. Air bubbles in the LCD</li> <li>2. Leaking Seal</li> <li>3. No Display</li> <li>4. Missing Segments</li> <li>5. Glass Cracks</li> <li>6. Idd current is higher than twice the initial value</li> </ul>
Remarks: <ul style="list-style-type: none"> <li>1. The test samples are applicable to only one test group.</li> <li>2. Sample size for each test group is 5 ~ 10 pieces.</li> <li>3. In case of a malfunction caused by ESD test, if it recovers to the normal state after resetting, it would be judged as a good part.</li> <li>4. EL backlights can produce black spots/blemishes in humidity and temperature test due to natural chemical reactions and fluorescence. This is checked for.</li> <li>5. Please use automatic switch menu (or roll menu) in test mode.</li> </ul>		

## 11 INCOMING INSPECTION STANDARDS

### 11.1 The Environmental Condition for Inspection

The environmental condition and visual inspection shall be conducted as below.

- (1) Ambient temperature:  $25 \pm 5$  °C
- (2) Humidity:  $60 \pm 5$  % RH
- (3) Viewing distance: 35 ~ 40 cm approx.
- (4) Viewing angle: Normal to the LCD panel as shown below
- (5) Ambient Illumination: 300 ~ 500 Lux. for external appearance inspection.



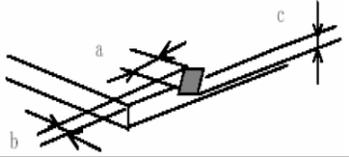
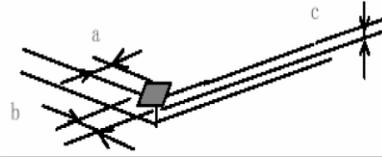
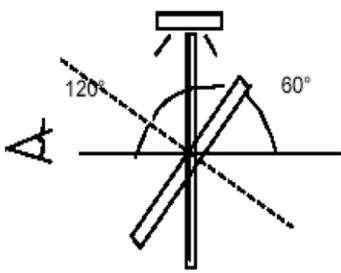
### 11.2 Classification of Defects and AQL

Class of defects	AQL	Definition
Major	1.0%	It is a defect that is likely to result in failure or to reduce materially the usability of the intended function.
Minor	1.5%	It is a defect that will not result in a functioning problem with deviation classified.

Note: Sampling plan according to GB / T2828.1-2003 / ISO 2859-1:1999 and ANSI/ASQC Z1.4-1993, Normal level 2.

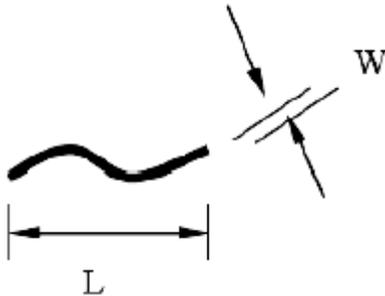
### 11.3 Inspection Parameters

Item		Specification / Description			Note	
Display	Function	No display			-	
		Malfunction			-	
Operating	Contrast ratio	Out of spec.			-	
	Line defect	No obvious Vertical and Horizontal line defects for the bright, dark and colored.			-	
	Point defect (red, green, blue, black, white)	Item	Acceptable number			1, 4, 5, 6
			A	B	Total	
		Bright dot	$N \leq 2$	$N \leq 2$	$N \leq 7$	
		Black / dark dot	$N \leq 3$	$N \leq 4$		
		Total dots	$N \leq 4$	$N \leq 5$		
		Two adjacent dots	Not allowed			
Three or more adjacent dots	Not allowed					
External Inspection (Non-operating)	Scratch on the Polarizer	L (mm)	W (mm)	Acceptable number	2	
		$L \leq 2.5$	$W \leq 0.1$	4		
		$L > 2.5$	$W > 0.1$	0		
	Dent or bubble on the polarizer	Dimension (mm)		Acceptable number	3	
		$D \leq 0.5$		4		
		$D \leq 0.15$		Disregard		
	Foreign material on the polarizer	Dimension (mm)		Acceptable number	3	
		$D \leq 0.5$		4		
		$D \leq 0.15$		Disregard		

Item		Specification / Description			Note
Touch Panel (If Present)	Scratch	L (mm)	W (mm)	Acceptable number	2
		$L \leq 10$	$W < 0.05$	Disregard	
			$0.05 \leq W < 0.1$	$N \leq 4$	
			$W \geq 0.1$	0	
	Foreign materials (Linear shape)	$L \leq 10$	$W < 0.05$	Disregard	2
			$0.05 \leq W < 0.1$	$N \leq 3$	
			$W \geq 0.1$	0	
	Foreign materials (Circular shape)	Dimension (mm)		Acceptable number	3
		$D \leq 0.25$		Disregard	
		$0.25 < D \leq 0.5$		$N \leq 6$	
$D > 0.5$		0			
Glass chips		$a \leq 5\text{mm}$ $b \leq 3\text{mm}$ $c \leq t$ (t: Glass Thickness)		7	
		$a \leq 3\text{mm}$ $b \leq 3\text{mm}$ $c \leq t$ (t: Glass thickness)			
Newton's rings	(In case of doubtful situations only) Observe at 60° from the product surface for a while under a Fluorescent lamp. (3-Wavelength lamp)	If Average Diameter $\leq (1/3)$ Touch Panel Area, Disregard.		7	
					

Note 1: The definition of dot defect: The dot defect was judged after repair and the size of a defective dot with size over 1/2 of one standard dot is regarded as one defective dot.

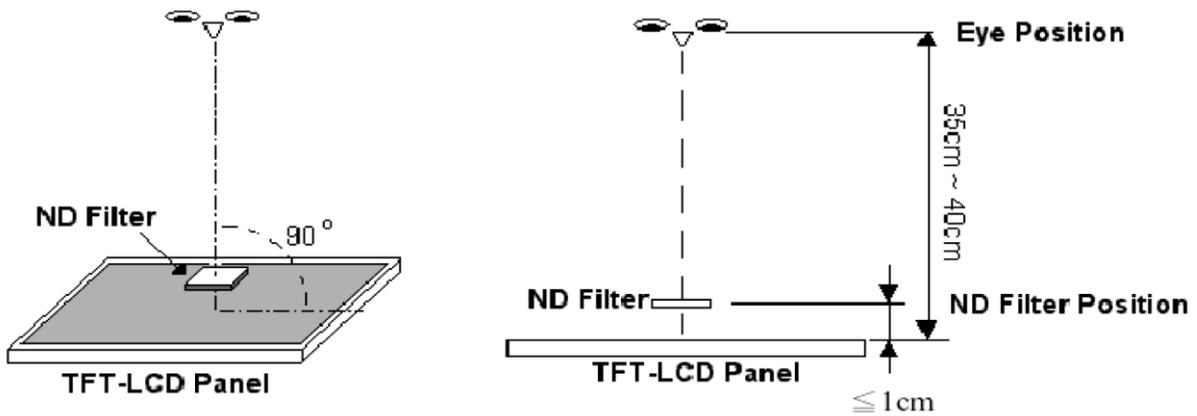
Note 2:



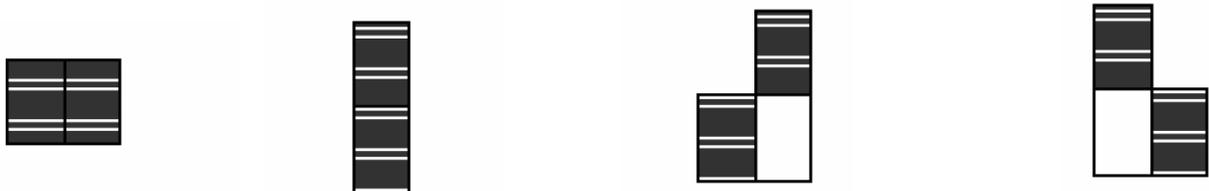
Note 3: Diameter -  $D = (a + b) / 2$



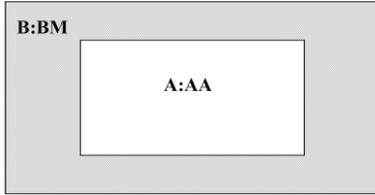
Note 4: A bright dot is defined with 6% transmission ND filter as shown below:



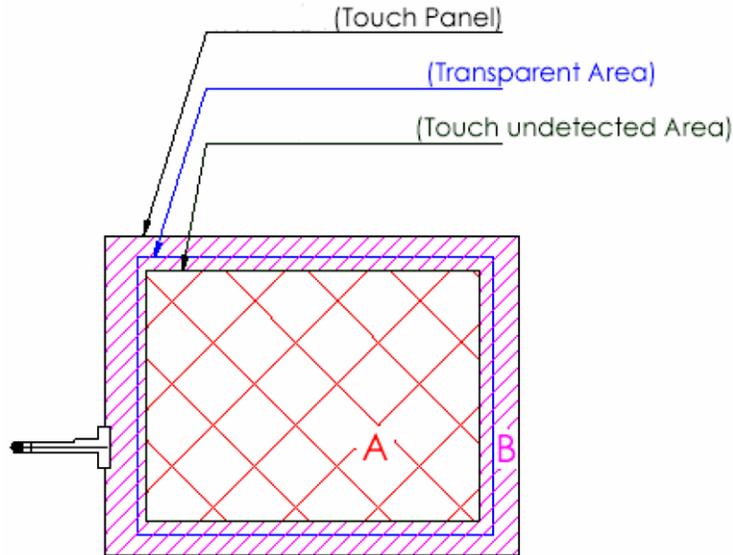
Note 5: Adjacent Dots:



Note 6:

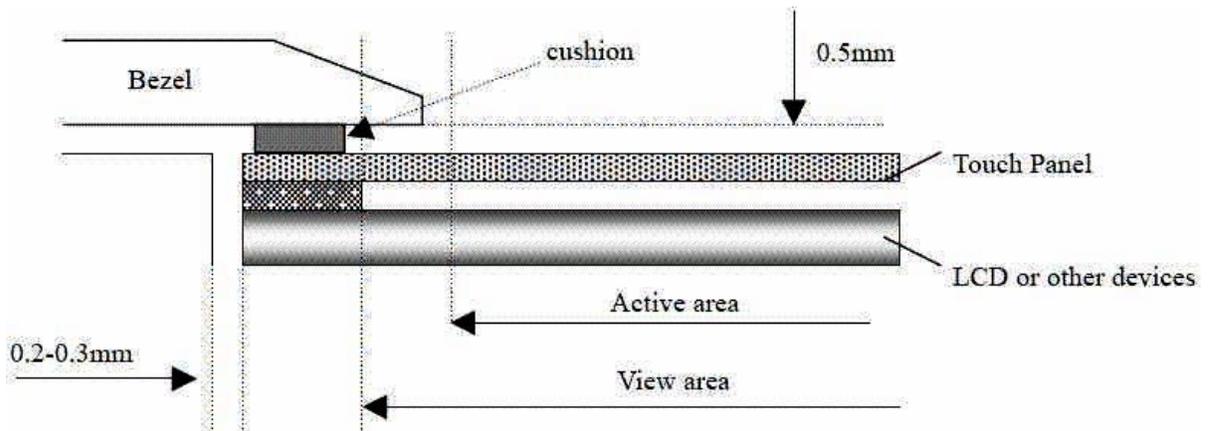


Note 7:



A: Area without any defect point effect on normal operation  
B: Defects are not specified in this area

**GENERAL INSTALLATION AND ASSEMBLY DIAGRAM:**



## 12 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 Trichlorotrifluoroethane. Do not wipe the display surface with dry or hard materials that will damage the polarizer 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 terminals 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 sunlight 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 electrochemical 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  $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$  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).

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## 13 PART NUMBER LABELLING AND ETCHING

All parts must be labeled, or etched (in the case of glass), with its Densitron Part Number and Revision.

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