



晶采光電科技股份有限公司
AMPIRE CO., LTD.

SPECIFICATIONS FOR LCD MODULE

CUSTOMER	
CUSTOMER PART NO.	
AMPIRE PART NO.	AM-640480E5TMQW-00H(R)
APPROVED BY	
DATE	

Preliminary Specification

Formal Specification

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*This specification is subject to change without notice.

RECORD OF REVISION

Revision Date	Page	Contents	Editor
2020/12/04	--	New Release	Tank

1. INTRODUCTION

This is a color active matrix TFT-LCD that uses amorphous silicon TFT as a switching device. This model is composed of a 10.4 inch TFT-LCD panel, a driving circuit and LED backlight system. This TFT-LCD has a high resolution (640(R.G.B) X 480) and can display up to 262,144 colors.

2. PHYSICAL SPECIFICATIONS

Item	Specifications	unit
Display resolution(dot)	640RGB (W) x 480(H)	dots
Display area	211.2 (W) x 158.4 (H)	mm
Pixel pitch	0.33(H) x 0.33 (V)	mm
Color configuration	R.G.B Vertical stripe	
Overall dimension	225.5(W) x 176.3(H) x 9.34(D)	mm
Brightness	500	cd/m ²
Contrast ratio	1500 : 1	
Backlight unit	LED	
Display color	262,144	colors

3. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN	MAX	UNIT	NOTE
Power Supply Voltage	V _{CC}	-0.3	5	V	
Signal Input Voltage	DCLK, DE R0~R5 G0~G5 B0~B5	0.7V _{CC}	V _{CC}	V	
Operation Temperature	Top	-30	80	°C	(1)
Storage Temperature	Tstg	-30	80	°C	(1)

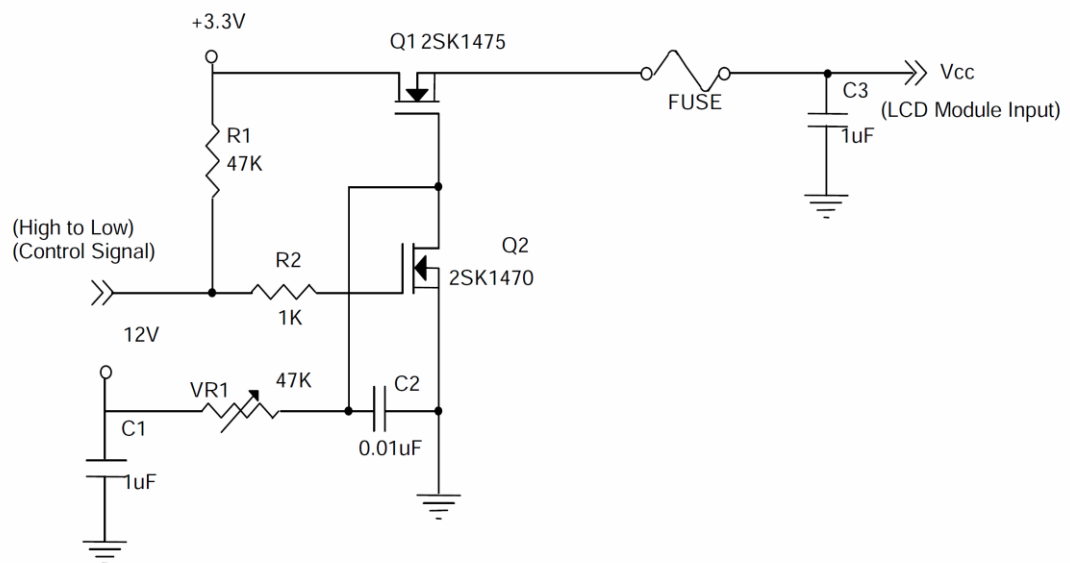
4. ELECTRICAL CHARACTERISTICS

4-1 TFT LCD Module voltage

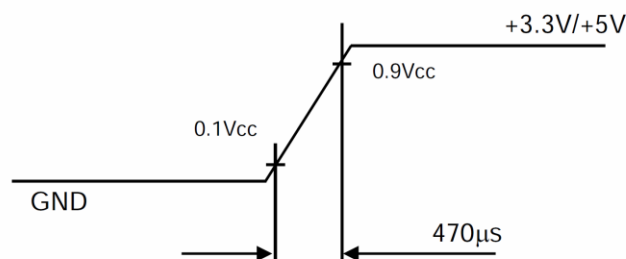
Parameter	Symbol	Value			Unit	Note	
		Min.	Typ.	Max.			
Power Supply Voltage	VCC	3.0	3.3	3.6	V	at VCC=3.3V	
		4.75	5.0	5.25	V	at VCC=5.0V	
Power Supply Current	White	---	390	490	540	mA	(3)a, at VCC=3.3V, 60Hz
			290	390	440	mA	(3)a, at VCC=5.0V, 60Hz
	Black	---	370	470	520	mA	(3)b, at VCC=3.3V, 60Hz
			280	380	430	mA	(3)b, at VCC=5.0V, 60Hz
Power Consumption	P _L	---	1.617	---	W	VCC=3.3V, 60Hz	
Logic input voltage	V _{IH}	0.7V _{CC}	-	V _{CC}	V		
	V _{IL}	0	-	0.3V _{CC}	V		

Note (1) The module is recommended to operate within specification ranges listed above for normal function.

Note (2) Measurement Conditions:



Vcc rising time is 470μs



Note (3) The specified power supply current is under the conditions at $T_a = 25 \pm 2 \text{ }^\circ\text{C}$, $f_v = 60 \text{ Hz}$, where as a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern



Active Area

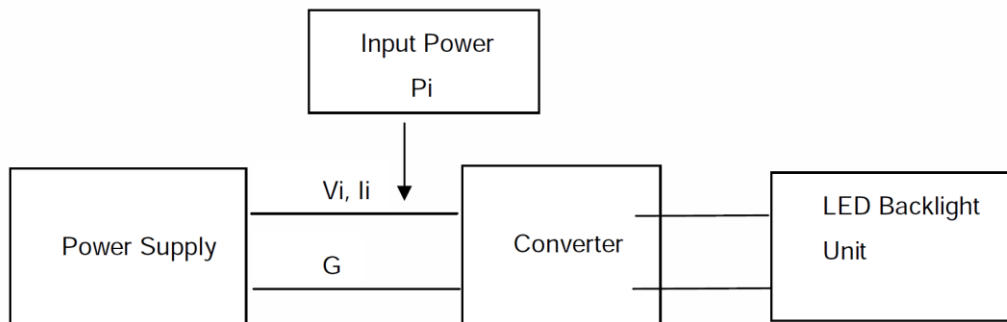
4-2 TFT LCD current consumption

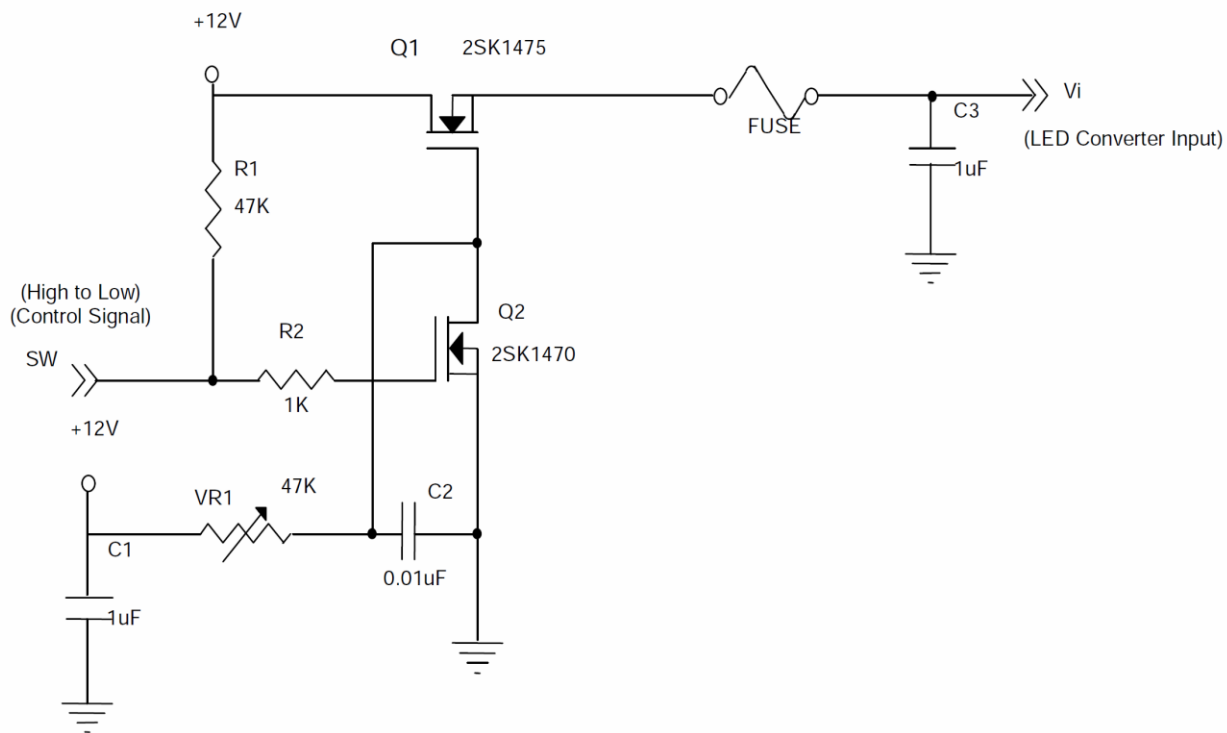
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Converter Power Supply Voltage		V_i	10.8	12.0	12.6	V	(Duty 100%)
Converter Power Supply Current		I_i	---	0.48	---	A	(1) $V_i = 12V$ (Duty 100%)
Converter Power Consumption		P_i	---	5.76	---	W	(1) $V_i = 12V$ (Duty 100%)
EN Control Level	Backlight on		2.0	3.3	5.0	V	
	Backlight off		0	---	0.8	V	
PWM Control Level	PWM High Level		2.0	3.3	5.0	V	
	PWM Low Level		0	---	0.8	V	
PWM Control Duty Ratio			20		100	%	
PWM Control Frequency		f_{PWM}	190	200	20K	Hz	
LED Life Time		L_L	50,000			Hrs	(2)

Note (1) LED current is measured by utilizing a high frequency current meter as shown below:

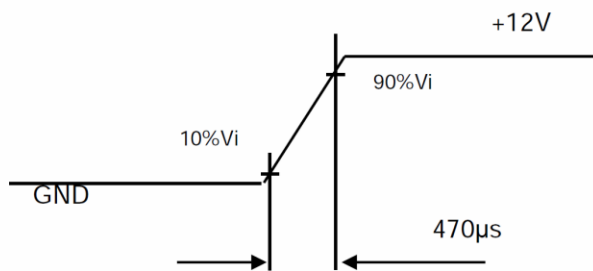
Note (2) The lifetime of LED is defined as the time when it continues to operate under the conditions at $T_a = 25 \pm 2 \text{ }^\circ\text{C}$ and $I_{LED} = 70\text{mA}_{DC}$ (LED forward current) until the brightness becomes $\leq 50\%$ of its original value. And minimum LED lifetime is estimated and provided by Nichia in Japan.

Operating LED under high temperature environment will reduce life time and lead to color shift.

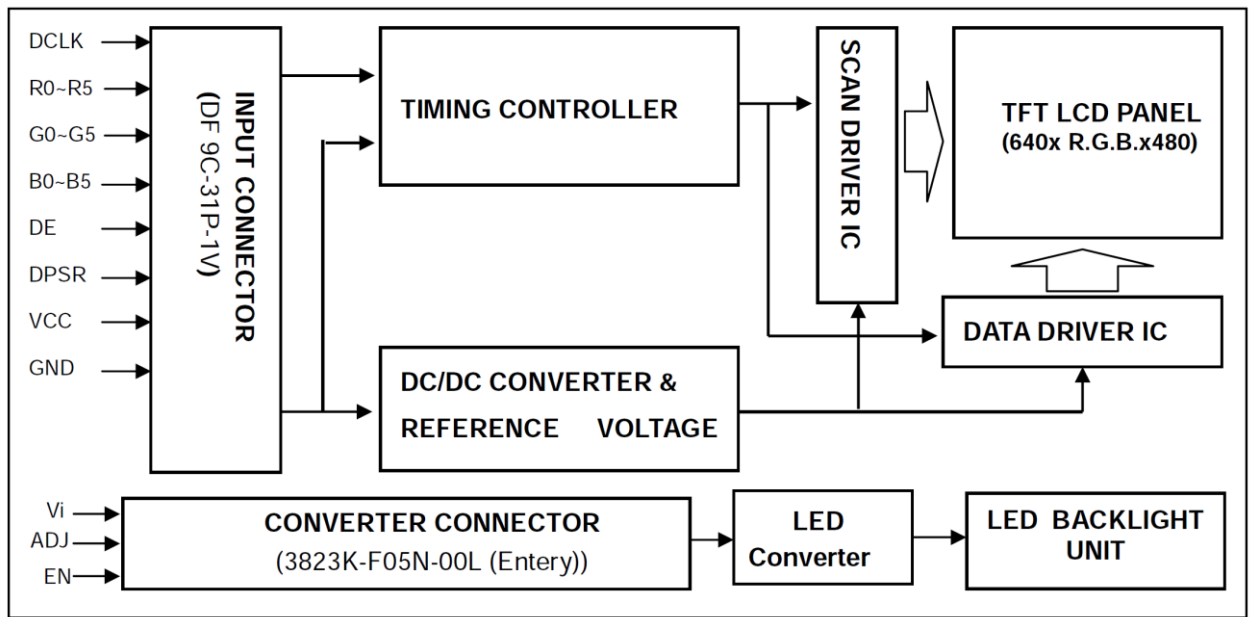




Vi rising time is 470us



5. BLOCK DIAGRAM



6. INTERFACE

6-1 LCD Module interface (CN1):

Pin	Name	Description
1	GND	Ground
2	DCLK	Dot clock
3	N.C.	N.C.
4	N.C.	N.C.
5	GND	Ground
6	R0	Red data (LSB)
7	R1	Red data
8	R2	Red data
9	R3	Red data
10	R4	Red data
11	R5	Red data (MSB)
12	GND	Ground
13	G0	Green data (LSB)
14	G1	Green data
15	G2	Green data
16	G3	Green data
17	G4	Green data
18	G5	Green data (MSB)
19	GND	Ground
20	B0	Blue data (LSB)
21	B1	Blue data
22	B2	Blue data
23	B3	Blue data
24	B4	Blue data
25	B5	Blue data (MSB)
26	GND	Ground
27	DE	Data enable signal
28	VCC	Power supply
29	VCC	Power supply
30	N.C.	Reserved, please keep it floating.
31	DPSR	Selection of scan direction

Note (1) Connector Part No.: DF 9C-31P-1V or equivalent.

6-2 Backlight interface (CN2):

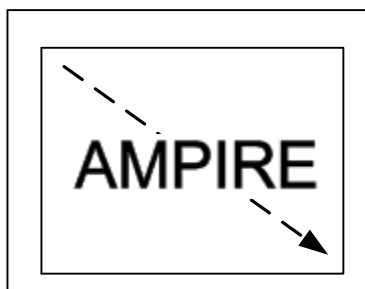
Pin	Symbol	Description	Remark
1	V_i	Converter input voltage	12V
2	V_{GND}	Converter ground	Ground
3	EN	Enable pin	
4	ADJ	Backlight Adjust	PWM Dimming
5	NC	Not Connect	

Note (1) Connector Part No.: 3823K-F05N-00L (Entry) or equivalent

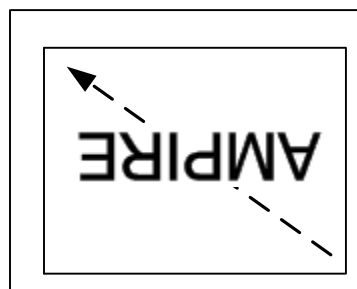
Note (2) User's connector Part No.: H208K-P05N-02B (Entry) or equivalent

6-3 Scanning Direction

The following figures show the image seen from the front view.
The arrow indicates the direction of scan.



Normal scan (DPSR: Low or Open)



Reverse scan (DPSR: High)

7. TIMING SPECIFICATION

7-1 Input Signal Timing Specifications.

The input signal timing specifications are shown as the following table and timing diagram.

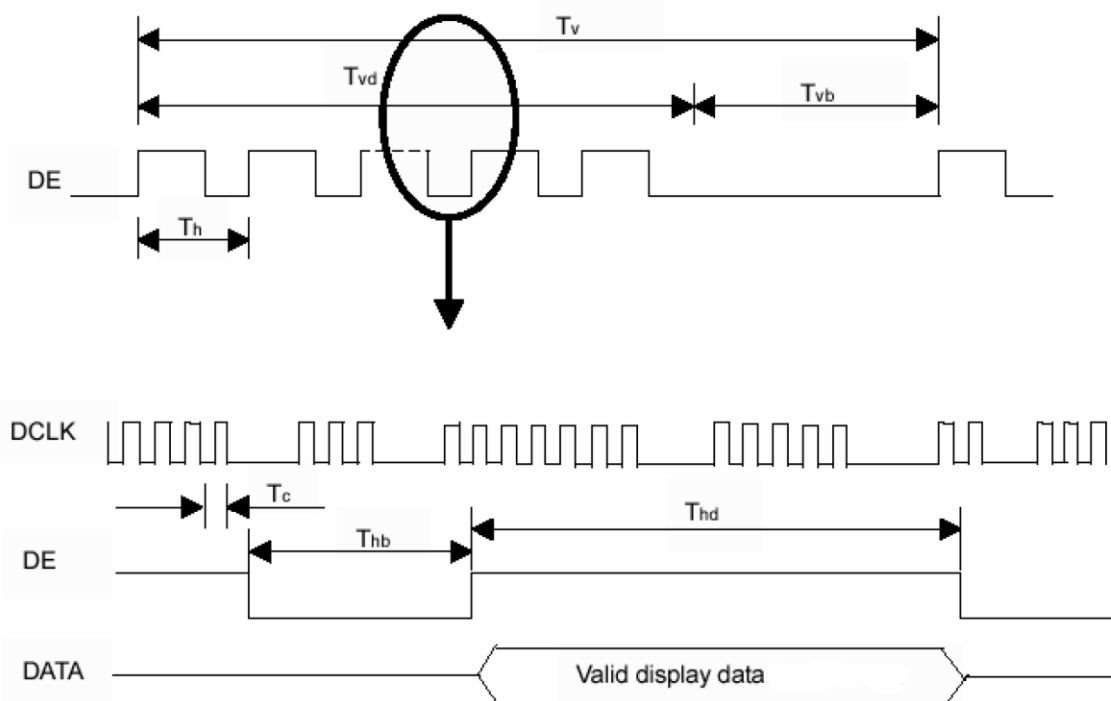
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Dot Clock	Frequency	Fc	21	25.175	29	MHz	-
	Period	Tc	34.48	39.72	47.62	ns	
	High Time	TCIH	0.35 Tc	0.5 Tc	0.65 Tc	ns	
	Low Time	TCIL	0.35 Tc	0.5 Tc	0.65 Tc	ns	
Dot Data	Setup Time	Tlvs	8	-	-	ns	(4)
	Hold Time	Tlvh	12	-	-	ns	(4)
DE	Setup Time	TSTC	8	-	-	ns	(5)
	Hold Time	THTC	12	-	-	ns	(5)
Horizontal Active Display Term	Frame Rate	Fr	-	60	-	Hz	
	Total	Th	730	800	900	Th	Th=Thd+Thb
	Display	Thd	-	640	-	Th	-
	Blank	Thb	90	160	260	Th	-
Vertical Active Display Term	Total	Tv	485	525	576	Tc	Tv=Tvd+Tvb
	Display	Tvd	-	480	-	Tc	-
	Blank	Tvb	5	45	96	Tc	-

Note : (1) This module is operated by DE only mode

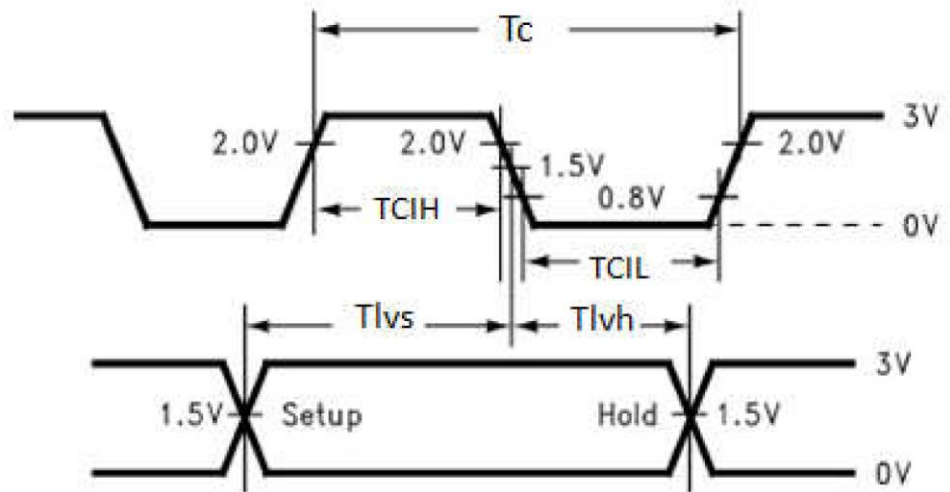
(2) Frame rate is 60Hz

(3) The Tv(Tvd+Tvb) must be integer, otherwise, this module would operate abnormally.

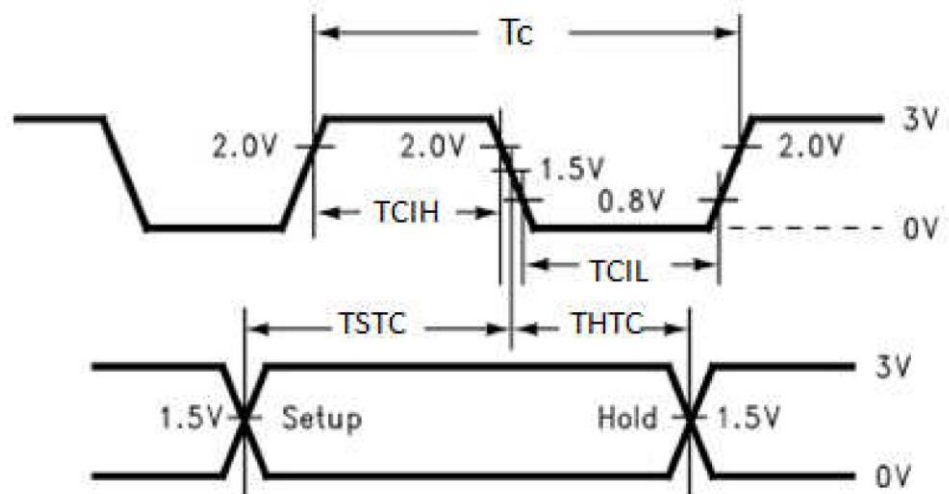
INPUT SIGNAL TIMING DIAGRAM



(4) Clock and data setup/hold and high/low time input waveforms.



(5) Clock and DE setup/hold and high/low time input waveforms.



7-2 Color Data Assignment

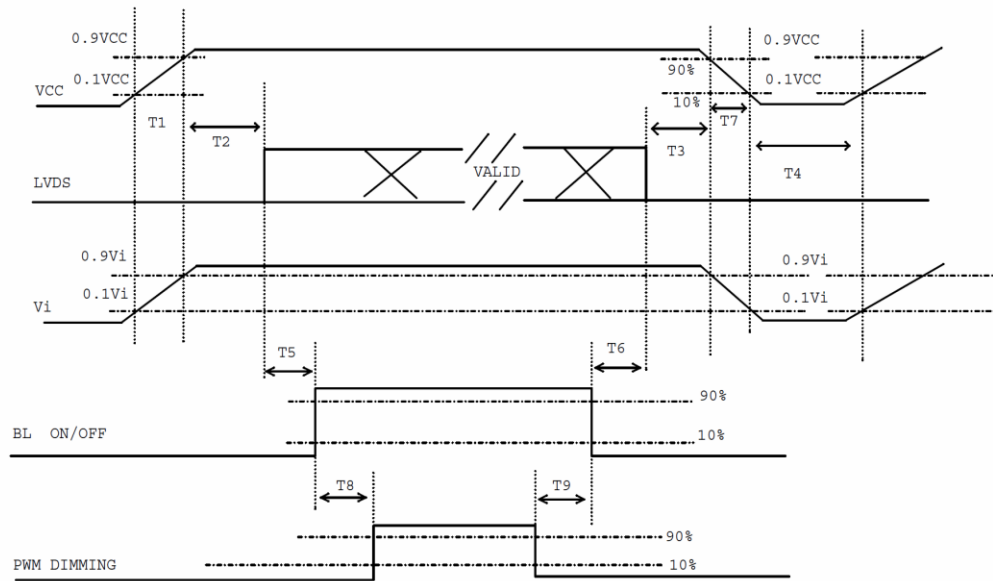
The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																	
		Red						Green						Blue					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	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
Gray Scale Of Red	Red(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Green	Green(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Gray Scale Of Blue	Blue(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Note (1) 0: Low Level Voltage, 1: High Level Voltage

7-3 Power On/Off Sequence

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should follow the conditions shown in the following diagram.



Power ON/OFF sequence

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0 V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	200	-	-	ms
T6	20	-	-	ms
T7	5	-	300	ms
T8	10	-	-	ms
T9	10	-	-	ms

8. OPTICAL CHARACTERISTICS

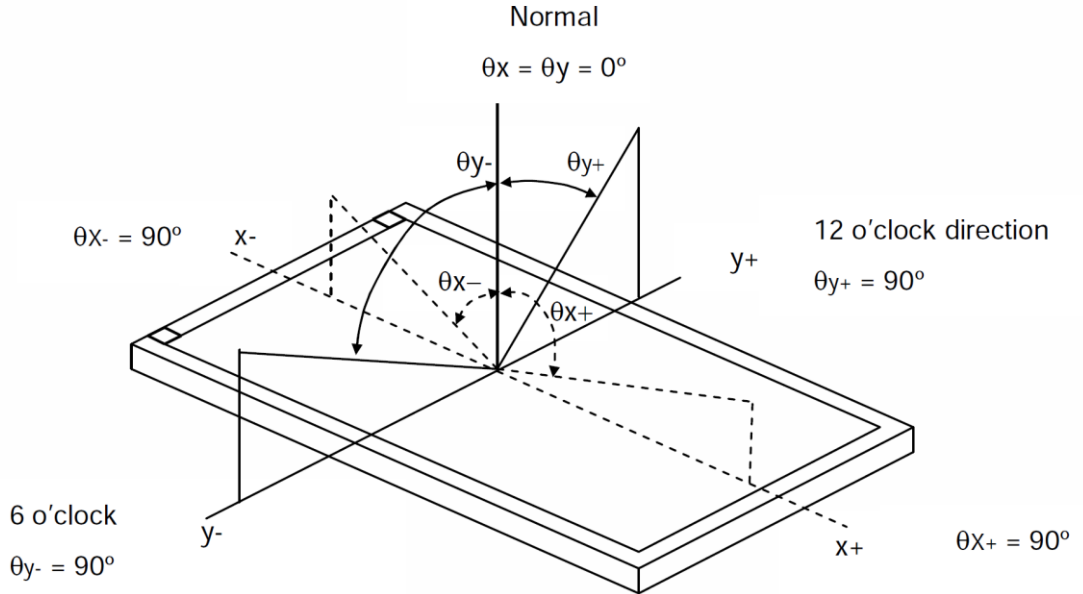
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note				
Color Chromaticity	Red	Rx	Typ - 0.05	0.619	Typ + 0.05	-	(1), (5)				
		Ry		0.357		-					
	Green	Gx		0.333		-					
		Gy		0.562		-					
	Blue	Bx		0.145		-					
		By		0.092		-					
	White	Wx		0.313		-					
		Wy		0.329		-					
	Center Luminance of White	L_C				450		500	-	-	(4), (5)
	Contrast Ratio	CR				1000		1500	-	-	(2), (5)
Response Time	T_R	$\theta_x=0^\circ, \theta_y=0^\circ$	-	14	19	ms	(3)				
	T_F		-	9	14	ms					
White Variation	δW	$\theta_x=0^\circ, \theta_y=0^\circ$	-	-	1.4	-	(5), (6)				
Viewing Angle	Horizontal	θ_{x+}	CR \geq 10	80	88	-	Deg.	(1), (5)			
		θ_{x-}		80	88	-					
	Vertical	θ_{y+}		80	88	-					
		θ_{y-}		80	88	-					

Measuring Condition

To be measured on the center area of panel after 10 minutes operation.

- Measuring surrounding : Dark room
- Ambient temperature : $25\pm 2^\circ\text{C}$
- 15min. Warm-up time.

Note (1) Definition of Viewing Angle (θ_x, θ_y):



Note (2) Definition of Contrast Ratio, (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio, CR} = L_{63} / L_0$$

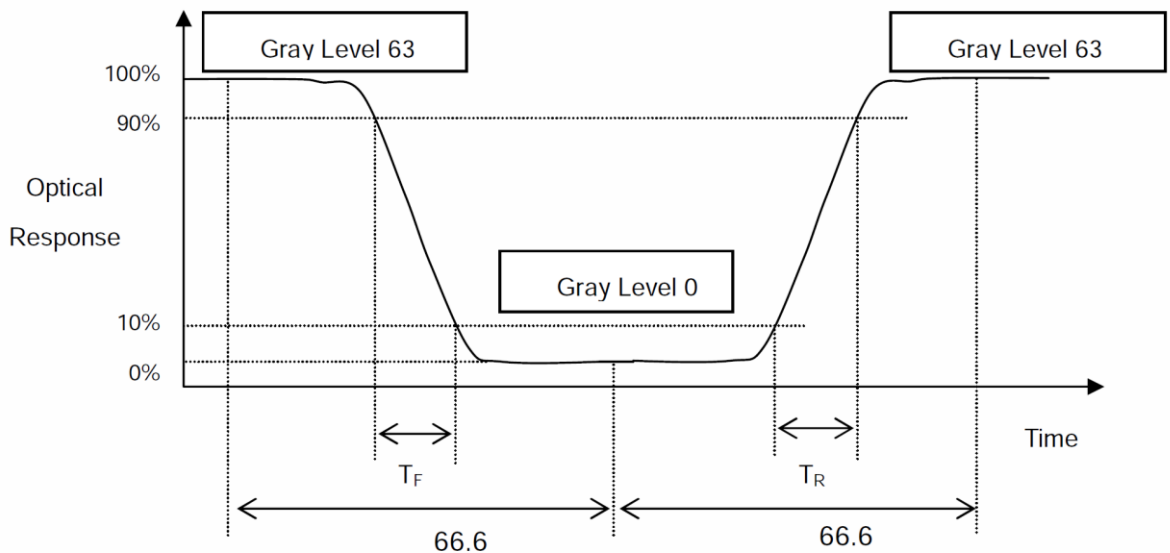
L63: Luminance of gray level 63

L 0: Luminance of gray level 0

$$\text{CR} = \text{CR} (5)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

Note (3) Definition of Response Time (T_R, T_F) and measurement method:



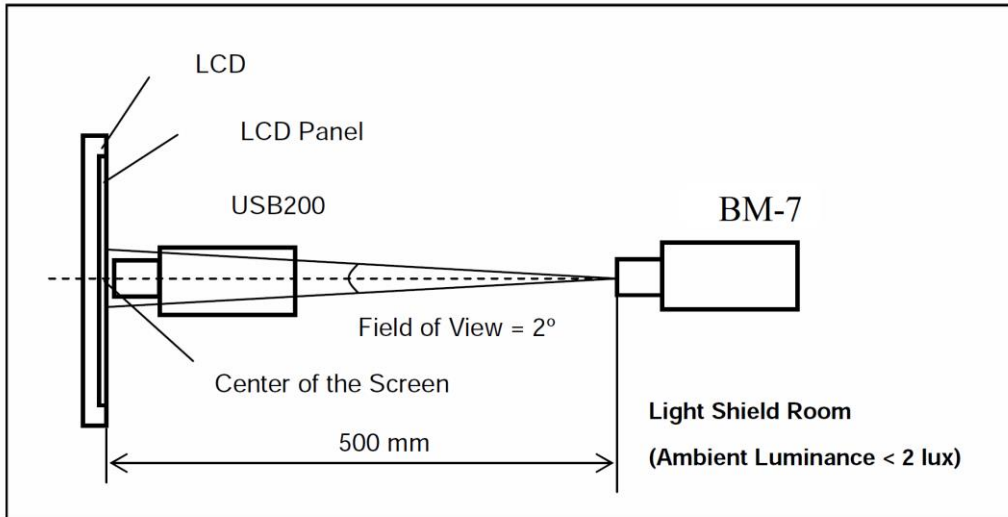
Note (4) Definition of Luminance of White (L_C):

Measure the luminance of gray level 63 at center point and 5 points

$L_c = L(5)$, where $L(X)$ is corresponding to the luminance of the point X at the figure in Note (6).

Note (5) Measurement Setup:

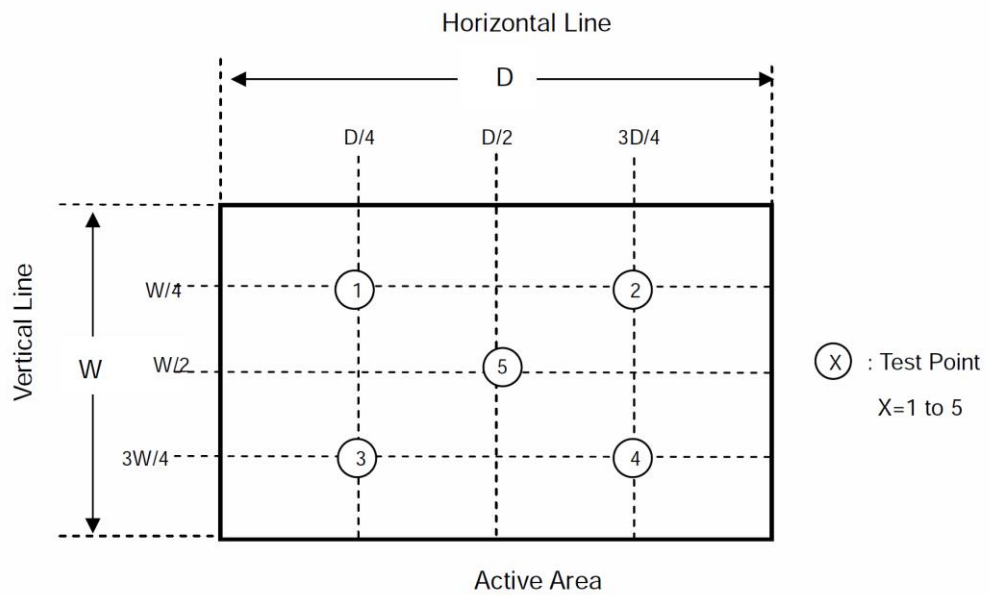
The LCD assembly should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 30 minutes in a windless room.



Note (6) Definition of White Variation (δW):

Measure the luminance of gray level 63 at 5 points

$$\delta W = \text{Maximum} [L(1), L(2), L(3), L(4), L(5)] / \text{Minimum} [L(1), L(2), L(3), L(4), L(5)]$$



9. RELIABILITY TEST CONDITIONS

Test Item	Test Conditions	Note
High Temperature Operation	80±3°C ,Dry t=240 hrs	
Low Temperature Operation	-30±3°C, Dry t=240 hrs	
High Temperature Storage	80±3°C , Dry t=240 hrs	1,2
Low Temperature Storage	-30±3°C ,Dry t=240 hrs	1,2
Thermal Shock Test	-20°C ~ 25°C ~ 70°C 30 m in. 5 min. 30 min. (1 cycle) Total 100 cycle(Dry)	1,2
Storage Humidity Test	60 °C, Humidity 90%, 240 hrs	1,2
Vibration Test (Packing)	Sweep frequency : 10 ~ 55 ~ 10 Hz/1min Amplitude : 0.75mm Test direction : X.Y.Z/3 axis Duration : 30min/each axis	2

Note(1) Condensation of water is not permitted on the module.

Note(2) The module should be inspected after 1 hour storage in normal conditions (15-35°C, 45-65%RH).

Note(3) The module shouldn't be tested over one condition, and all the tests are independent.

Note(4) All reliability tests should be done without the protective film.

Definitions of life end point:

- Current drain should be smaller than the specific value.
- Function of the module should be maintained.
- Appearance and display quality should not have degraded noticeably.
- Contrast ratio should be greater than 50% of the initial value.

10. USE PRECAUTIONS

10.1 Handling Precautions

- 10.1.1. The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- 10.1.2. If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.
- 10.1.3. Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- 10.1.4. The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- 10.1.5. If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:
 - Isopropyl alcohol
 - Ethyl alcoholSolvents other than those mentioned above may damage the polarizer. Especially, do not use the following:
 - Water
 - Ketone
 - Aromatic solvents
- 10.1.6. Do not attempt to disassemble the LCD Module.
- 10.1.7. If the logic circuit power is off, do not apply the input signals.
- 10.1.8. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
 - 10.1.8.1. Be sure to ground the body when handling the LCD Modules.
 - 10.1.8.2. Tools required for assembly, such as soldering irons, must be properly ground.
 - 10.1.8.3. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
 - 10.1.8.4. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

10.2 Storage Precautions

- 10.2.1. When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.
- 10.2.2. The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:
Temperature : 0°C ~ 40°C Relatively humidity: ≤80%
- 10.2.3. The LCD modules should be stored in the room without acid, alkali and harmful gas.

10.3 Transportation Precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

10.4 Other

- 10.4.1 AMIPRE will provide one year warrantee for all products and three months warrantee for all repairing products.
- 10.4.2 Do not keep the LCD at the same display pattern continually. The residual image will happen and it will damage the LCD. Please use screen saver.

11. OUTLINE DIMENSION

