Product Specifications

20.1” VGA Color TFT-LCD Module
Model Name: T201VN02 V0

( ) Preliminary Specifications
(◆) Final Specifications

Note: This Specification is subject to change without notice.

Contents

Record of Revision

Version	Date	Chapter	Description	Remark
0	Nov. 15,'04		First release	
0.1	Dec. 13,'04		Update spec	
0.2	Jan. 14,'05		Update spec	
0.3	Feb. 16,05	3	Add Electronic Block Diagram	
		3-1	Lamp life time update : Min.50000hr, Typ.60000hr	
		3-1	Inrush Current update : Max 5.7→Typ.4.3, Max 4.8	
		3-6	Power sequence update : t3 must be put comment.(450ms>t3 ≧200ms, keep black picture.	
		4	Viewing Angle update : Add Min. 80	
		6-1	Add UL6500 and IEC60065 Certificate number	

1. General Description

This specification applies to the 20.1 inch Color TFT-LCD Module T201VN02 V0. This LCD module has a TFT active matrix type liquid crystal panel 640x480 pixels, and diagonal size of 20.1 inch. This module supports 640x480 VGA mode (Non-interlace). This module is without inverter.

Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot.

The T201VN02 V0 has been designed to apply the 8-bit TTL interface method. It is intended to support displays where high brightness, wide viewing angle, high color saturation, and high color depth are very important.

* General Information

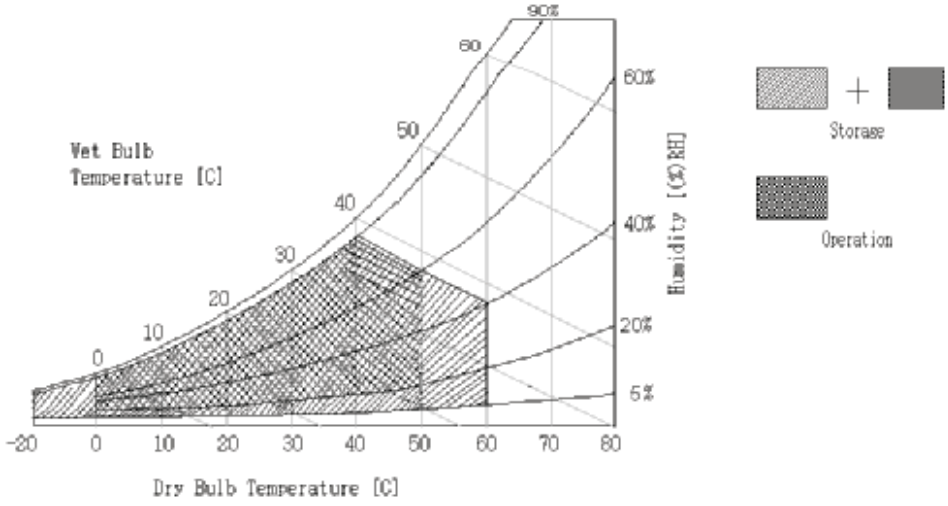
Items	Specification	Unit	Note
Active Screen Size	20.1 inches		
Display Area	408 (H) x 306(V)	mm	
Outline Dimension(typ.)	434.0(H) x 331.2(V) x 29.7(D)	mm	Without inverter
Driver Element	a-Si TFT active matrix		
Display Colors	16.7M	Colors	
Number of Pixels	640 x 480	Pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	0.6375(H) x 0.6375(W)		
Surface Treatment	AG+LR		

2. Absolute Maximum Ratings

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

Parameter	Symbol	Min.	Max.	Unit	Note
Power Input Voltage	**Vcc**	-0.3	5.5	V_{dc}	At 25±5℃
Operating Temperature	**T_{OP}**	0	50	℃	1
Storage Temperature	**H_{ST}**	-20	60	℃	1
Operating Ambient Humidity	**H_{OP}**	10	90	%RH	1
Storage Humidity	**H_{ST}**	10	90	%RH	1

Note: 1. Temperature and relative humidity range are shown in the figure below. Wet bulb temperature should be 39℃



3. Electrical Specification

3-1 Electrical Characteristics

The T201VN02 V0 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 CCFL, is typically generated by an inverter.

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
LCD:						
Power Supply Input Voltage	Vcc	4.5	5.0	5.5	Vdc	
Power Supply Input Current	Icc	-	600	700	mA	1
Power Consumption	Pc	-	3.0.	-	Watt	1
Inrush Current	I_{RUSH}	-	4.3	4.8	Apeak	1
TTL High threshold volt	V_{IH}	2.7	-	3.6	V	
TTL Low threshold volt	V_{IL}	0	-	0.7	V	
Lamp Power Consumption			41.04		W	2
Life Time		50000	60000		hr	3

The design of the inverter must have specifications for the lamp in LCD Assembly. The performance of the Lamp in LCM, for example life time or brightness, is extremely influenced by the characteristics of the DC-AC Inverter. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter. When you design or order the inverter, please make sure unwanted lighting caused by the mismatch of the lamp and the inverter (no lighting, flicker, etc) never occurs. When you confirm it, the LCD Assembly should be operated in the same condition as installed in your instrument.

Do not attach a conducting tape to lamp connecting wire. If the lamp wire attach to conducting tape, TFT-LCD Module have a low luminance and the inverter has abnormal action because leakage current occurs between lamp wire and conducting tape.

The relative humidity must not exceed 80% non-condensing at temperatures of 40℃ or less. At temperatures greater than 40℃, the wet bulb temperature must not exceed 39℃. When operate at low temperatures, the brightness of CCFL will drop and the life time of CCFL will be reduced.

Note1 : The specified current and power consumption are under the Vcc=5.0V, 25℃, fv= 60Hz, fCLK=25.2Mhz condition whereas mosaic pattern (8x6) is displayed and fv is the frame frequency.

Note2 : The lamp power consumption shown above does include loss of external inverter at 25 ℃. The used lamp current is the lamp typical current

Note3 : The life is determined as the time at which luminance of the lamp is 50% compared to that of initial value at the typical lamp current on condition of continuous operating at 25 ±2℃. The lamp current should fix in 4.2mA(typ.) and then keep the 60000hr(typ.) lamp life

The output of the inverter must have symmetrical (negative and positive) voltage waveform and symmetrical current waveform (Asymmetry ratio is less than 10%). Please do not use the inverter which has asymmetrical voltage and asymmetrical current and spike wave.

Requirements for a system inverter design which is intended to have a better display performance, a better power efficiency and a more reliable lamp.

It shall help increase the lamp lifetime and reduce its leakage current.

a. The asymmetry rate of the inverter current and voltage waveform should be 10% below;
b. The distortion rate of the current and voltage waveform should be within √2±10%;
c. The ideal sine current and voltage waveform shall be symmetric in positive and negative polarities.

3-2 Interface Connections

- LCD connector (CN1) : FH12-50S-0.5SH (Hirose) or equivalent

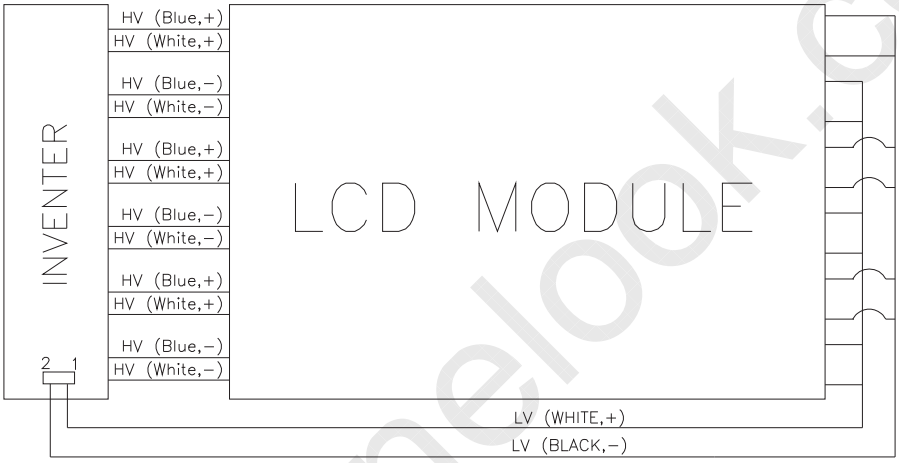
P/N	Symbol	Function	P/N	Symbol	Function
1	NC		26	R0	Red Data
2	NC		27	GND	Ground
3	NC		28	G7	Green Data
4	GND	Ground	29	G6	
5	GND	Ground	30	G5	
6	V_{CC}	Power Input (+5.0V)	31	G4	
7	V_{CC}		32	GND	Ground
8	V_{CC}		33	G3	Green Data
9	V_{CC}		34	G2	
10	GND		35	G1	
11	NC		36	G0	
12	NC		37	GND	Ground
13	GND		38	B7	Blue Data
14	DE	Data Enable	39	B6	
15	GND		40	B5	
16	DCLK	Dot Clock	41	B4	
17	GND	Ground	42	GND	Ground
18	R7	Red Data (R7 :MSB)	43	B3	Blue Data
19	R6		44	B2	
20	R5		45	B1	
21	R4		46	B0	
22	GND	Ground	47	GND	Ground
23	R3	Red Data	48	GND	Ground
24	R2		49	NC	
25	R1		50	NC	

Note: All GND (ground) pins should be connected together and to Vss which should also be connected to the LCD's metal frame. All Vcc (power input) pins should be connected together.

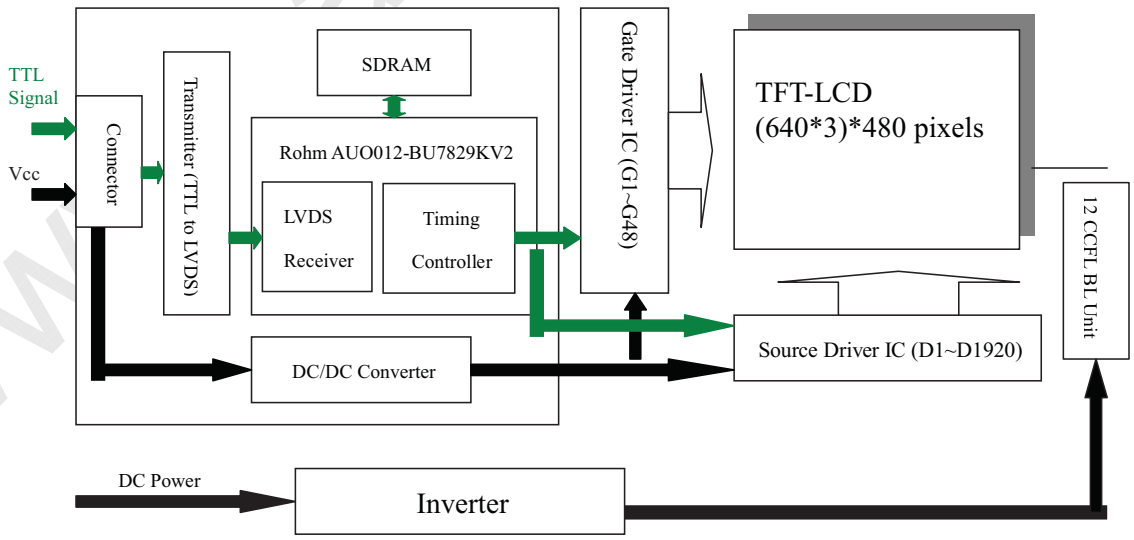
Backlight Connector Pin Configuration

Electrical specification (Lamp spec.)

Parameter	Min	Typ	Max	Units	Condition
CCFL current(ICFL)	4.0(Ref)	4.2	7.0	[mA] rms	(Ta=25℃)
CCFL Frequency(FCFL)	40	55	60	[KHz]	(Ta=25℃)
CCFL Ignition Voltage(Vs)	1510	-	-	[Volt] rms	(Ta= 0℃)
CCFL Voltage (Reference) (VCFL)	-	760	-	[Volt] rms	(Ta=25℃)
CCFL Power consumption (PCFL)	-	41.04	-	[Watt]	(Ta=25℃)



Module Block Diagram



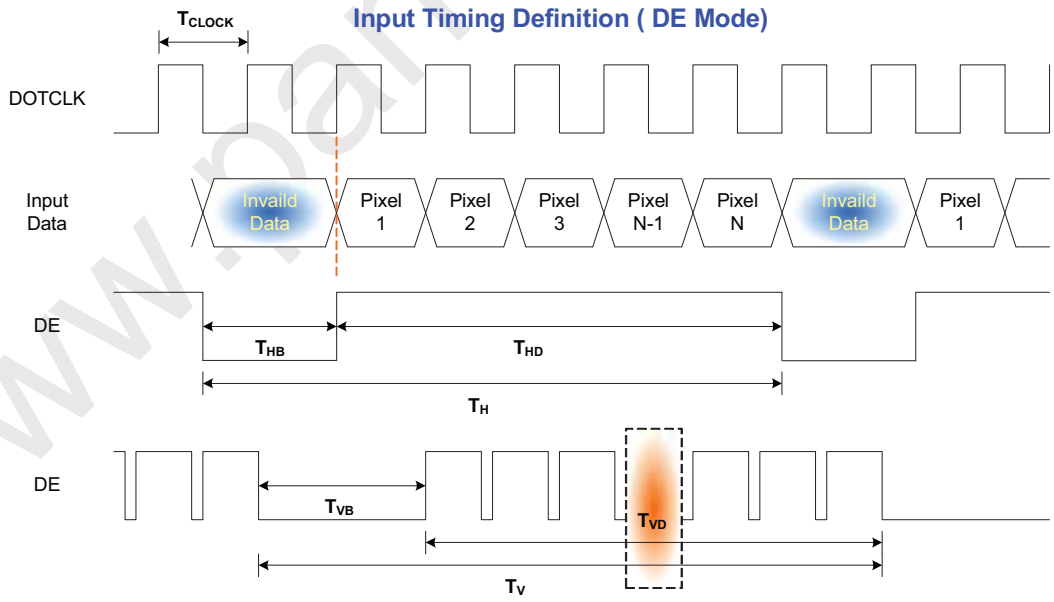
3-3 Signal Timing Specifications

This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

Timing Table (DE mode only)

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock frequency		1/ T_{Clock}	20	25.18	30	MHz
Vertical Section	Period	T_V	520	525	622	T_{Line}
	Active	T_{VD}	480	480	480	
	Blanking	T_{VB}	40	45	142	
Horizontal Section	Period	T_H	770	800	1070	T_{Clock}
	Active	T_{HD}	640	640	640	
	Blanking	T_{HB}	130	160	430	

3-4 Signal Timing Waveforms



Note : Since this is DE only mode, please set the HS and VS to logic 1.

3-5 Color Input Data Reference

The brightness of each primary color (red, green and blue) is based on the 8 bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

COLOR DATA REFERENCE

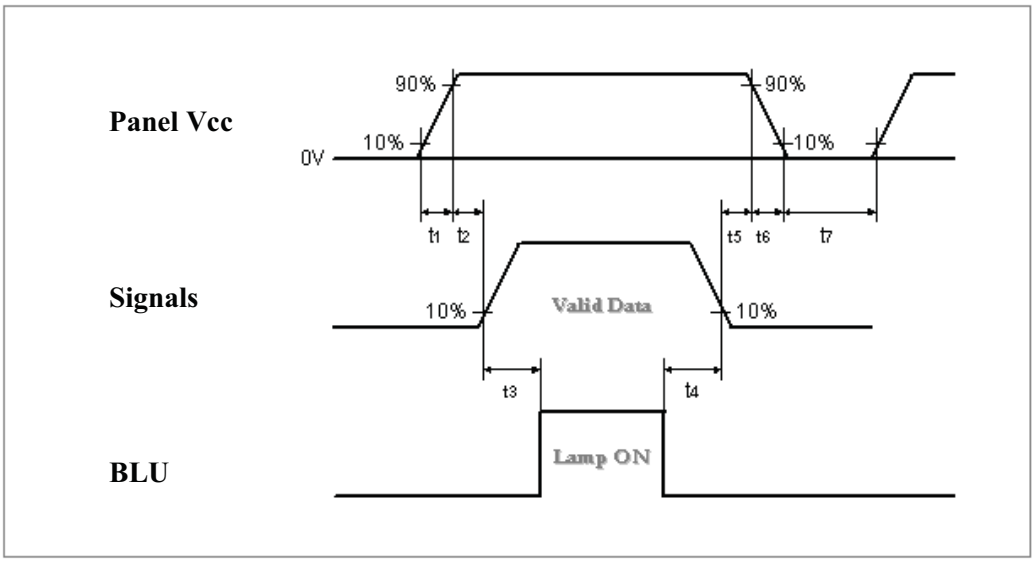
Color		Input Color Data																							
		RED								GREEN								BLUE							
		MSB								MSB								MSB							
		LSB								LSB								LSB							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED(000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(001)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	RED(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN(000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

	GREEN(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
BLUE	BLUE(000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

	BLUE(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

3-6 Power Sequence



Parameter	Values			Units
	Min.	Typ.	Max.	
t1	0.47	-	10	ms
t2	0	-	50	ms
t3	450 (Note1)	-	-	ms
t4	100	-	-	ms
t5	0	-	50	ms
t6	-	-	500	ms
t7	1000	-	-	ms

Apply the lamp voltage within the LCD operating range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal.

Caution : The above on/off sequence should be applied to avoid abnormal function in the display. In case of handling, make sure to turn off the power when you plug the cable into the input connector or pull the cable out of the connector.

Note1 : The 450ms timing is separated into 2 parts and each one has following characteristic:

0~200ms : If t3 setting is in this timing period, it will have the risk of abnormal display

200~450ms : Black pattern display

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25℃. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0°.

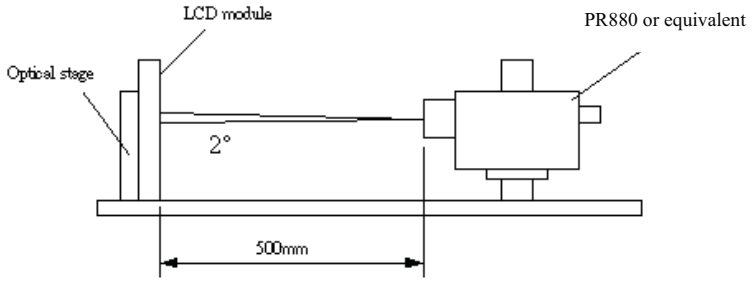


Fig.4-1 Optical measurement equipment and method

Parameter		Symbol	Values			Units	Notes
			Min.	Typ.	Max.		
Contrast Ratio		CR	450	600	-		1
Surface Luminance, white		LWH	400	500	-	cd/㎡	2
Luminance Variation		δ_{WHITE} 5 p	-	-	1.25		3
Response Time		Tr	-	15	25		4
Response Time		Tf	-	10	20		4
Response Time (Gray to Gray, Average)		T_γ	-	16	25	ms	5
Color Coordinates			-	-	-		
	RED	R_X	TYP. -0.03	0.644	TYP. +0.03		
		R_Y		0.333			
	GREEN	G_X		0.273			
		G_Y		0.604			
	BLUE	B_X		0.145			
		B_Y		0.064			
	WHITE	W_X		0.282			
		W_Y		0.284			
Color Saturation			72	75	-	%	
Viewing Angle (Contrast Ration>10)							
	x axis, right(φ =0°)	θ_r	80	85	-	Degree	5
	x axis, left(φ =180°)	θ_l	80	85	-		
	y axis, up(φ =90°)	θ_u	80	85	-		
	y axis, down (φ =0°)	θ_d	80	85	-		

Note:

1. Contrast Ratio (CR) is defined mathematically as:

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

2. Surface luminance is luminance value at point 1 across the LCD surface 50cm from the surface with all pixels displaying white. From more information see FIG 4-2. When I_{BL} = 4.2mA, L_{WH}=500cd/㎡ (typ.) L_{WH}=Lon1, Where Lon1 is the luminance with all pixels displaying white at center 1 location.

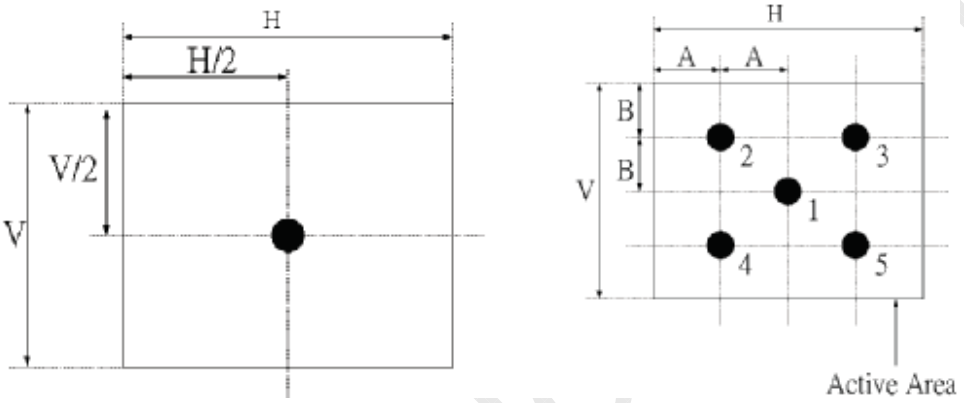


Fig.4-2 Optical measurement point

3. The variation in surface luminance, δ WHITE is defined (center of Screen) as:

$$\delta_{WHITE(5P)} = \text{Maximum}(L_{on1}, L_{on2}, \ldots, L_{on5}) / \text{Minimum}(L_{on1}, L_{on2}, \ldots L_{on5})$$

4. Response time is the time required for the display to transition from white(L255) to black(L0) (Decay Time, Tr_D=Tf) and from black(L0) to white(L255) (Rise Time, Tr_R=Tr). For additional information see FIG4-3.

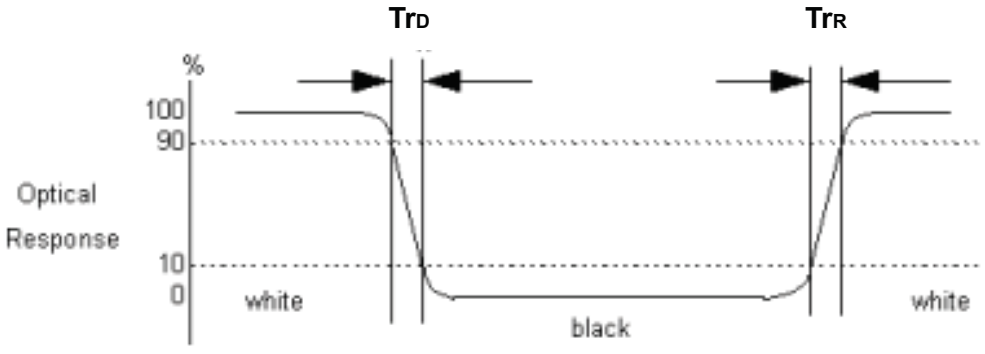


Fig.4-3 Response time

5. The response time is defined as the following figure and shall be measured by switching the input signal for different gray level. For additional information see FIG4-4

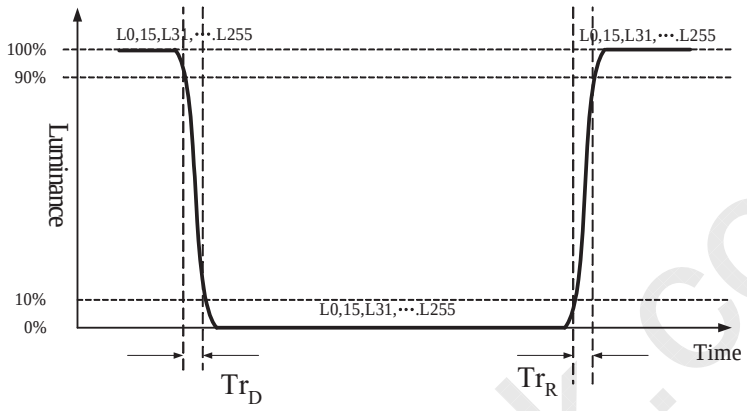


Fig.4-4 Response time

6. 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 FIG4-5.

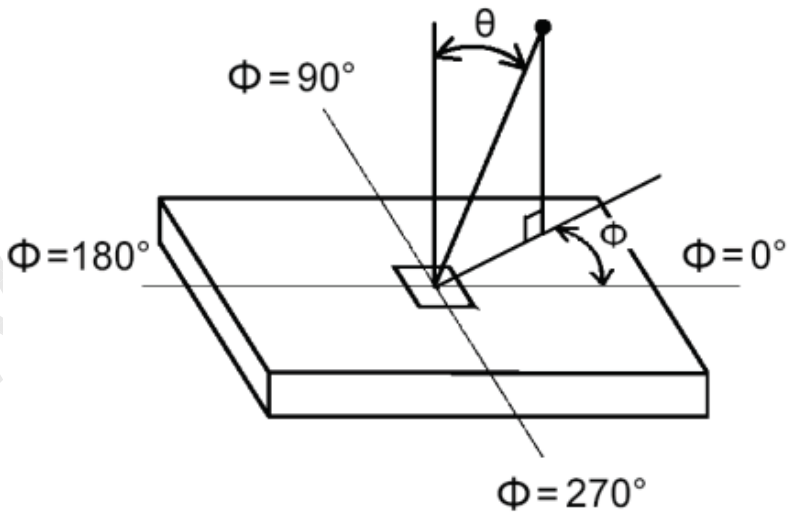


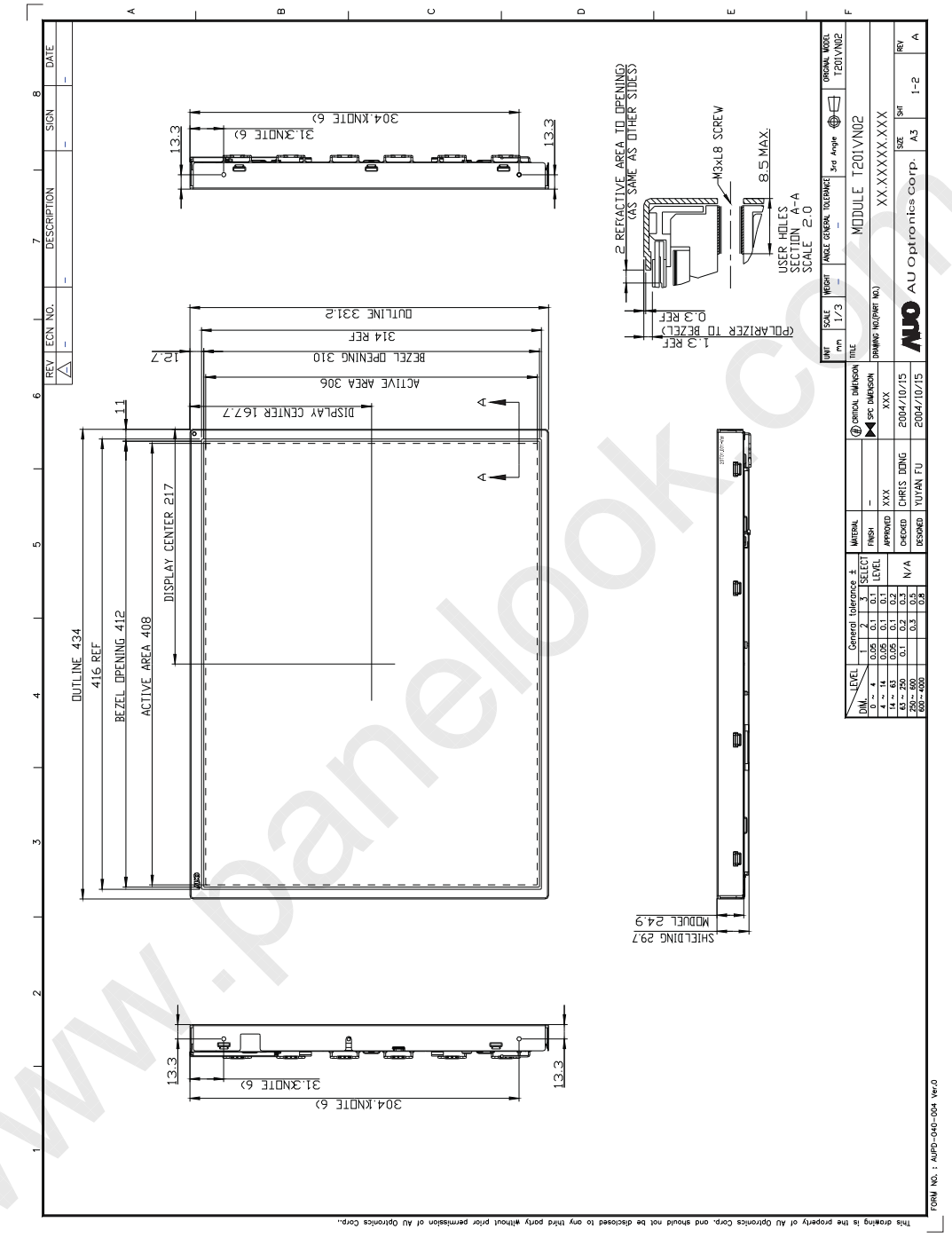
Fig.4-5 Viewing Angle Definition

5. Mechanical Characteristics

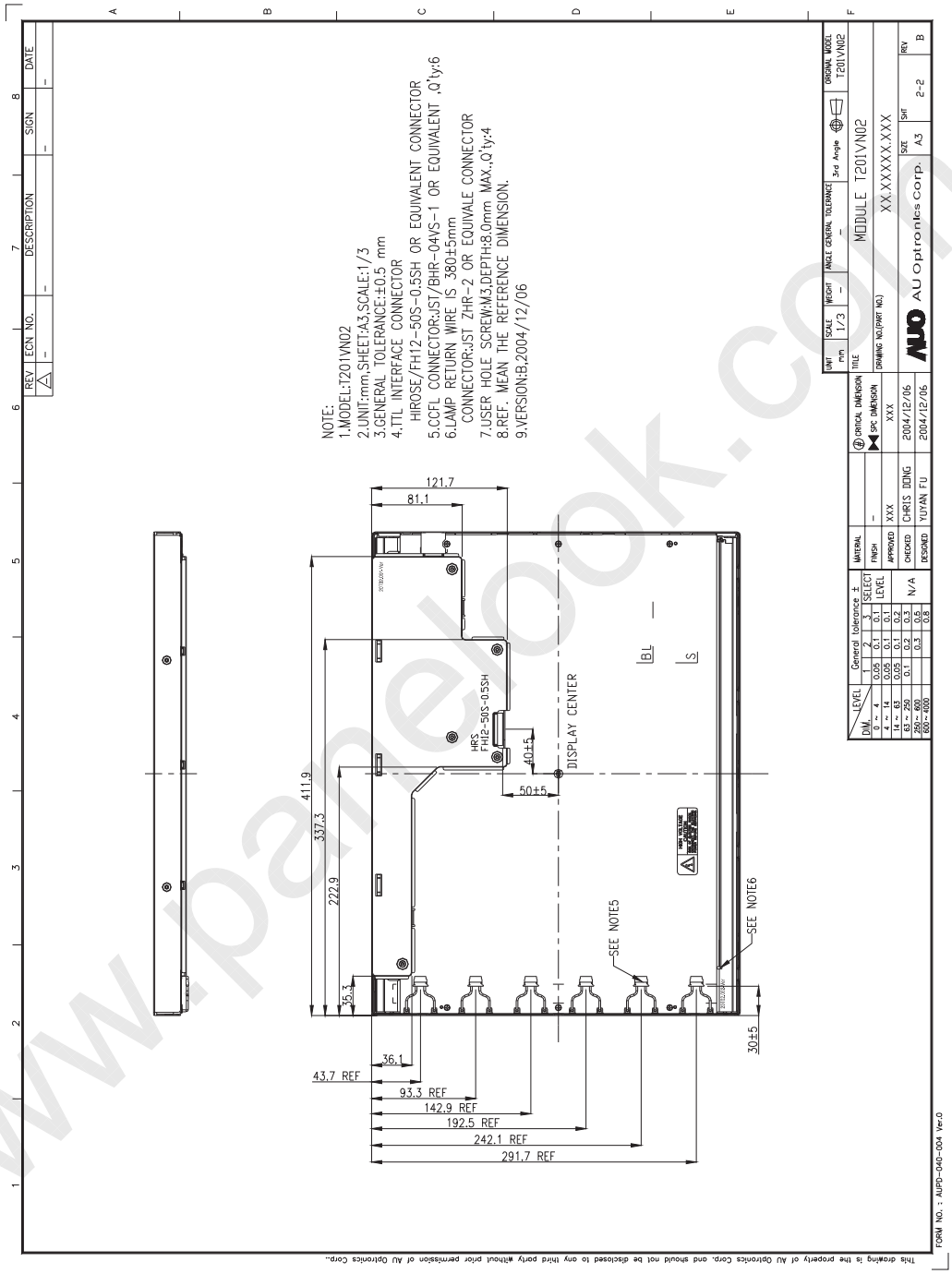
The contents provide general mechanical characteristics for the model T201VN02 V0. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outline Dimension	Horizontal	434.0mm
	Vertical	331.2mm
	Depth	29.7mm(w/o inverter)
Bezel Area	Horizontal	412.0mm
	Vertical	310.0mm
Active Display Area	Horizontal	408.0mm
	Vertical	306.0mm
Weight	2100g (Typ.)	
Surface Treatment	AG,3H	

Front View



Rear View



6. International Standard

6-1. Safety

(1) UL6500, Underwriters Laboratories, Inc. (AUO file number : E204356)
Standard for Safety of Information Technology Equipment Including electrical Business Equipment.

(2) CAN/CSA C22.2 No. 950-95 Third Edition, Canadian Standards Association, Jan. 28, 1995
Standard for Safety of Information Technology Equipment Including Electrical Business Equipment.

(3) EN60950 : 1992+A2: 1993+A2: 1993+C3: 1995+A4: 1997+A11: 1997
IEC 950: 1991+A1: 1992+A2: 1993+C3: 1995+A4:1996
IEC 60065 (AUO Certificate number : JPTUV-008549)
European Committee for Electro technical Standardization (CENELEC)
EUROPEAN STANDARD for Safety of Information Technology Equipment Including Electrical Business Equipment.

6-2. EMC

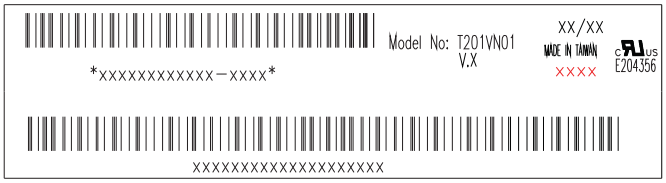
a) ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHz to 40GHz. “American National standards Institute(ANSI), 1992

b) C.I.S.P.R “Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment.” International Special committee on Radio Interference.

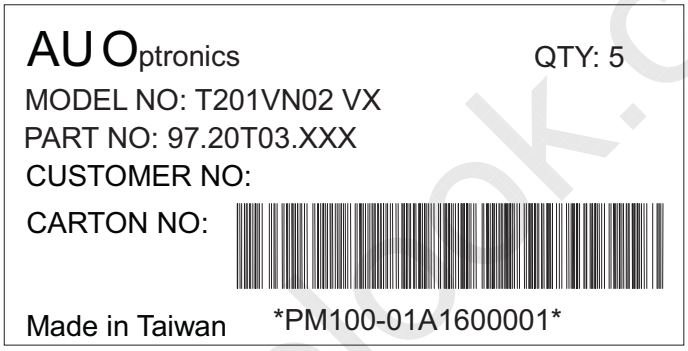
c) EN 55022 “Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment.” European Committee for Electrotechnical Standardization. (CENELEC), 1998

7. Packing

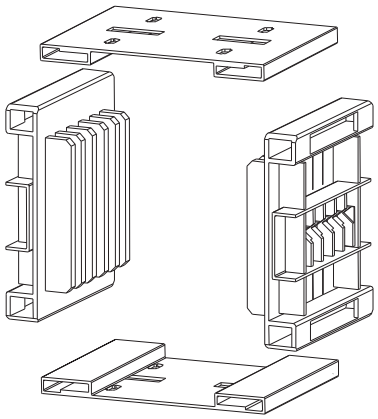
Label Sample



Carton Label



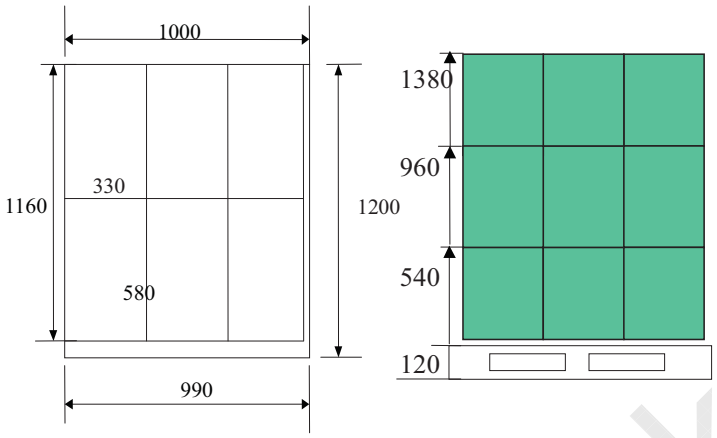
Cushion set



Carton Box, 330mm(W)x580mm(L)x420mm(H)

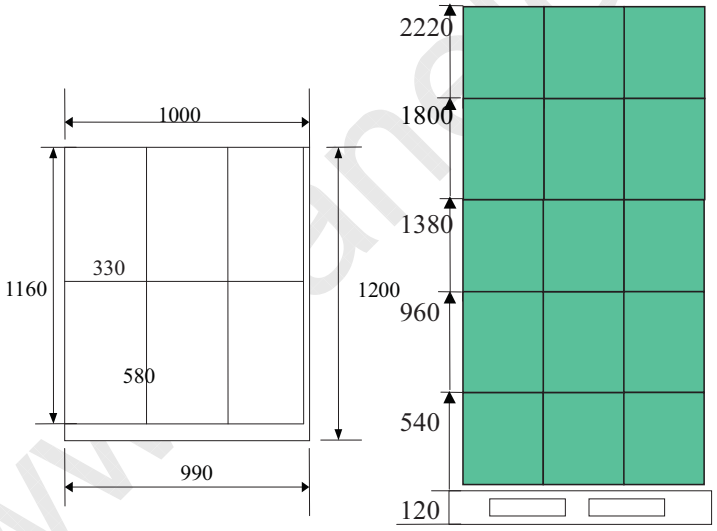
Pallet Package

Air Cargo : (3 *2) *3 layers, total 18 boxes with 90 pcs panel in one pallet



Top view Side view

Ocean shipping : (3 *2) *5layers, total 30 boxes with 150 pcs panel in one pellet



Top view Side view

8. PRECAUTIONS

Please pay attention to the followings when you use this TFT LCD module.

8-1 MOUNTING PRECAUTIONS

(1) You must mount a module using holes arranged in four corners or four sides.

(2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.

(3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.

(4) You should adopt radiation structure to satisfy the temperature specification.

(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.

(6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)

(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front/ rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.

(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.

(9) Do not open the case because inside circuits do not have sufficient strength.

8-2 OPERATING PRECAUTIONS

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage: V=±200mV(Over and under shoot voltage)

(2) Response time depends on the temperature. (In lower temperature, it becomes longer..)

(3) Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.

(4) Be careful for condensation at sudden temperature change. Condensation makes

damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.

(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.

(6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interface.

8-3 ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

8-4 PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

8-5 STORAGE

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5℃ and 35℃ at normal humidity.

(2) The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

8-6 HANDLING PRECAUTIONS FOR PROTECTION FILM

(1) The protection film is attached to the bezel with a small masking tape. When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.

(2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of flue still on the Bezel after the protection film is peeled off.

(3) You can remove the glue easily. When the glue remains on the Bezel or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.