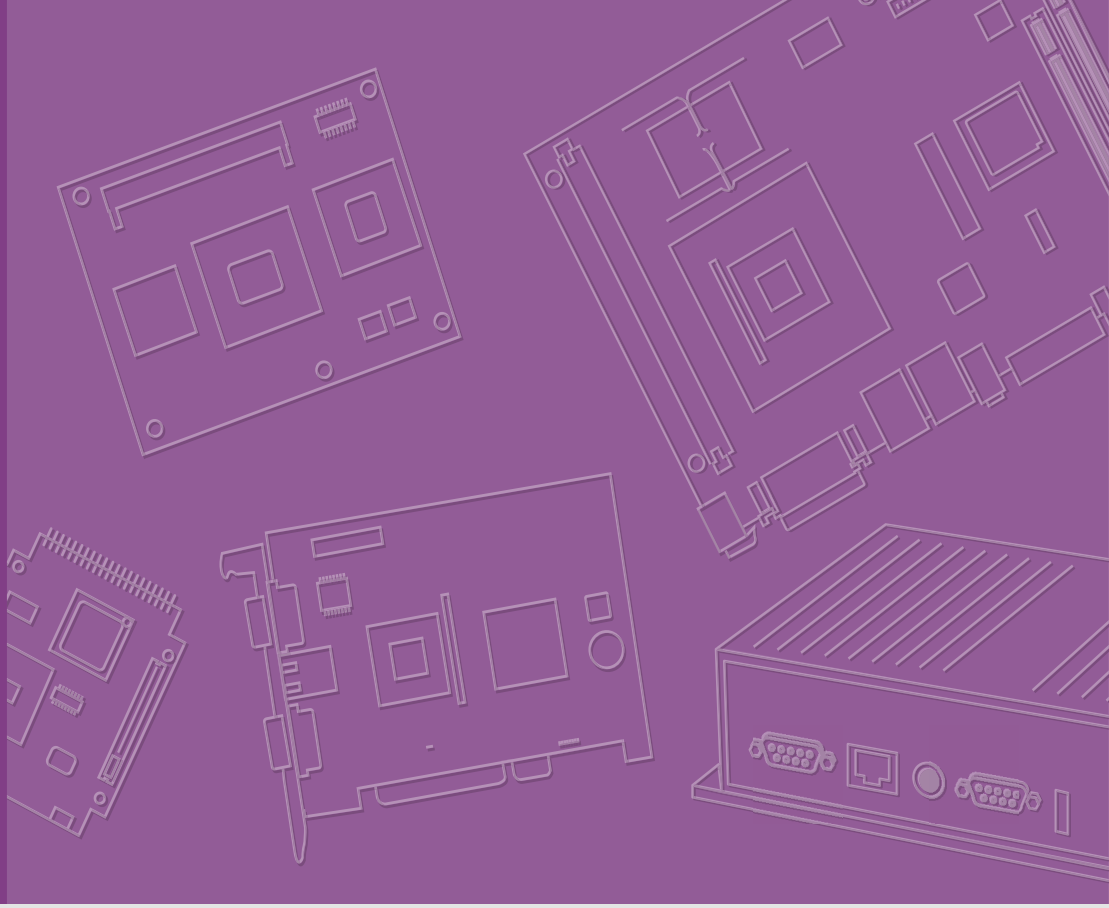

User Manual

IDK-2112P-K2XGA1
IDK-2112N-K2XGA1

12.1” XGA Ultra High-Brightness Industrial Display Kit with Projected Capacitive Touch Solution

ADVANTECH

Enabling an Intelligent Planet

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Acknowledgments

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A Message to the Customer

Advantech Customer Services

Each and every Advantech product is built to the most exacting specifications to ensure reliable performance in the harsh and demanding conditions typical of industrial environments. Whether your new Advantech equipment is destined for the laboratory or the factory floor, you can be assured that your product will provide the reliability and ease of operation for which the name Advantech has come to be known.

Your satisfaction is our primary concern. Here is a guide to Advantech's customer services. To ensure you get the full benefit of our services, please follow the instructions below carefully.

Technical Support

We want you to get the maximum performance from your products. So if you run into technical difficulties, we are here to help. For the most frequently asked questions, you can easily find answers in your product documentation. These answers are normally a lot more detailed than the ones we can give over the phone.

So please consult this manual first. If you still cannot find the answer, gather all the information or questions that apply to your problem, and with the product close at hand, call your dealer. Our dealers are well trained and ready to give you the support you need to get the most from your Advantech products. In fact, most problems reported are minor and are able to be easily solved over the phone.

In addition, free technical support is available from Advantech engineers every business day. We are always ready to give advice on application requirements or specific information on the installation and operation of any of our products.

Product Warranty (2 years)

Advantech warrants to you, the original purchaser, that each of its products will be free from defects in materials and workmanship for two years from the date of purchase.

This warranty does not apply to any products which have been repaired or altered by persons other than repair personnel authorized by Advantech, or which have been subject to misuse, abuse, accident or improper installation. Advantech assumes no liability under the terms of this warranty as a consequence of such events.

Because of Advantech's high quality-control standards and rigorous testing, most of our customers never need to use our repair service. If an Advantech product is defective, it will be repaired or replaced at no charge during the warranty period. For out-of-warranty repairs, you will be billed according to the cost of replacement materials, service time and freight. Please consult your dealer for more details.

If you think you have a defective product, follow these steps:

1. Collect all the information about the problem encountered. (For example, CPU speed, Advantech products used, other hardware and software used, etc.) Note anything abnormal and list any on-screen messages you get when the problem occurs.
2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.
3. If your product is diagnosed as defective, obtain a return merchandise authorization (RMA) number from your dealer. This allows us to process your return more quickly.
4. Carefully pack the defective product, a fully-completed Repair and Replacement Order Card and a photocopy proof of purchase date (such as your sales receipt) in a shippable container. A product returned without proof of the purchase date is not eligible for warranty service.
5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

Contents

Chapter 1

Overview

1.1 Introduction

The Advantech IDK-2112P series features a 12.1" industrial grade PCAP LCD display. The IDK-2112P series supports low power consumption, and is ideal for embedded applications that require flexible mechanical designs.

1.2 Specifications

1.2.1 LCD Panel

- **Display Size:** 12.1", 4:3
- **Resolution:** 1024 x 768
- **Display Mode:** Normally Black (IPS like)
- **Viewing Angle (Horizontal/Vertical):** 178°/178°
- **Brightness:** 1200 cd/m^2
- **Contrast Ratio:** 1000:1
- **Response Time** (ms): 25
- **Colors:** 262k (6bit) / 16.7M (8bit)
- **LCD Nominal Input Voltage / Current:** 3.3V / 370mA
- **External LED Driver Board Input Voltage/ Current:** 12V / 1.4A
- **Power Consumption:** 18W (white pattern)
- **Signal Interface:** LVDS
- **Weight:** 490 g (0.99 lb)
- **Dimensions (W x H x D):** 260 x 204 x 8.4 mm (10.2 x 8.03 x 0.33 in)

1.2.2 Touch Screen (IDK-2112P)

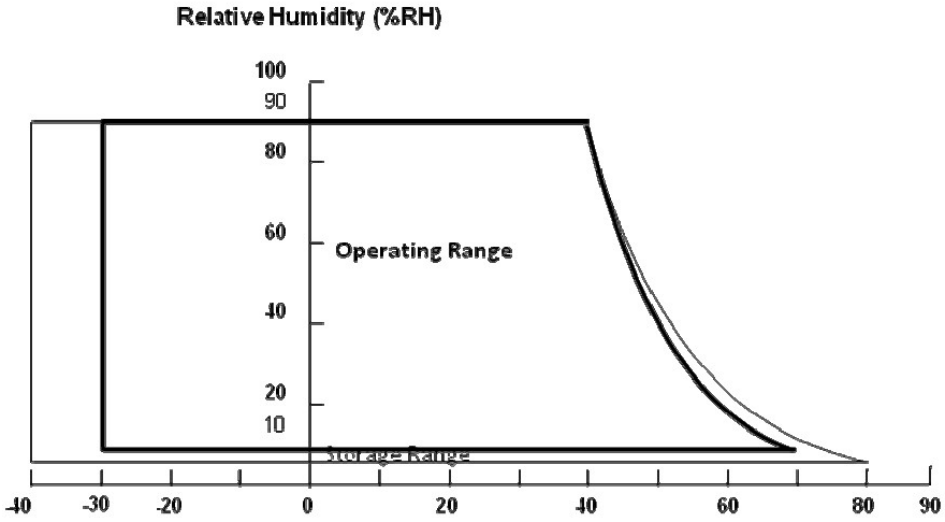
- **Touch Screen:** Projected Capacitive
- **Light Transmission:** 88 ± 2%
- **Interface:** USB
- **Surface Treatment:** Clear
- **Black Print:** Yes

1.2.3 Environmental Specifications

- **Operating Temperature:** -20 ~ 70 °C (-4 ~ 158 °F)
- **Storage Temperature:** -30 ~ 80 °C (-22 ~ 176 °F)

Note! *The temperature and relative humidity range is shown in the following figure:*

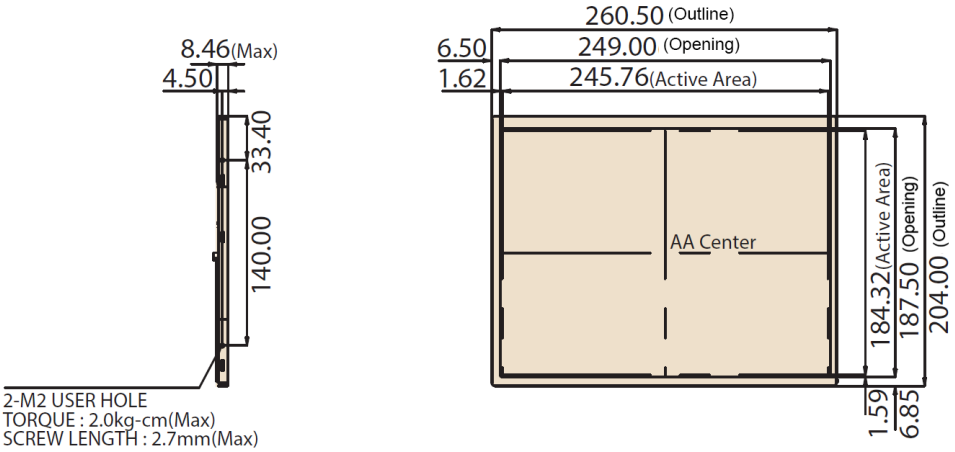
- 90% RH Max. (Ta ≤ 40 °C/104 °F).
- Wet-bulb temperature should be 39 °C Max. (Ta > 40 °C/104 °F).



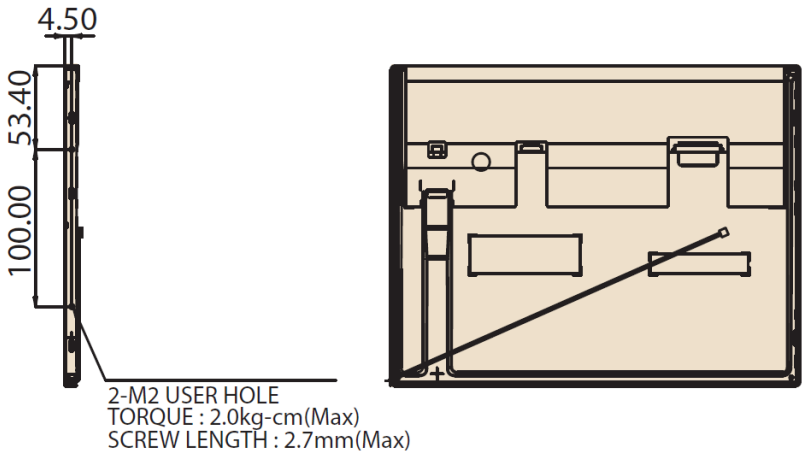
1.3 Mechanical Specifications

1.3.1 IDK-2112N-K2XGA1

Front View **Unit: mm**

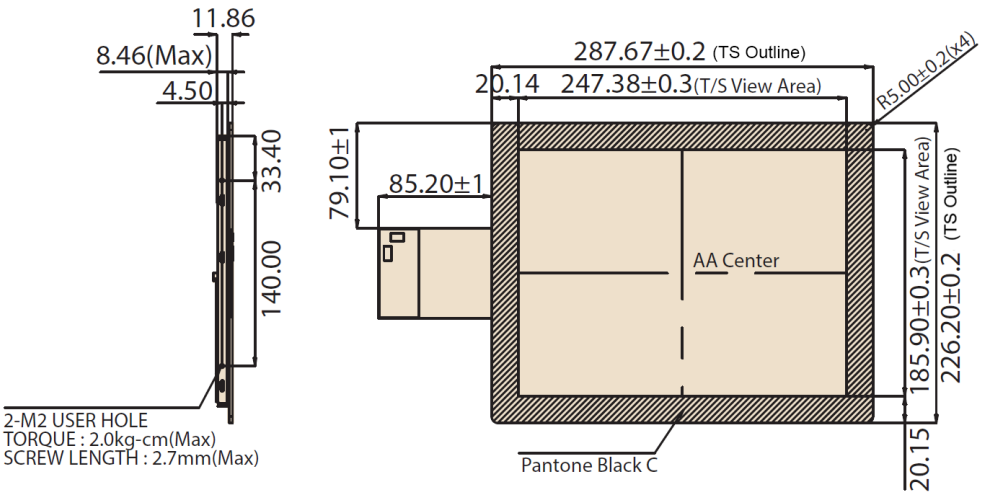


Rear View:

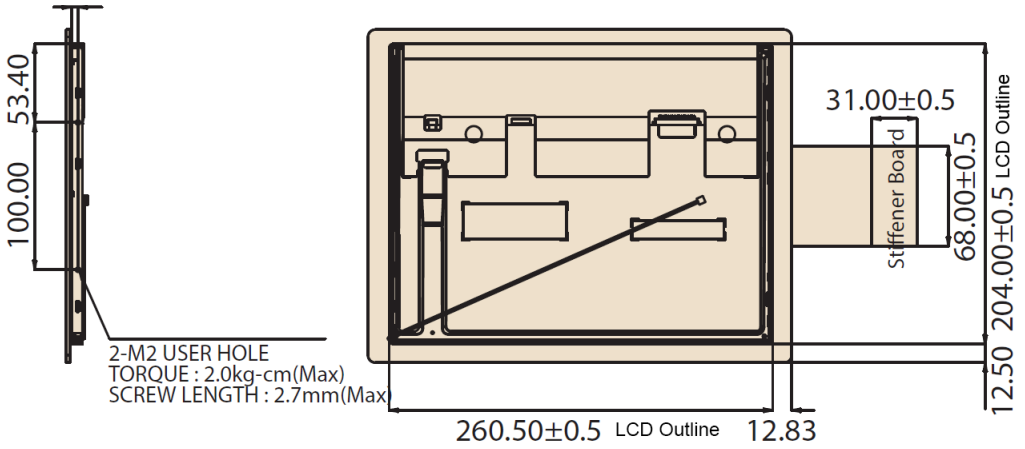


1.3.2 IDK-2112P-K2XGA1

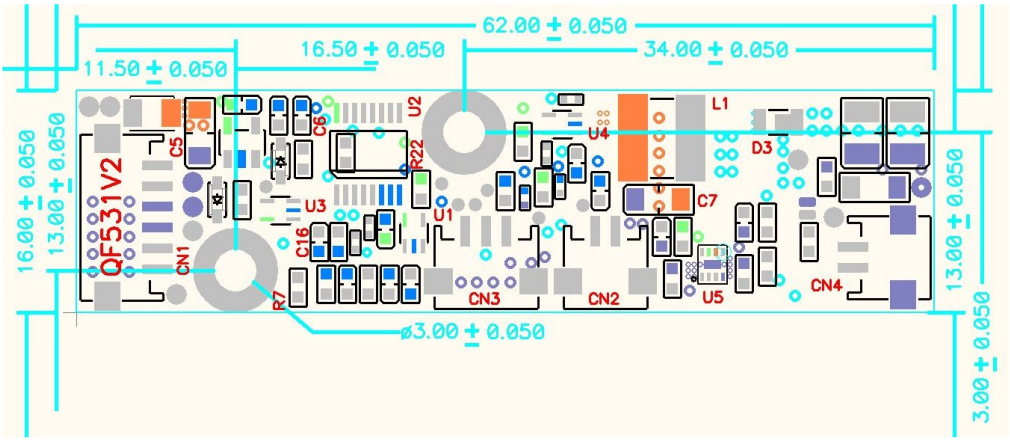
Front View: **Unit: mm**



Rear View:



1.3.3 LED Driver Board

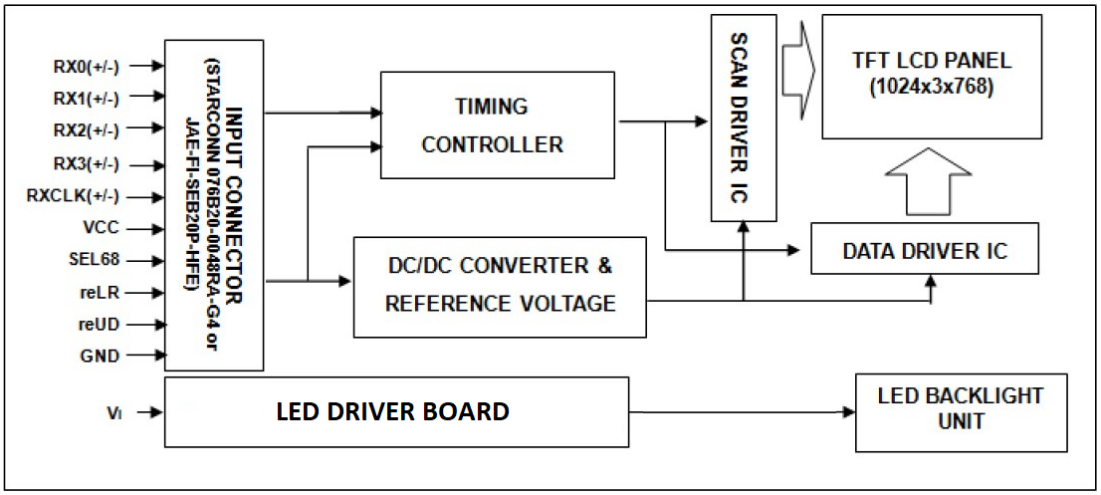


Chapter 2

LCD Display

2.1 Functional Block Diagram

The following diagram shows the functional block of the 12.1" Color TFT-LCD Module:



2.2 Absolute Maximum Ratings

2.2.1 TFT LCD Module

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VCC	-0.3	4	[Volt]	(1)

2.2.2 LED Driver Board

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Converter Voltage	V_i	-0.3	18	[Volt]	(1), (2)
Enable Voltage	EN	-	5.5	[Volt]	
Backlight Adjustment	ADJ	-	5	[Volt]	

Note (1) *Permanent damage to the device may occur if maximum values are exceeded. Effective operation should be restricted to the conditions described under "Normal Operating Conditions".*

Note (2) *Specified lamp values.*

2.3 LCD Electronics Specifications

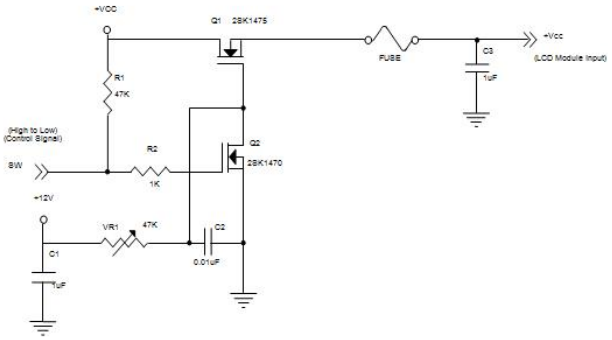
This solution's input power specifications are as follows:

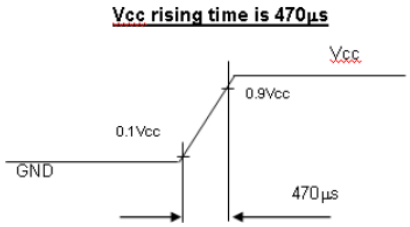
Table 2.1: Power Specifications

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	VCC	3.0	3.3	3.6	[Volt]	(1) at Vcc=3.3V
Rush Current	IRUSH	-	-	4	[A]	
Input Current	White	-	370	450	[mA]	(3)a, at Vcc=3.3V
	Black	-	300	380		(3)b, at Vcc=3.3V
Power Consumption	PLCD	-	1.22	1.49	[Watt]	
LVDS Differential Input Voltage	VID	100	-	600	[mV]	
LVDS Common Input Voltage	VICM	0.7	-	1.6	[V]	

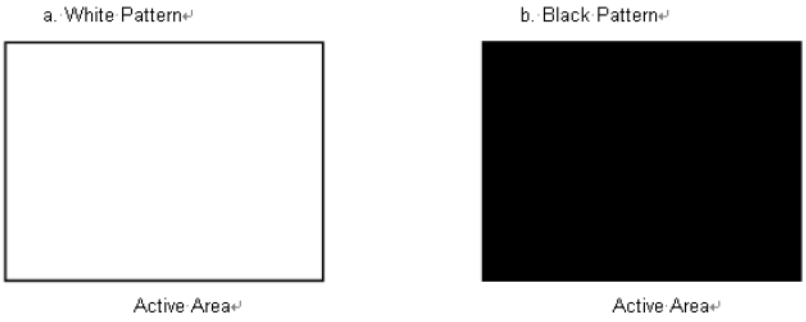
Note (1) *The assembly should always be operated within the ranges above.*

Note (2) *Measurement conditions are detailed below:*





Note (3) *The specified power supply current is under the conditions at Vcc = 3.3V, Ta = 25 ± 2 °C/77 ± 3.4 °F, fv = 60 Hz, whereas a power dissipation check patterns are displayed below.*



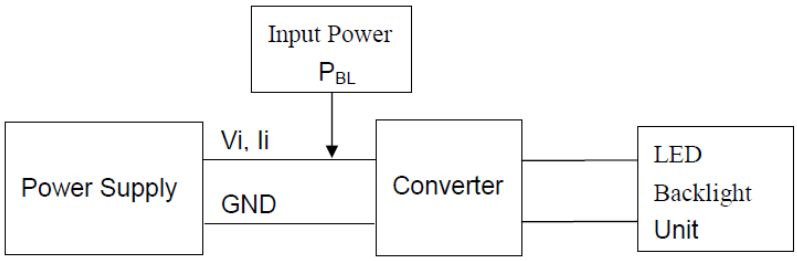
2.4 Backlight Unit (LED Driver Board)

The following characteristics are measured in stable conditions at 25 °C (77 °F).

Table 2.2: Backlight Driving Conditions

Parameter		Symbol	Values			Unit	Note
			Min.	Typ.	Max.		
Converter Power Supply Voltage		Vi	11.2	12	13.2	V	
Converter Power Supply Current		Ii	-	1.4	-	A	@ Vi = 12V (Duty 100%)
Backlight Power Consumption		PBL	-	16.8	-	W	@ Vi = 12V (Duty 100%)
EN Control Level	Backlight On	BLON	3	-	5	V	
	Backlight Off		0	-	0.8	V	
PWM Control Level		E_PWM	0	-	5	V	
PWM Control Duty Ratio		-	5	-	100	%	@200Hz
PWM Control Frequency		fPWM	500	-	40K	Hz	
LED Life Time		LL	50,000	-	-	Hrs	(2)

Note (1) *LED currents are measured by high frequency current meters as demonstrated below:*



Note (2) *LED life time are based on estimated data. Life time is defined as continued operation time under 25 ± 2 °C/77 ± 3.4 °F temperature conditions at 100% capacity until the brightness reduces to ≤50% of its original value. Operating LED screens in high temperature conditions reduces lifetime and leads to color shifts.*

2.5 Input Terminal Pin Assignment

2.5.1 TFT LCD MODULE

Table 2.3: Pin Description

Pin	Name	Description	Remark
1	RX3+	Differential Data Input, CH3 (Positive)	
2	RX3-	Differential Data Input, CH3 (Negative)	
3	NC	NC	
4	SEL68	LVDS 6/8 Bit Select Function Control, Low→6 Bit Input Mode High→8 Bit Input Mode	Note (3) (4)
5	GND	Ground	
6	RXC+	Differential Clock Input (Positive)	
7	RXC-	Differential Clock Input (Negative)	
8	GND	Ground	
9	RX2+	Differential Data Input, CH2 (Positive)	
10	RX2-	Differential Data Input, CH2 (Negative)	
11	GND	Ground	
12	RX1+	Differential Data Input, CH1 (Positive)	
13	RX1-	Differential Data Input, CH1 (Negative)	
14	GND	Ground	
15	RX0+	Differential Data Input, CH0 (Positive)	
16	RX0-	Differential Data Input, CH0 (Negative)	
17	reLR	Horizontal Reverse Scan Control, Low →Normal Mode High→ Horizontal Reverse Scan	Note (3) (4)
18	reUD	Vertical Reverse Scan Control, Low→Normal Mode High→ Vertical Reverse Scan	Note (3) (4)
19	VCC	Power Supply	
20	VCC	Power Supply	

Note (1) *Connector Part No.: STARCONN 076B20-0048RA-G4 or equivalent.*

Note (2) *User's Connector Part No.: JAE FI-SE20ME or equivalent.*

Note (3) *"Low" stands for 0V. "High" stands for 3.3V.*

Note (4) *SEL68, reLR, reUD.*

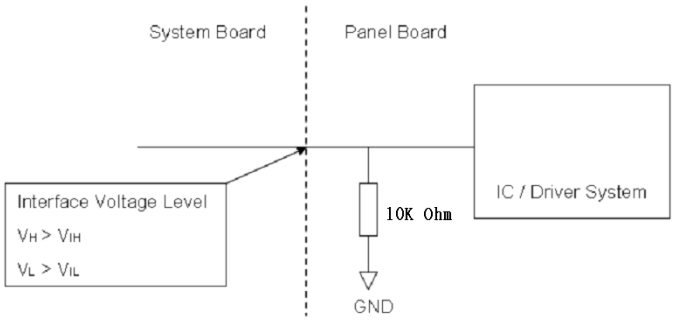
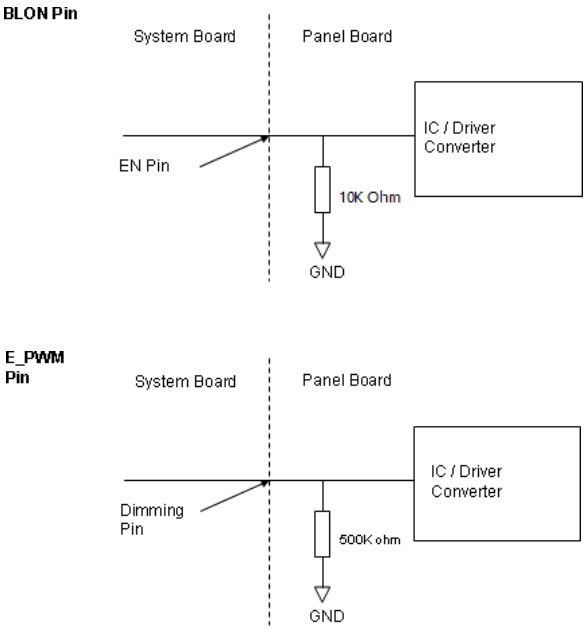


Table 2.4: Backlight Pin Assignment

Pin	Symbol	Description	Remark
1	Vi	Converter Input Voltage	12V
2	Vi	Converter Input Voltage	12V
3	VGND	Converter Ground	Ground
4	VGND	Converter Ground	Ground
5	EN	ON/OFF control	ON=+3~5V OFF=0~0.8V
6	ADJ	Backlight Adjust	PWM Diming (500Hz~40KHz, 0~5VDC)

Note (1) *Connector Part No.: S6B-ZR-SM4 (JST) or equivalent.*

Note (2) *EN(BLON), ADJ(E_PWM) as shown below:*



2.6 Color Data Input Assignment

The brightness of each primary color (red, green, or 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.

Table 2.5: Color Data Input Assignment

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
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	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
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	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
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	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*

The brightness of each primary color (red, green, or 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 the assignment of color versus data input.

Table 2.6: Color Data Input Assignment

Color		Data Signal																							
		Red								Green								Blue							
		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 Colors	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	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	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	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
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	0	0	0	0	0	0
	Red(1)	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(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	Red(253)	1	1	1	1	1	1	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
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	0	0	0	0	0	0
	Green(1)	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(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
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	Green (253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	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
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	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	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	0	0	0	0	0	0	1	0
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	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	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

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

2.7 Interface Timing

2.7.1 Input Signal Timing Specifications

The input signal timing specifications are demonstrated in the following table and timing diagram.

Table 2.7: Display Timing Specifications

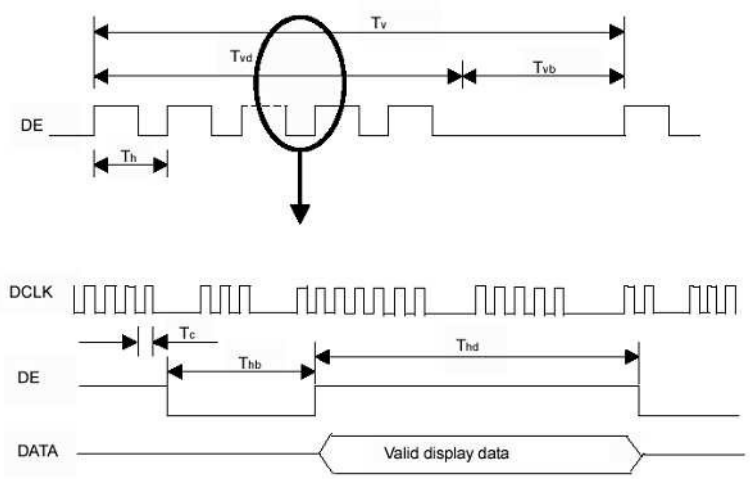
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	Fc	57.5	64.9	74.4	MHz	
Vertical Active Display Term	Total	Tv	774	806	848	Th	Th=Tvd+Tvb
	Display	Tvd	-	768	-	Th	-
	Blank	Tvb	6	38	80	Th	-
Horizontal Active Display Term	Total	Th	1240	1344	1464	Tc	Th=Thd+Thb
	Display	Thd	-	1024	-	Tc	
	Blank	Thb	216	320	440	Tc	-

Note (1) *Since this assembly is operated in DE only mode, Hsync and Vsync input signals should be set to low logic levels. Otherwise, this assembly could operate abnormally.*

Note (2) *Frame rate is 60Hz*

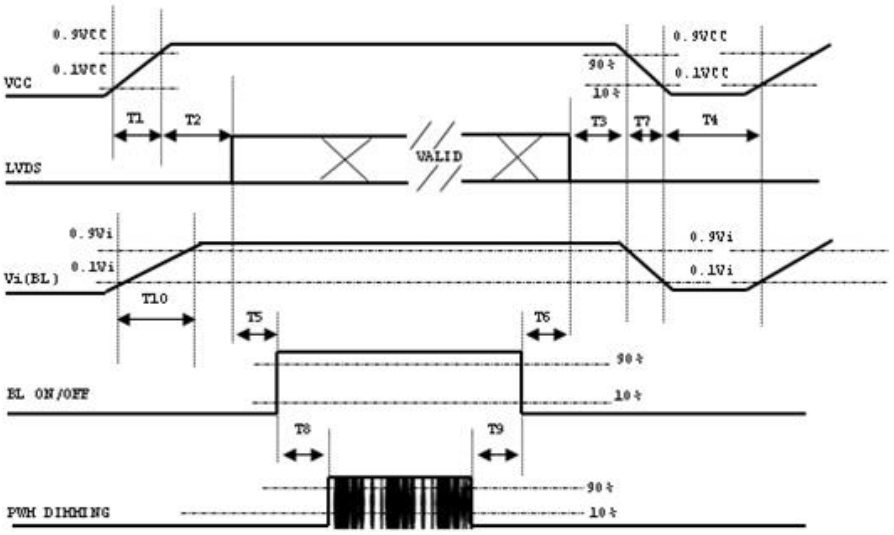
Note (3) *The Tv (Tvd+Tvb) must be an integer. If not, this module will operate abnormally.*

INPUT SIGNAL TIMING DIAGRAM



2.8 Power On/Off Sequence

The power sequence specifications are displayed in the following table and diagram.



Note (1) *Please avoid interface signal floating states at invalid periods.*

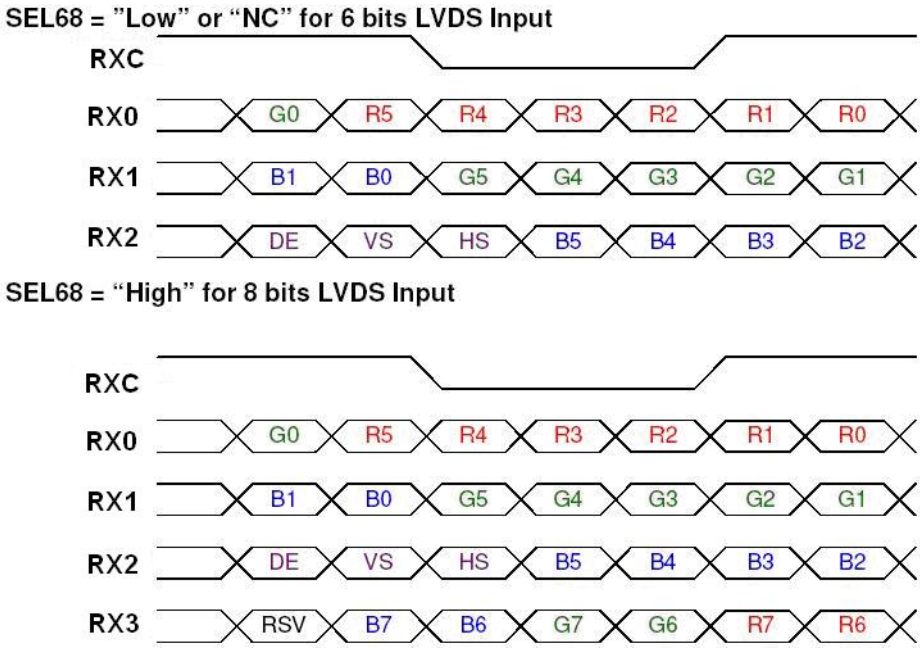
Note (2) *When the interface signal is invalid, be sure to reduce the LCD VCC power supply to 0 V.*

Note (3) *The backlight converter power must be turned on after the power supply for the logic and the interface signal turns on. The backlight converter power must be turned off before the power supply for the logic and the interface signal turns off.*

Table 2.8: Timing Specifications

Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	450	-	-	ms
T6	200	-	-	ms
T7	10	-	100	ms
T8	10	-	-	ms
T9	10	-	-	ms
T10	20	-	50	ms

2.9 The Input Data Format



Note (1) *R/G/B data 7: MSB, R/G/B data 0: LSB*

Note (2) *Please follow PSWG*

Signal Name	Description	Remark
R7 R6 R5 R4 R3 R2 R1 R0	Red Data 7 (MSB) Red Data 6 Red Data 5 Red Data 4 Red Data 3 Red Data 2 Red Data 1 Red Data 0 (LSB)	Red-pixel Data Each red pixel's brightness data consists of these 8 bits pixel data.
G7 G6 G5 G4 G3 G2 G1 G0	Green Data 7 (MSB) GreenData 6 GreenData 5 GreenData 4 GreenData 3 GreenData 2 GreenData 1 GreenData 0 (LSB)	Green-pixel Data Each green pixel's brightness data consists of these 8 bits pixel data.
B7 B6 B5 B4 B3 B2 B1 B0	Blue Data 7 (MSB) Blue Data 6 Blue Data 5 Blue Data 4 Blue Data 3 Blue Data 2 Blue Data 1 Blue Data 0 (LSB)	Blue-pixel Data Each blue pixel's brightness data consists of these 8 bits pixel data.
RXCLKIN+ RXCLKIN-	LVDS Clock Input	
DE	Display Enable	
VS	Vertical Sync	
HS	Horizontal Sync	

Note (3) *Output signals from any system should be at low or Hi-Z states when the VCC is turned off.*

2.10 Scanning Direction

The following figures display the image as seen from the front. The arrow indicates the direction of the scan.

Fig.1 Normal Scan	Fig.2 Reverse Scan
	
Fig.3 Reverse Scan	Fig.4 Reverse Scan
	

Fig. 1 Normal scan (pin 17, reLR = Low, pin 18, reUD = Low)

Fig. 2 Reverse scan (pin 17, reLR = High, pin 18, reUD = Low)

Fig. 3 Reverse scan (pin 17, reLR = Low, pin 18, reUD = High)

Fig. 4 Reverse scan (pin 17, reLR = High, pin 18, reUD = High)

Chapter 3

Touchscreen and Touch Controller

3.1 Touchscreen

3.1.1 Touch Characteristics

IDK-2112P series products use projected capacitive (PCAP) touch-screens.

3.1.2 Optical Characteristics

Item	Specifications
Transparency	88 ± 2%
Haze	< 0.5%

3.1.3 Mechanical Characteristics

Item	Specifications
Surface Hardness	7H (Follows JIS K 5600 standard, use Mitsubishi Pencil 750g)
Cover Lens Thickness	1.8mm
Overall Thickness	2.33 ± 0.20 mm (0.9 ±.007 in)
Compressive Stress	>=400 Mpa
Controller and Tail Type	COF (Chip on FPC tail)
FPC Tail Bending Radius	R2.5mm (.098 in)
Holding Force for Tail	0.7 kg (1.54 lb) to pull strength and sustain minutes in straight-line pulling (180 degrees) and 90 degrees pulling orientation
Connector Pins and Pitch	4 x pins, pitch is 1.25 mm (.049 in)
Top Surface Finish Type	Clear
Decoration Lens Artwork	Black border

3.2 Touch Controller

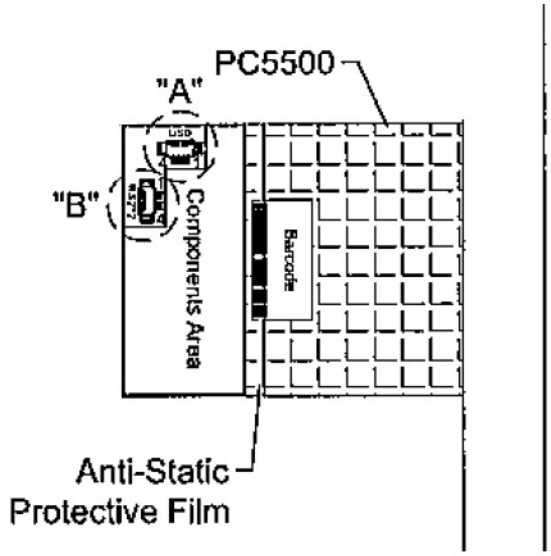
Advantech's IDK-2112P series projective capacitive touch-screen adopts a COF (Chip on FPC) design. Therefore, an extra touch control board is not required. This communicates with a PC system directly through USB connectors. This superior design is sensitive, accurate, and user friendly.

3.2.1 Electrical Specifications

Item	Specifications
Line Drawing Accuracy:	1pt +/- 1 mm offset / 10 mm 2pt +/- 2 mm offset / 10 mm Touch (point) accuracy : 1pt +/- 2.5 mm Touch (point) accuracy : 2pt +/- 5.0 mm Refer to Windows 7 Logo regulation
Operating Voltage	5V
Insulation Resistance	DC25V and 20MΩ or more
Chattering	25 ~ 30 msec or less
The COF Tail Interface	USB
Report Rate	> 100Hz

3.2.2 Pin Assignment and Description

This device has two interfaces — USB and RS232. The Connectors and Pin assignment are displayed below.



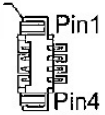
Molex 53261-0471(USB)

Detail A
Scale 4:1

1. Pin Assignment

	USB
1	VCC_5V
2	D-
3	D+
4	GND

Molex 53261-0471
(RS232)



Detail B
Scale 4:1

2. Pin Assignement

	RS232
1	VCC_5V
2	Rx
3	Tx
4	GND

Appendix A

LCD Optical Characteristics

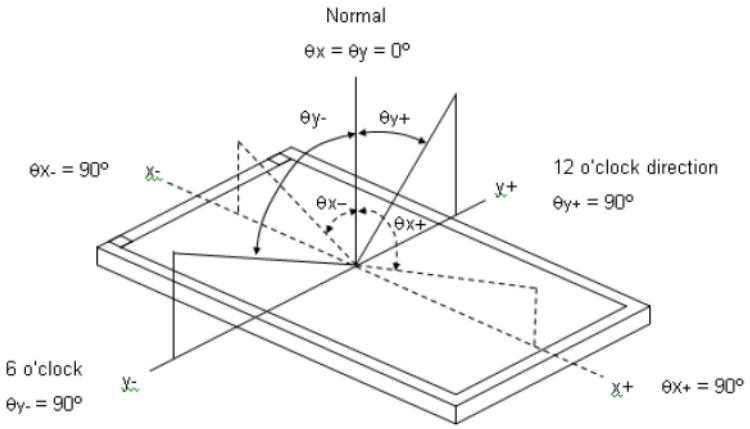
A.1 LCD Module Optical Characteristics

The optical characteristics are measured under stable conditions at 25 °C/77 °F (Room Temperature):

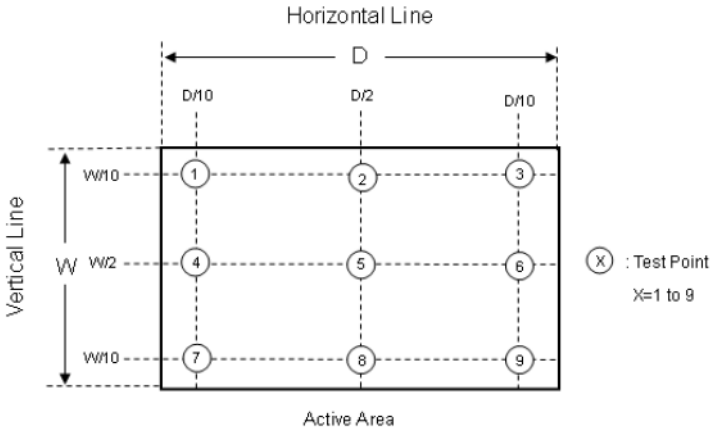
Table A.1: Optical Characteristics

Item	Conditions	Min.	Typ.	Max.	Unit	Note
Viewing Angle	Horizontal CR ≧ 10	170	178	-	[degree]	
	Vertical CR ≧ 10	170	178	-		
Luminance Uniformity		70	-	-	[%]	
Color Coordinates (CIE 1931)	White x	Typ – 0.045	0.313	Typ + 0.045	-	
	White y		0.329			
Response Time	Rising	-	13	18	[ms]	
	Falling	-	12	17		
White Luminance		1000	1200	-	[cd/m^2]	
Contrast Ratio		700	1000	-		

Note! *Definition of viewing angle*



Note! *5-points position*

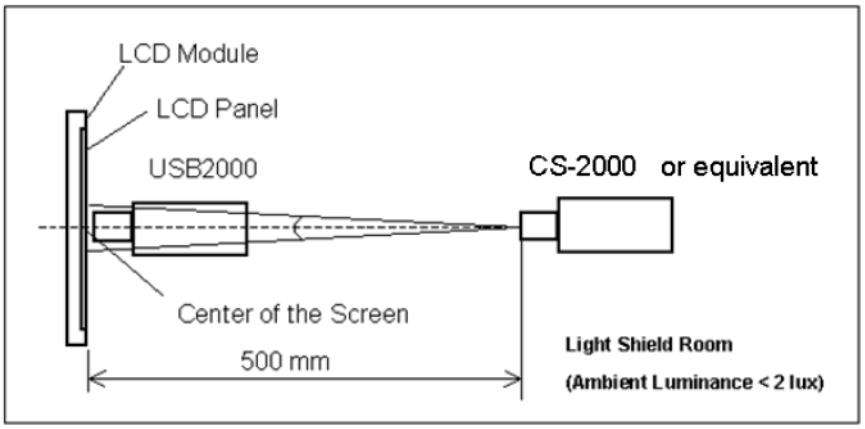


Note! *5-point luminance uniformity is defined by dividing the maximum luminance values by the minimum test point luminance*

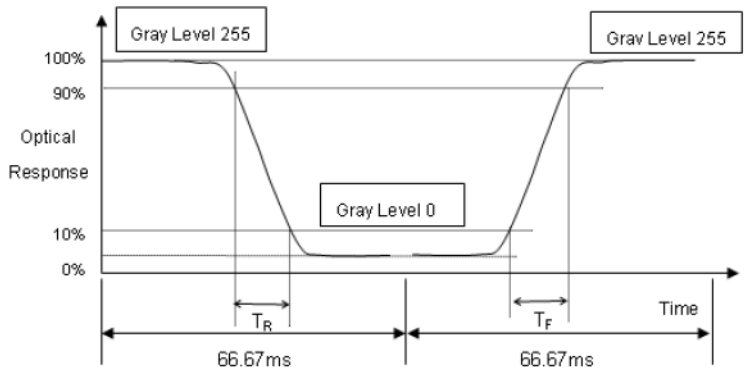
$$\delta_{W5} = \frac{\text{Minimum [L (1) ~ L (5)]}}{\text{Maximum [L (1) ~ L (5)]}}$$

Note! *Measurement method*

The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measurement. In order to stabilize the luminance, the measurement should be executed after lighting the backlight for 20 minutes in a stable, windless, and dark room.



Note! *Definition of response time*



Note! *Definition of Contrast Ratio (CR): The contrast ratio can be calculated using the following expression.*

Contrast Ratio (CR) = L255 / L0

L255: Luminance of gray level 255

L 0: Luminance of gray level 0

CR = CR (5)

CR (X) is corresponding to the Contrast Ratio of the point X (See Figure A2)

Appendix B

Safety Precautions

B.1 Safety Precautions

Optical characteristics are measured under stable conditions at 25 °C/77 °F (Room Temperature)

1. The front polarizer is easily damaged, be careful not to scratch it.
2. Be sure to turn off the power supply when inserting or disconnecting the input connector.
3. Wipe off water drops immediately. Prolonged contact with water may cause discoloration or spots.
4. When the panel surface is soiled, wipe it with absorbent cotton, or another soft cloth.
5. Since the panel is made of glass, it may break or crack if struck or dropped on a hard surface.
6. As the CMOS LSI is used in this module, be careful of static electricity and ground yourself before handling it.
7. Do not open or modify the Module Assembly.
8. Do not press the reflector sheet at the back of the module in any direction.
9. In the event that a Module has to be put back into the packing container after removal, grab the far ends of the LED light bar reflector edge gently. Not doing so could result in damage to the TFT Module.
10. At the insertion or removal of the signal interface connector, be sure not to rotate nor tilt the Interface Connector on the TFT Module.
11. After installation of the TFT Module into an enclosure, do not twist nor bend the TFT Module. During integration of the enclosure, be careful not to apply bending/twisting forces to the TFT Module from the outside. This may result in damage to the TFT Module.
12. This LCD module contains a small amount of materials without flammability grading. The LCD module should be supplied by power compliant with the requirements of the Limited Power Source (IEC60950 or UL1950).

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Please verify specifications before quoting. This guide is intended for reference purposes only.

All product specifications are subject to change without notice.