LG Display

LM215WF3
Liquid Crystal Display

Product Specification

SPECIFICATION
FOR
APPROVAL

(●) Preliminary Specification
( ) Final Specification

Title	21.5" Full HD TFT LCD

BUYER	General
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LM215WF3
SUFFIX	SDD1

*When you obtain standard approval,
please use the above model name without suffix

APPROVED BY	SIGNATURE / DATE
/	
/	
/	

Please return 1 copy for your confirmation with your signature and comments.

APPROVED BY	SIGNATURE / DATE
S. Y. Park / G.Manager	
REVIEWED BY	
S. J. So / Manager [C]	
D. Y. Kim/ Manager [M]	
S. H. Cho / Manager [P]	
PREPARED BY	
Y. T. YOO / Engineer	

MNT Products Engineering Dept.
LG Display Co., Ltd

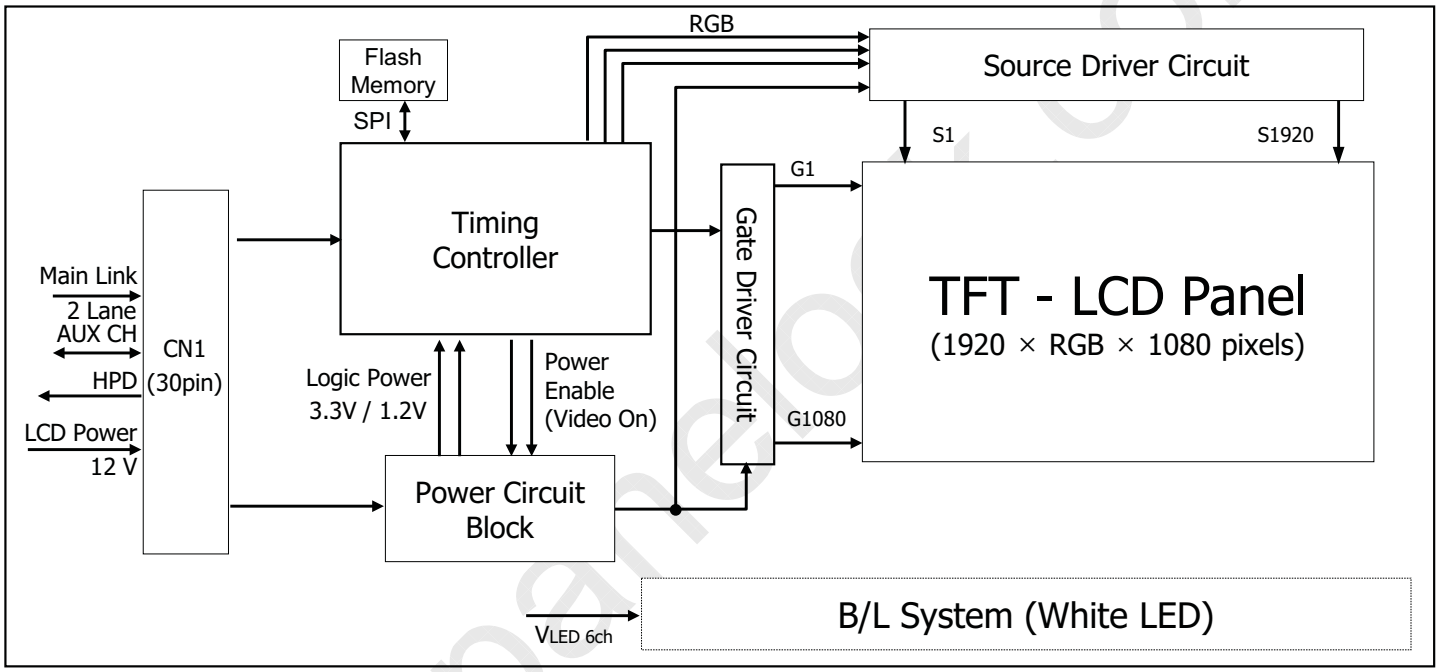
Contents

RECORD OF REVISIONS

Revision No	Revision Date	Page	Description
0.0	Aug. 24. 2012	-	First Draft (Preliminary)

1. General Description

LM215WF3 is a Color Active Matrix Liquid Crystal Display with Light Emitting Diode (White LED) backlight system without LED driver. The matrix employs a-Si Thin Film Transistor as the active element. It is a trans missive type display operating in the normally black mode. It has a 21.5inch diagonally measured active display area with Full HD resolution (1920 vertical by 1080 horizontal pixel array) 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 8bit gray scale signal for each dot, thus, presenting a palette of more than 16M colors. .
It has been designed to apply the 8bit 4Lane Display port interface.
It is intended to support displays where high brightness, super wide viewing angle, high color saturation, and high color are important.



[Figure 1] Block diagram

General Features

Active Screen Size	21.46 inches(545.22mm) diagonal
Outline Dimension	528.3(H) × 318.765(V) × 10.95(T) mm (with Cover Glass)
Pixel Pitch	0.2475mm x 0.2475mm
Pixel Format	1920 horiz. By 1080 vert. Pixels RGB stripes arrangement
Color Depth	8-bit, 16,777,216 colors
Luminance, White	415 cd/m^2 (Center 1 Point, Typ.)
Viewing Angle (CR>10)	View Angle Free (R/L 178(Typ.), U/D 178(Typ.))
Power Consumption	Total 30.72 Watt (Max.) (8.4 Watt @V_{LCD}, Max 22.32 Watt_ Duty 100% of DC 60 mA_ w/o driver)
Weight	2050g (Typ), 2150g (Max)
Display Operating Mode	Trans missive mode, normally black
Surface Treatment	Cover Glass with Anti-Reflection layer coated

2. Absolute Maximum Ratings

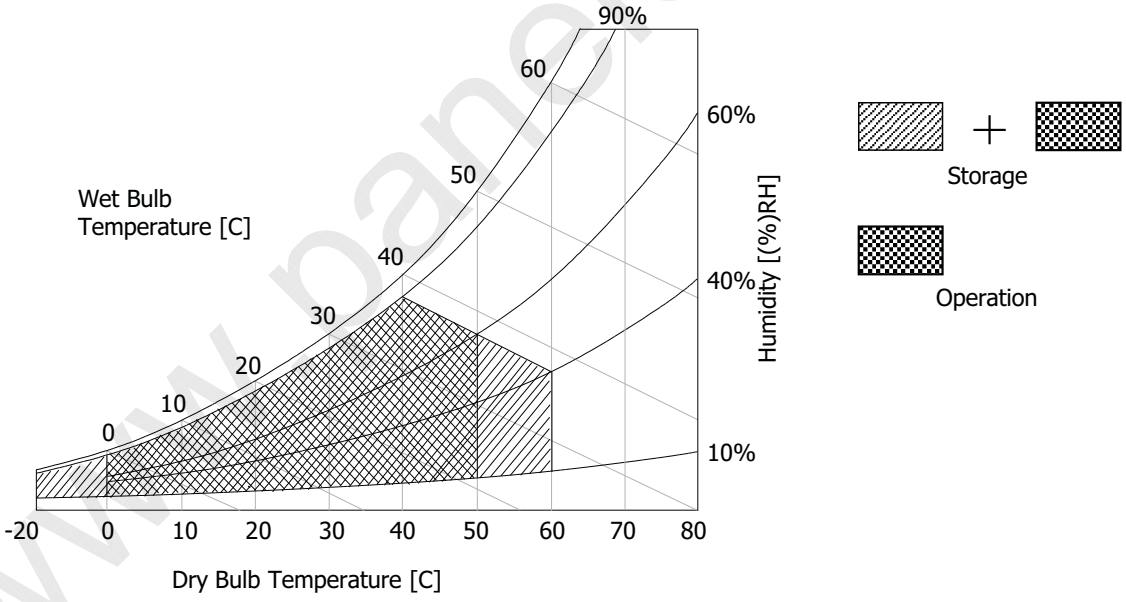
The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Values		Units	Notes
		Min	Max		
Power Input Voltage	VLCD	-0.3	14	Vdc	at 25 ± 2°C
Operating Temperature	TOP	0	50	°C	1
Storage Temperature	TST	-20	60	°C	
Operating Ambient Humidity	HOP	10	90	%RH	
Storage Humidity	HST	10	90	%RH	

Note.

1. Temperature and relative humidity range are shown in the figure below.
   Wet bulb temperature should be 39 °C Max, and no condensation of water.
2. Storage condition is guaranteed under LCM packing condition (with Al-Bag).



[Figure 2] Temperature and relative humidity

3. Electrical Specifications

3-1. Electrical Characteristics

It requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input power for the WLED.

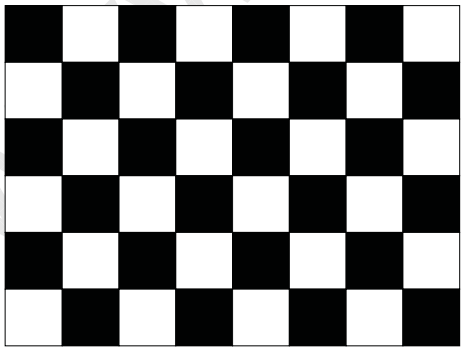
Table 2-1. ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
MODULE :						
Power Supply Input Voltage	V_{LCD}	11.4	12.0	12.6	Vdc	
Permissive Power Input Ripple	V_{RF}	-	-	400	mV	
Power Supply Input Current	I_{LCD}	271	387	503	mA	1
		378	539	701	mA	2
Power Consumption	P_{LCD}		4.6	6.0	Watt	1
	P_{LCD}		6.5	8.4	Watt	2
Rush current	I_{RUSH}	-	-	3.0	A	3

Note.

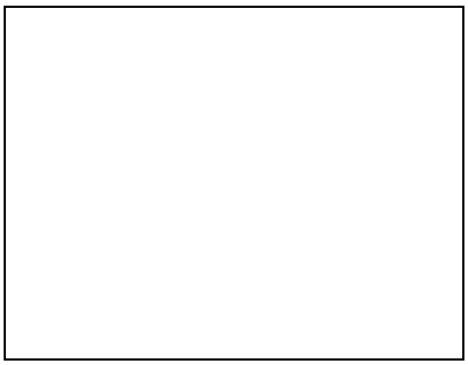
1. The specified current and power consumption are under the V_{LCD}=12.0V, 25 ± 2°C,f_V=60Hz condition whereas mosaic pattern(8 x 6) is displayed and f_V is the frame frequency.
2. The current is specified at the maximum current pattern.
3. The duration of rush current is about 2ms and rising time of power Input is 1ms(min.)

White : 255Gray
Black : 0Gray



Mosaic Pattern(8 x 6)

Maximum current pattern



White Pattern

Table 2-2. LED Bar ELECTRICAL CHARACTERISTICS

Items	Symbol	Spec			Unit	Remark	Notes
		Min	Typ	Max			
LED String Current	I_S	-	60	62.5	Vrms		1,2,3, 4,7
LED String Voltage	V_S	-	59.5	62	Vrms	Ta=25℃, 100% PWM at 60 mA	1,2,3, 7
BL Power	P_{BL}	-	21.42	22.32	W	Ta=25℃, 100% PWM at 60 mA	1,4,6, 7
LED Life Time	LED_LT	30K	-	-	Hrs	TJ ≤ 80℃, 100% PWM at 60 mA	5,7
LED Junction Temperature	Tj	-	-	90	℃	-	5,6,7

LED driver design guide

: The design of the LED driver must have specifications for the LED in LCD Assembly.

The performance of the LED in LCM, for example life time or brightness, is extremely influenced by the characteristics of the LED driver.

So all the parameters of an LED driver should be carefully designed and output current should be Constant current control.

Please control feedback current of each string individually to compensate the current variation among the strings of LEDs.

When you design or order the LED driver, please make sure unwanted lighting caused by the mismatch of the LED and the LED driver (no lighting, flicker, etc) never occurs.

When you confirm it, the LCD module should be operated in the same condition as installed in your instrument.

1. Specified values are for a single LED bar.
2. The specified current is input LED chip 100% duty current.
3. The specified voltage is input LED string voltage at typical 60mA 100% duty current.
4. The specified power consumption is input LED string power consumption at typical 60mA 100% duty current.
5. The life is determined as the time at which luminance of the LED is 50% compared to that of initial value at the typical LED current on condition of continuous operating at 25 ± 2°C.
6. The LED power consumption shown above does not include loss of external driver.
   The used LED BL current is the LED typical current.
   String Power Consumption is calculated with $P_S = V_S \times 60mA$
   BL Power Consumption is calculated with $P_{BL} = P_S \times 6$
7. LED operating DC Forward Current and Junction Temperature must not exceed LED Max Ratings.

3-2. Interface Connections

3-2-1. LCD Module

- LCD Connector(CN1) : 20525-130E-01 (I-PEX) or Equivalent

Table 3. MODULE CONNECTOR(CN1) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	VIN	12V for LCM Main Power	16	I2C_SCL	DDC Clock
2	VIN	12V for LCM Main Power	17	SPDIF	Audio output from DP RX
3	VIN	12V for LCM Main Power	18	HPD	Hot Plug Detect Signal
4	VIN	12V for LCM Main Power	19	GND	High Speed Ground
5	VIN	12V for LCM Main Power	20	AUX_CHN	Component Signal for Auxiliary Channel
6	VIN	12V for LCM Main Power	21	AUX_CHP	True Signal for Auxiliary Channel
7	GND	Ground	22	GND	High Speed Ground
8	GND	Ground	23	Lane0P	True Signal for Main Link 0
9	GND	Ground	24	Lane0N	Component Signal for Main Link 0
10	GND	Ground	25	GND	High Speed Ground
11	GND	Ground	26	Lane1P	True Signal for Main Link 1
12	GND	Ground	27	Lane1N	Component Signal for Main Link 1
13	DDC_SDA	DDC Data	28	GND	High Speed Ground
14	DDC_SCL	DDC Clock	29	VIDEO_ON	Video status from DP RX
15	I2C_SDA	DDC Data	30	VSYNC	Vertical Frame Sync.

Note: 1. All GND(ground) pins should be connected together and to Vss which should also be connected to the LCD's metal frame.

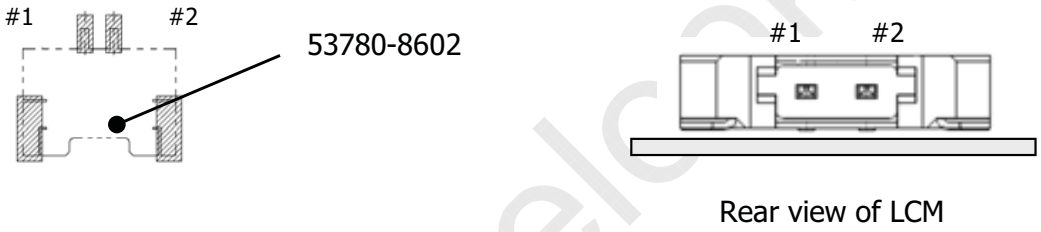
[Figure 3] User Connector diagram

3-2-2. User Connector

- LCD Connector(CN2) : 53780-8602 (Manufactured by Molex) or Equivalent

Table 4. THERMAL SENSOR CONNECTOR(CN2) PIN CONFIGURATION

Pin	Symbol	Description	NOTES
1	DXP	Positive connection to remote temperature sensor.	
2	DXN	Negative connection to remote temperature sensor.	



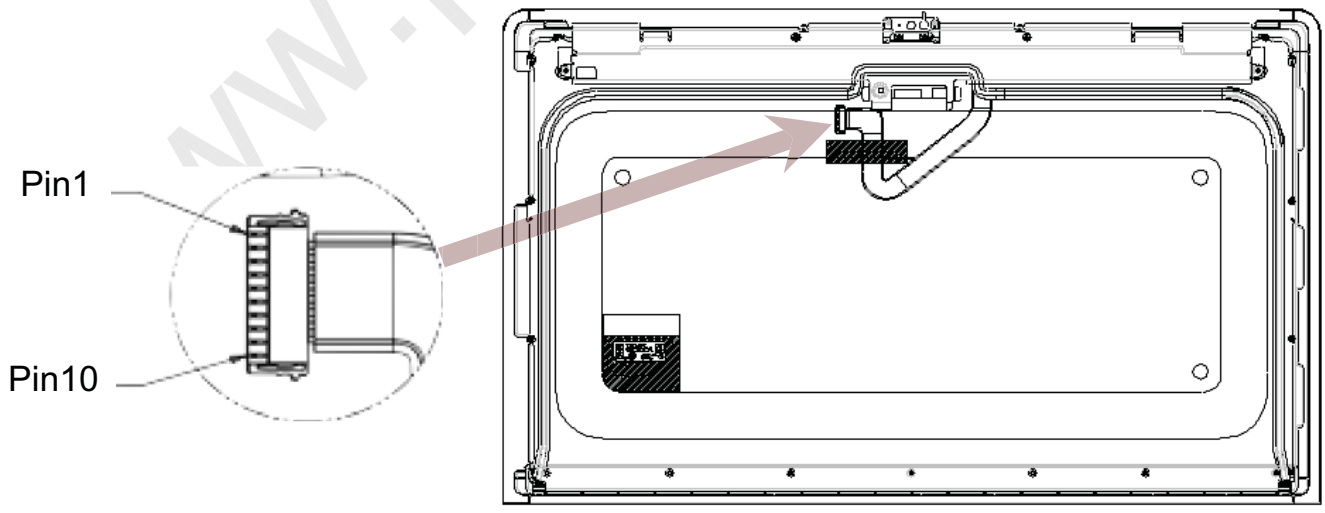
[Figure 3-1] Thermal Sensor Connector diagram

3-2-3. Backlight Interface

Driver connector: 504050-1001 (Manufactured by Molex)
Mating Connector: 504050-1091 (Manufactured by Molex)

Table 5. LED DRIVER CONNECTOR PIN CONFIGURATION

Pin	Symbol	Description	NOTES
1	NC	Not connected	
2	LED6-	LED channel 6 cathode	
3	LED5-	LED channel 5 cathode	
4	LED4-	LED channel 4 cathode	
5	CA135	Channel 1,3,5 Common anode	
6	CA246	Channel 2,4,6 Common anode	
7	LED3-	LED channel 3 cathode	
8	LED2-	LED channel 2 cathode	
9	LED1-	LED channel 1 cathode	
10	NC	Not connected	



[Figure 4] LED Driver Connector Pin

3-3. Signal Timing Specifications

All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

Table 6. TIMING TABLE

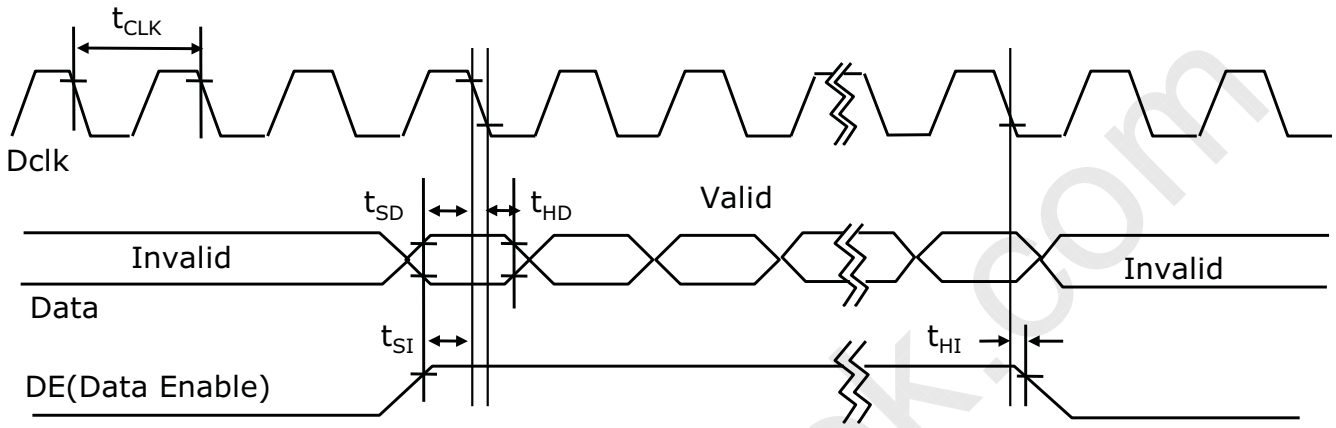
ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Period	t_{CLK}	7.22	7.22	7.22	ns	
	Frequency	-	138.5	138.5	138.5	MHz	
Horizontal	total	t_{HP}	2080	2080	2080	t_{CLK}	
	Frequency	f_H	66.59	66.59	66.59	KHz	
	Blanking		160	160	160	t_{CLK}	
	valid	t_{WH}	1920	1920	1920	$t_{CLK/2}$	
Vertical	total	t_{VP}	1111	1111	1111	t_{HP}	
	Frequency	f_V	60	60	60	Hz	
	Blanking		31	31	31	t_{HP}	
	valid	t_{WV}	1080	1080	1080	t_{HP}	

Note: Hsync period and Hsync width-active should be even number times of t_{CLK}. If the value is odd number times of t_{CLK}, display control signal can be asynchronous. In order to operate this LCM a Hsync, Vsync, and DE(data enable) signals should be used.

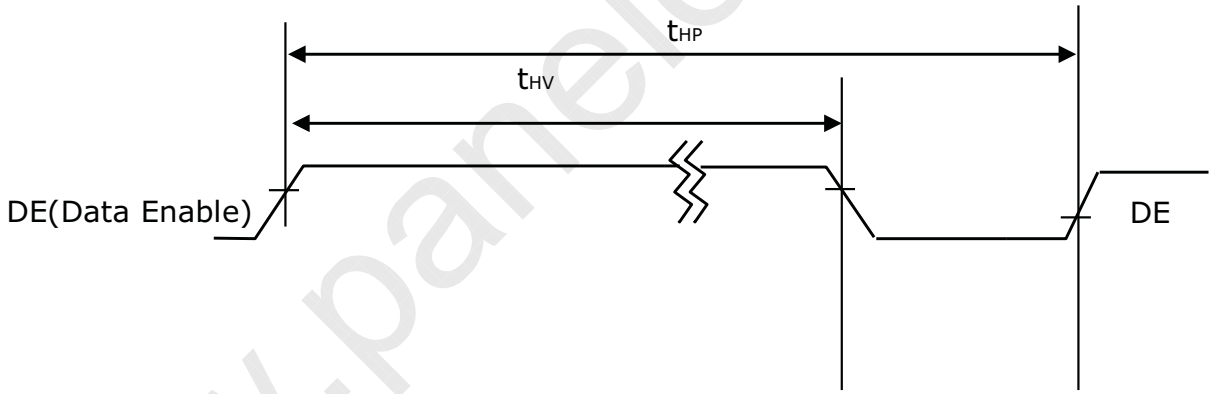
1. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.
2. Vsync and Hsync should be keep the above specification.
3. Hsync Period, Hsync Width, and Horizontal Back Porch should by any times of character number(8).
4. The polarity of Hsync, Vsync is not restricted.

3-4. Signal Timing Waveforms

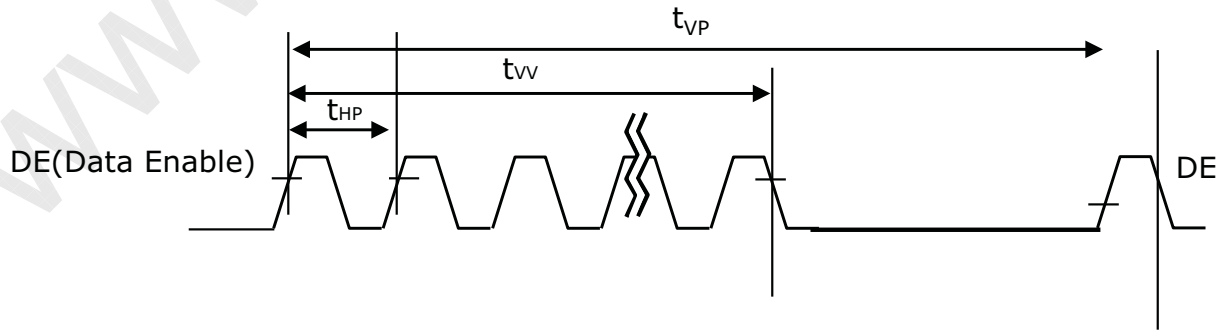
1. DCLK , DE, DATA waveforms



2. Horizontal waveform



3. Vertical waveform



3-5. Color Input Data Reference

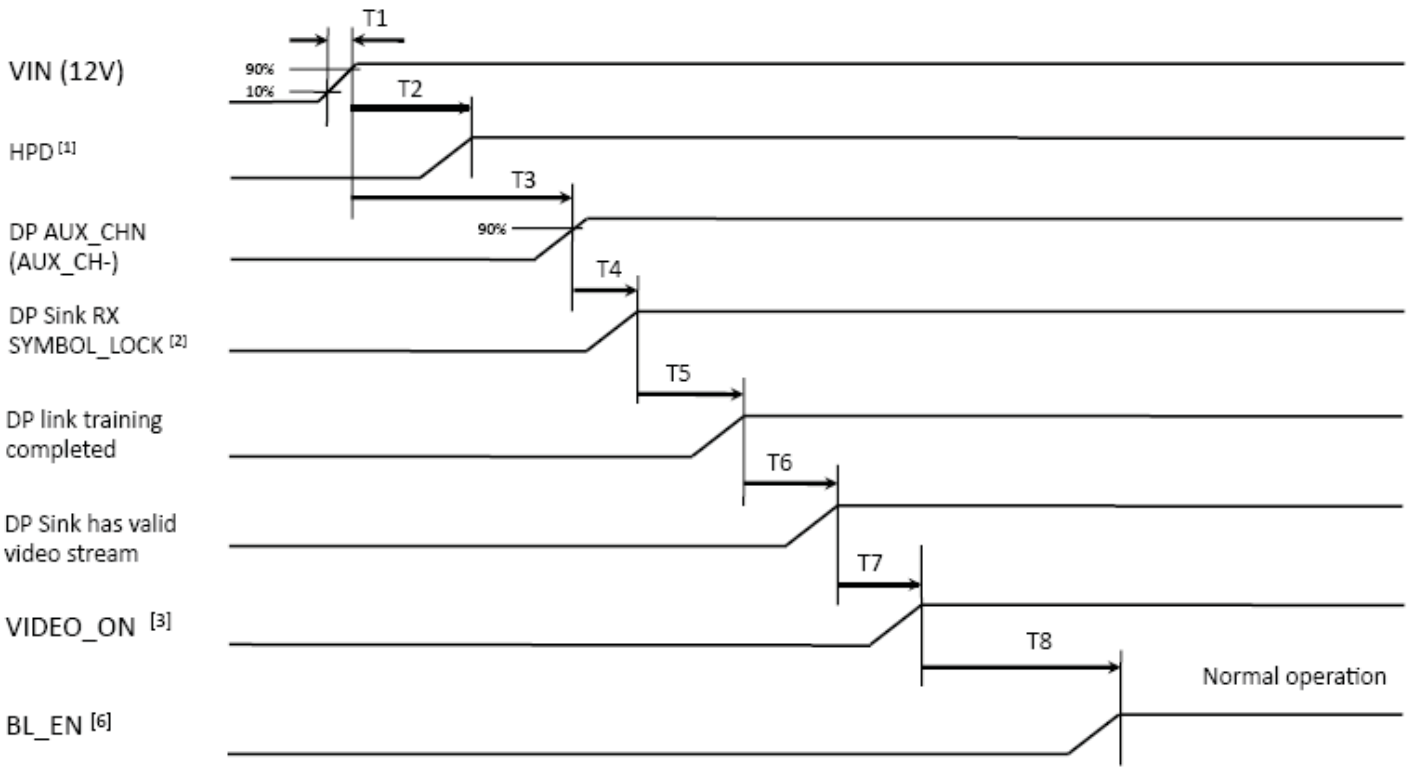
The Brightness of each primary color(red,green,blue) is based on the 8-bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

Table 7. COLOR DATA REFERENCE

Color		Input Color Data																							
		RED								GREEN								BLUE							
		MSB							LSB	MSB							LSB	MSB							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) Dark	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) Dark	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) Dark	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

3-6-1. Power Sequence

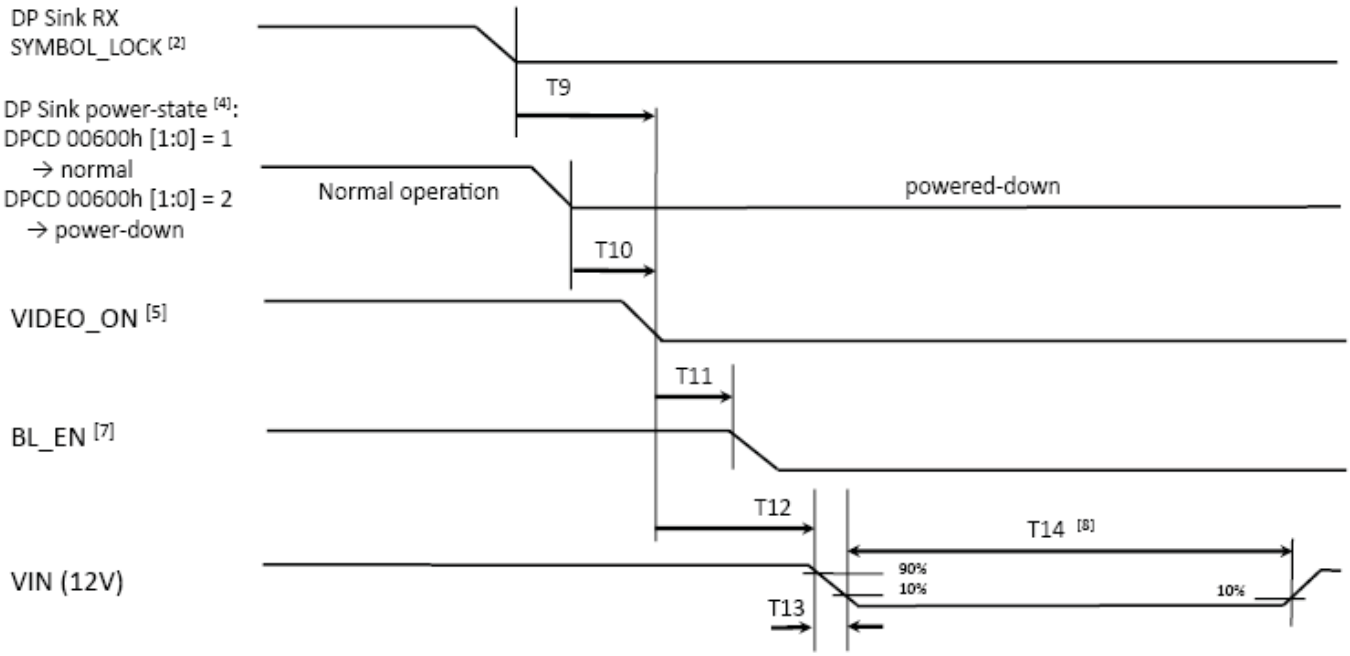


Parameter	Min	Max	Units
T1	0.4	10	ms
T2	0	-	ms
T3	-	-	ms
T4	0	-	ms
T5	0	-	ms

Parameter	Min	Max	Units
T6	0	-	ms
T7	0	200	ms
T8	200	-	ms

Notes : [1] HPD is asserted high by Sink at power-up
[2] SYMBOL_LOCK indicated by contents of Sink DPCD registers 00202h to 00205h
[3] VIDEO_ON asserted high by Sink when video to panel is valid
[6] BL_EN is an active-high MLB enable signal for panel BLU

Notes : 1. Please avoid floating state of interface signal at invalid period.
2. When the interface signal is invalid, be sure to pull down the power supply for LCD V_{LCD} to 0V.
3. LED power must be turn on after power supply for LCD and interface signal are valid.

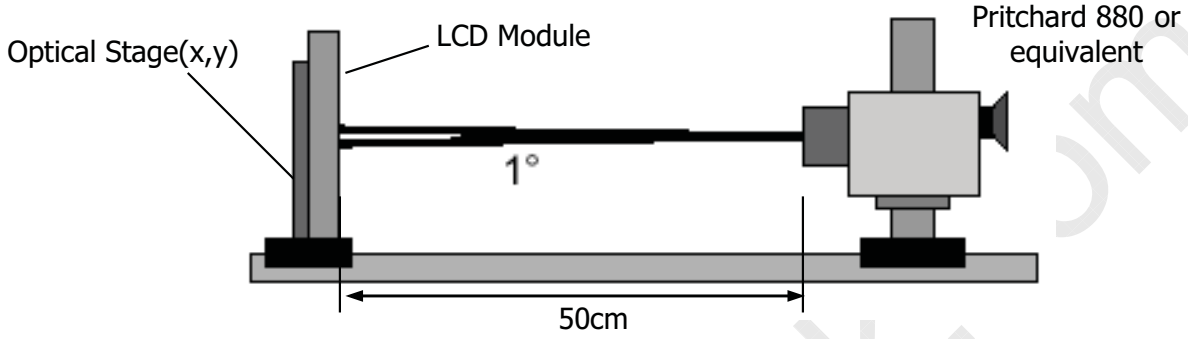


Parameter	Min	Max	Units
T9	0	10	ms
T10	0	5	ms
T11	-	10	ms
T12	0	-	ms
T13	0.01	1000	ms
T14	250	-	ms

Notes : [2] SYMBOL_LOCK indicated by contents of Sink DPCD registers 00202h to 00205h
[4] Power-state set by Source in Sink DPCD register 00600h
[5] VIDEO_ON asserted low by Sink because of :
1) loss of SYMBOL_LOCK or
2) DP Sink is powered down
[7] BL_EN must be asserted low by system as rapidly as possible when video is invalid to avoid visible artifacts
[8] T14 defines minimum off-time for 12V power
[9] min. times of 0 indicate precedence ordering of events, e.g. where actual timing is TBD

4. Optical Specifications

Optical characteristics are determined after the unit has been 'ON' for approximately 30 minutes in a dark environment at 25±2°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 ° and aperture 1 degree.
FIG. 8 presents additional information concerning the measurement equipment and method.



[Figure 5] Optical characteristic measurement equipment and method

Table 8. OPTICAL CHARACTERISTICS (Ta=25 °C, V_{LCD}=12.0V, f_V=60Hz Dclk=138.5MHz)

Parameter		Symbol	Values			Units	Notes
			Min	Typ	Max		
Contrast Ratio		CR	700	1000	-		1
Surface Luminance, white		L_{WH}	330	415	-	cd/m²	2
Luminance Variation		δ_{WHITE}	75			%	3
Response Time	Rise Time	Tr_R	-	6.5	14	ms	4.1
	Decay Time	Tr_D	-	7.5	14	ms	4.1
Color Coordinates [CIE1931]	RED	Rx	Typ -0.03	0.655	Typ +0.03		
		Ry		0.332			
	GREEN	Gx		0.296			
		Gy		0.625			
	BLUE	Bx		0.149			
		By		0.048			
	WHITE	Wx		0.313			
		Wy		0.329			
Color Shift	Horizontal	θ_{CST_H}	-	178	-	Degree	5
	Vertical	θ_{CST_V}	-	178	-		
Viewing Angle (CR>10)							
General	Horizontal	θ_H	170	178	-	Degree	6
	Vertical	θ_V	170	178	-		
Effective	Horizontal	θ_{GMA_H}		178	-	Degree	7
	Vertical	θ_{GMA_V}		178	-		
Gray Scale				2.2			8

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

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

It is measured at center point(Location P1)

2. Surface luminance(L_{WH})is luminance value at Center of the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 9.

3. The variation in surface luminance , δ WHITE is defined as :

$$\delta_{WHITE} = \frac{\text{Minimum}(L_{P1}, L_{P2}, \ldots . L_{P9})}{\text{Maximum}\,(L_{P1}, L_{P2}, \ldots . L_{P9})} \times 100$$

Where L1 to L9 are the luminance with all pixels displaying white at 9 locations.
For more information see FIG 6.

4. Response time is the time required for the display to transition from black to white (Rise Time, Tr_R) and from white to black (Decay Time, Tr_D). For additional information see FIG 10

5. Color shift is the angle at which the color difference is lower than 0.04.
For more information see FIG 11.
- Color difference (Δu'v')

$$u' = \frac{4x}{-2x+12y+3} \qquad v' = \frac{9y}{-2x+12y+3}$$

$$\Delta u'v' = \sqrt{(u'_1 - u'_2)^2 + (v'_1 - v'_2)^2}$$

u'1, v'1 : u'v' value at viewing angle direction
u'2, v'2 : u'v' value at front (θ=0)

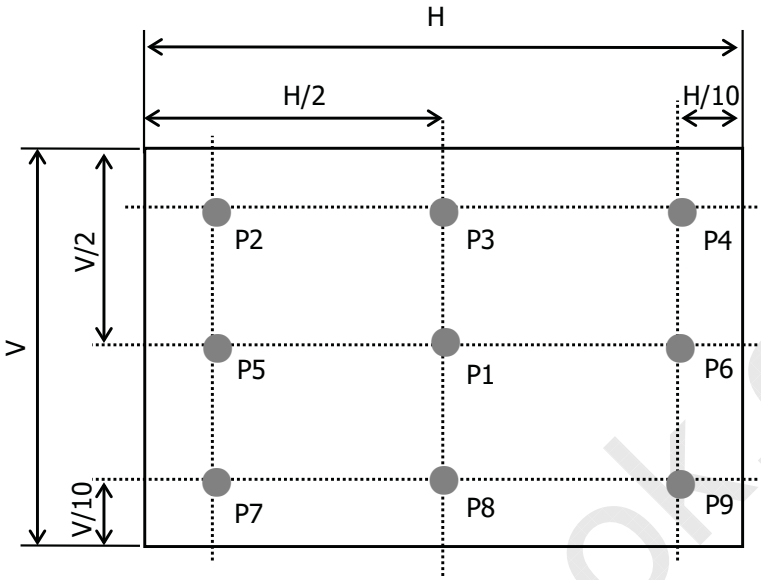
- Pattern size : 25% Box size
- Viewing angle direction of color shift : Horizontal, Vertical

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 FIG 12.

7. Effective viewing angle is the angle at which the gamma shift of gray scale is lower than 0.3.
For more information see FIG 13 and FIG 14.

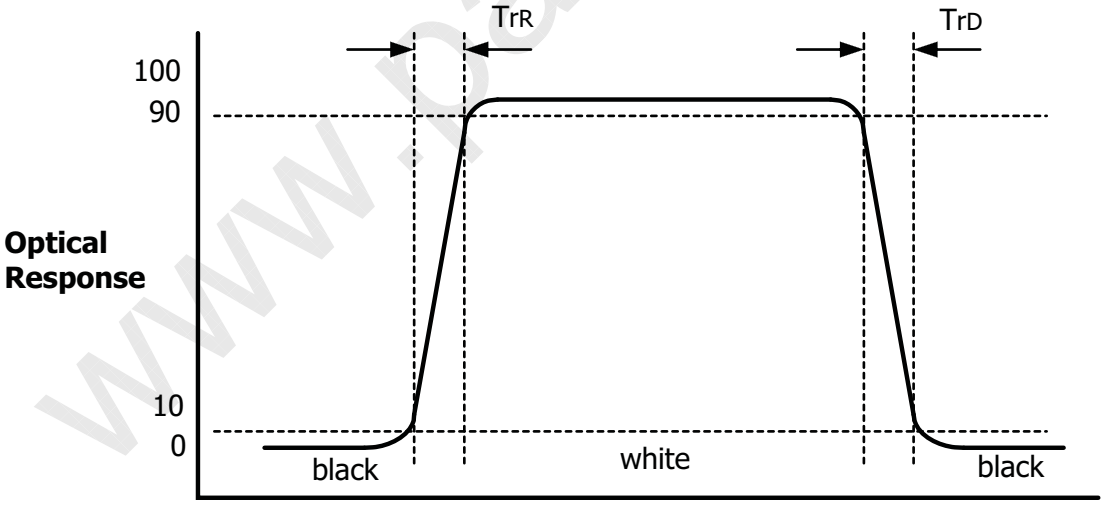
8. Gray scale specification
Gamma Value is approximately 2.2. For more information see Table 10.

Measuring point for surface luminance & measuring point for luminance variation.



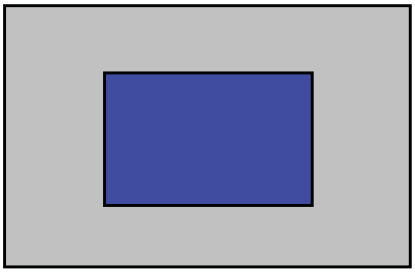
[FIG 6] Measure Point for Luminance

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



[FIG 7] Response Time

Color shift is defined as the following test pattern and color.



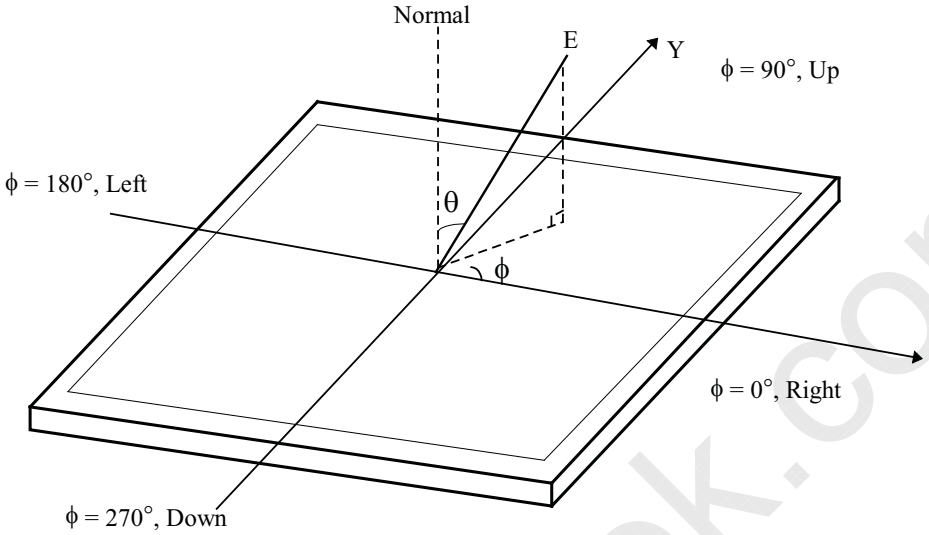
25% Box size

[FIG 8] Test Pattern

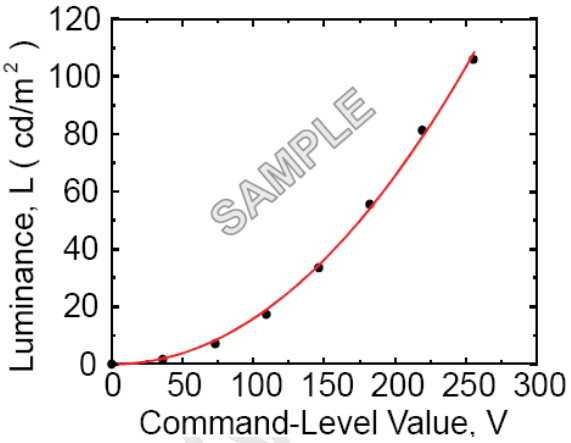
Average RGB values in Bruce RGB for Macbeth Chart

	Dark skin	Light skin	Blue sky	Foliage	Blue flower	Bluish green
R	98	206	85	77	129	114
G	56	142	112	102	118	199
B	45	123	161	46	185	178
	Orange	Purplish blue	Moderate red	Purple	Yellow green	Orange yellow
R	219	56	211	76	160	230
G	104	69	67	39	193	162
B	24	174	87	86	58	29
	Blue	Green	Red	Yellow	Magenta	cyan
R	26	72	197	241	207	35
G	32	148	27	212	62	126
B	145	65	37	36	151	172
	White	Neutral 8	Neutral 6.5	Neutral 5	Neutral 3.5	black
R	240	206	155	110	63	22
G	240	206	155	110	63	22
B	240	206	155	110	63	22

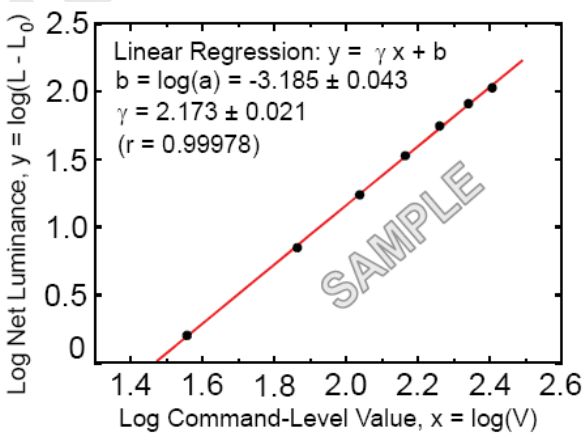
Dimension of viewing angle range.



[FIG 9] Viewing angle



[FIG 10] Sample Luminance vs. gray scale (using a 256 bit gray scale)



[FIG 11] Sample Log-log plot of luminance vs. gray scale

$$L = aV^{r} + L_b$$

$$\log(L - L_b) = r\log(V) + \log(a)$$

Here the Parameter α and γ relate the signal level V to the luminance L.

The GAMMA we calculate from the log-log representation (FIG. 11)

Table 9. Gray Scale Specification

Gray Level	Relative Luminance [%] (Typ.)
0	0.10
31	1.08
63	4.71
95	11.5
127	21.7
159	35.5
191	53.1
223	74.5
255	100

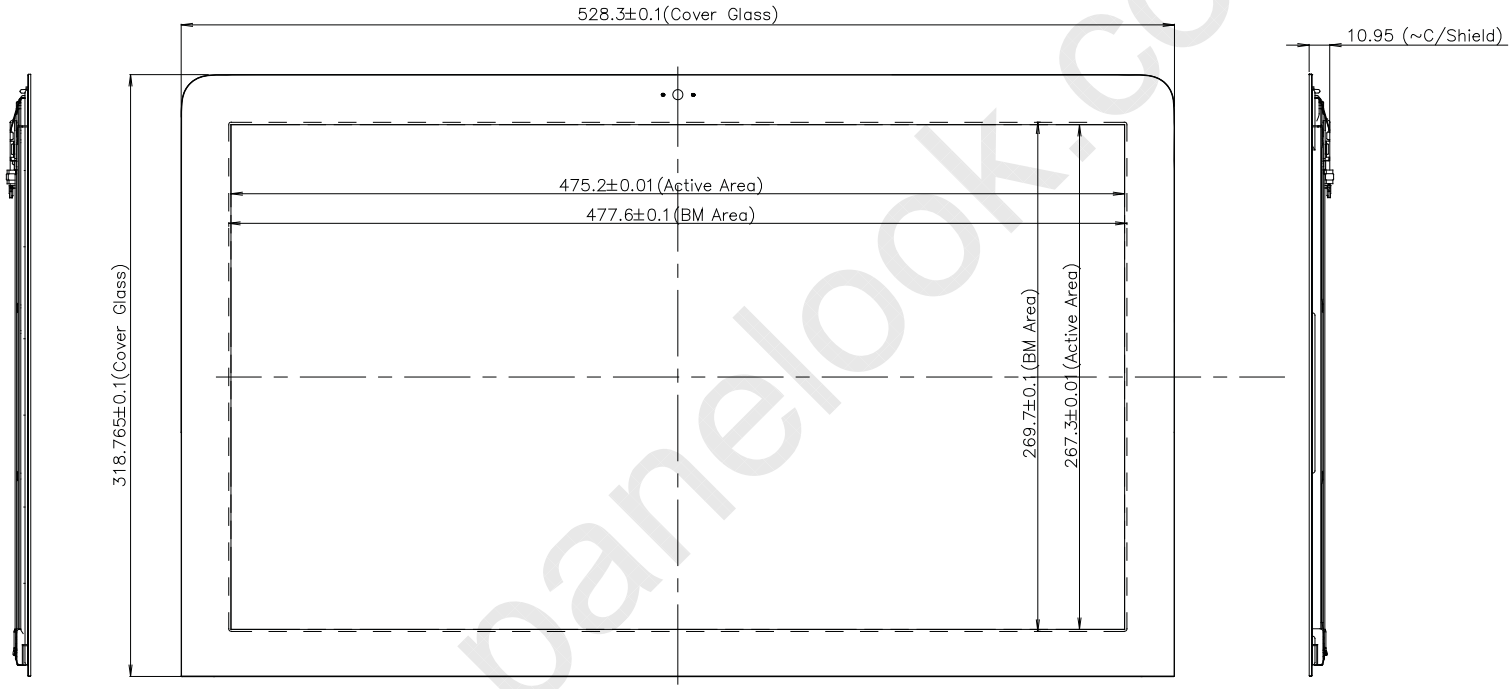
5. Mechanical Characteristics

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

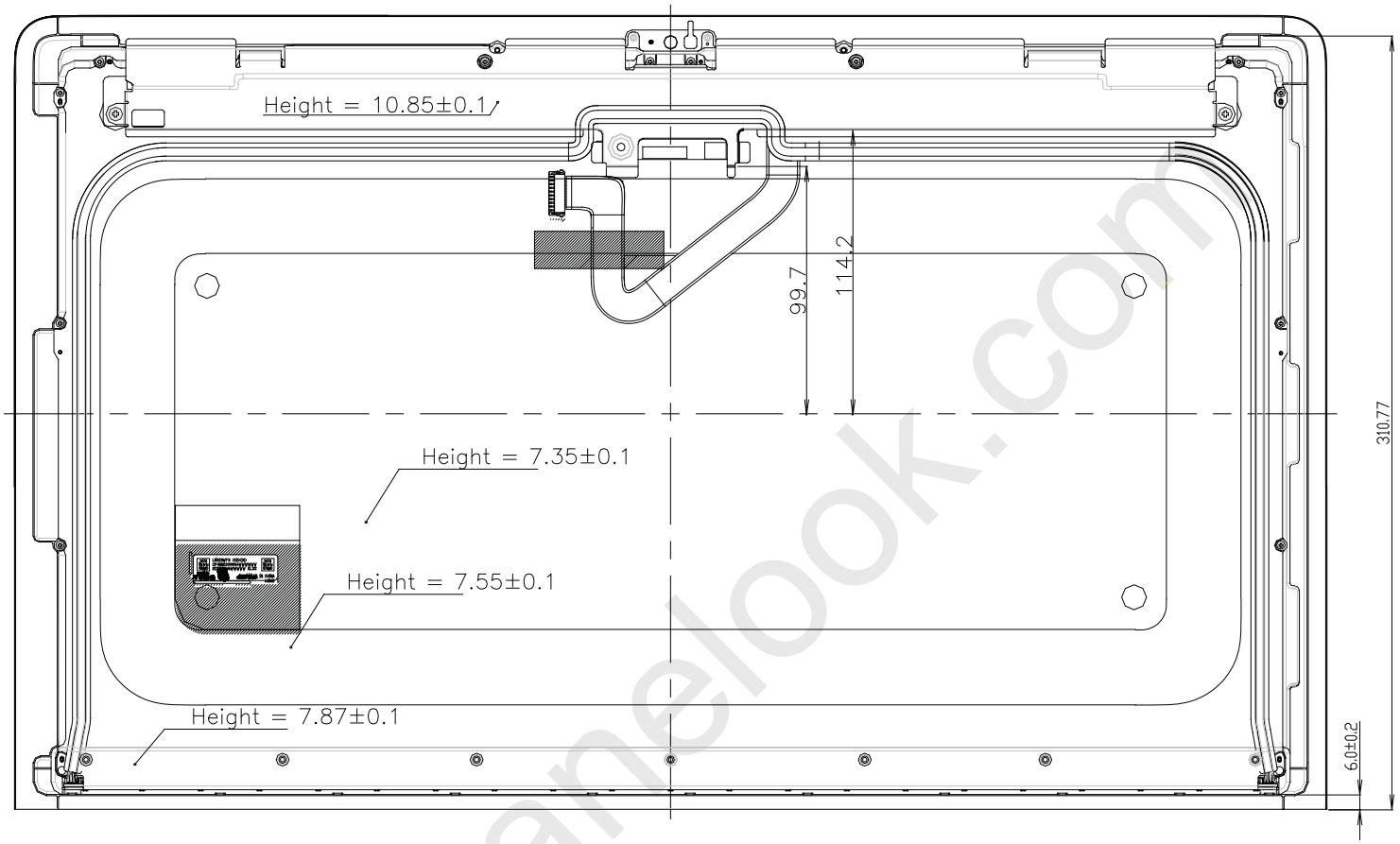
Outline Dimension	Horizontal	528.3mm
	Vertical	318.765mm
	Depth	10.95mm (with Cover Shield)
Bezel Area	Horizontal	477.6mm
	Vertical	269.7mm
Active Display Area	Horizontal	475.2mm
	Vertical	267.3mm
Weight	2050g (Typ.), 2150g(Max.)	
Surface Treatment	Cover Glass with Anti-Reflection layer coated	

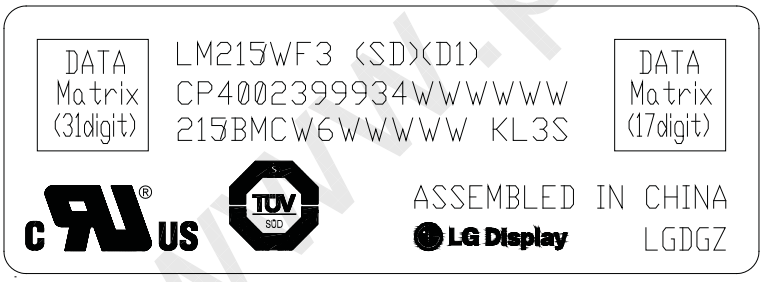
Notes : Please refer to a mechanic drawing in terms of tolerance at the next page.

<FRONT VIEW>



<REAR VIEW>





Notes
1. Unspecified tolerances are to be ±0.1mm.
2. Unspecified contents have to be discussed with designer
3. LCM Weight : 2000g (Typ.) , 2100g (Max.)
4. The ass'y should have no defect in appearance.
5. LCM Flatness spec : Max 0.5mm(Cup)
   – Measuring method : LCM Flatness of 153pts can be mea
6. In case of FAI/cpk data in detail, refer to (3/3) drawing

6. Reliability

Environment test condition

No	Test Item	Condition
1	High temperature storage test	Ta= 60°C 240h
2	Low temperature storage test	Ta= -20°C 240h
3	High temperature operation test	Ta= 50°C 50%RH 240h
4	Low temperature operation test	Ta= 0°C 240h
5	Vibration test (non-operating)	Wave form : random Vibration level : 1.0G RMS Bandwidth : 10-300Hz Duration : X,Y,Z, 20 min One time each direction
6	Shock test (non-operating)	Shock level : 120G Waveform : half sine wave, 2ms Direction : ±X, ±Y, ±Z One time each direction
7	Humidity condition Operation	Ta= 40 °C ,90%RH
8	Altitude storage / shipment	0 - 40,000 feet(12,192m)

7. International Standards

7-1. Safety

a) UL 60950-1, Underwriters Laboratories Inc.
Information Technology Equipment - Safety - Part 1 : General Requirements.

b) CAN/CSA C22.2 No.60950-1-07, Canadian Standards Association.
Information Technology Equipment - Safety - Part 1 : General Requirements.

c) EN 60950-1, European Committee for Electrotechnical Standardization (CENELEC).
Information Technology Equipment - Safety - Part 1 : General Requirements.

d) IEC 60950-1, The International Electrotechnical Commission (IEC).
Information Technology Equipment - Safety - Part 1 : General Requirements.

7-2. EMC

a) ANSI C63.4 "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz." American National Standards Institute (ANSI), 2003.

b) CISPR 22 "Information technology equipment – Radio disturbance characteristics – Limit and methods of measurement." International Special Committee on Radio Interference (CISPR), 2005.

c) CISPR 13 "Sound and television broadcast receivers and associated equipment – Radio disturbance characteristics – Limits and method of measurement." International Special Committee on Radio Interference (CISPR), 2006.

7-3. Environment

a) RoHS, Directive 2002/95/EC of the European Parliament and of the council of 27 January 2003

8. Packing

8-1. Designation of Lot Mark

a) Lot Mark

A	B	C	D	E	F	G	H	I	J	K	L	M

A,B,C : SIZE(INCH)
D : YEAR
E : MONTH
F ~ M : SERIAL NO.

Note

1. YEAR

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mark	A	B	C	D	E	F	G	H	J	K

2. MONTH

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	3	4	5	6	7	8	9	A	B	C

b) Location of Lot Mark

Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

8-2. Packing Form

a) Package quantity in one box : 11pcs

b) Box Size : 408 X 355 X 600 (mm)

9. PRECAUTIONS

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

9-1. 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 the 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.

9-2. 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 higher 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 minimized the interference.
(7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.
(8) A screw which is fastened up the steels should be a machine screw.
(if not, it causes metallic foreign material and deal LCM a fatal blow)
(9) Please do not set LCD on its edge.

9-3. 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.

9-4. PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

9-5. 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°C and 35°C 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.

9-6. 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 glue 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 surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.