



User Manual

IDK-2115N-K2XGB2

IDK-2115R-K2XGB2

**15" XGA Ultra High Brightness
Display Kit with LED Backlight
and Five (5) Wire Resistive
Touch Solution**

ADVANTECH

Enabling an Intelligent Planet

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Chapter 1

Overview

1.1 General Description

The Advantech IDK-2115 series comes with a 15" 1200 cd/m² industrial grade LCD display and an LED driving board. The series is also available with flexible options for touchscreens and enhanced treatments such as an AR surface treatment and an optical bonding solution. Equipped with a high level of brightness and wide operating temperature range, IDK-2115 provides superior sunlight readability and is perfect for applications whether in semi-outdoor or outdoor environments.

1.2 Key Specifications

1.2.1 LCD Panel

- **Display Size:** 15", 4:3 LED backlight panel
- **Resolution:** 1024 x 768
- **Viewing Angle (U/D/L/R):** 88°/88°/88°/88°
- **Brightness:** 1200 cd/m²
- **Contrast Ratio:** 2500:1
- **Response Time (ms):** 23 ms
- **Colors:** 262K/16.2M
- **Input Voltage / Current:** 3.3V/0.8A
- **Power Consumption:** 18.36 W (W/ LED Driver Board)
- **Signal Interface:** 1 channel LVDS
- **Weight:** 1010 g
- **Dimensions (W x H x D):** 326.5 x 253.5 x 9.1 mm

1.2.2 LED Driver Board

- **Efficiency:** 90%
- **Input Voltage / Current:** 12V/ 1.31A
- **Dimensions (W x H x D):** 80 x 54.2 x 10 mm

1.2.3 Touchscreen (R Series)

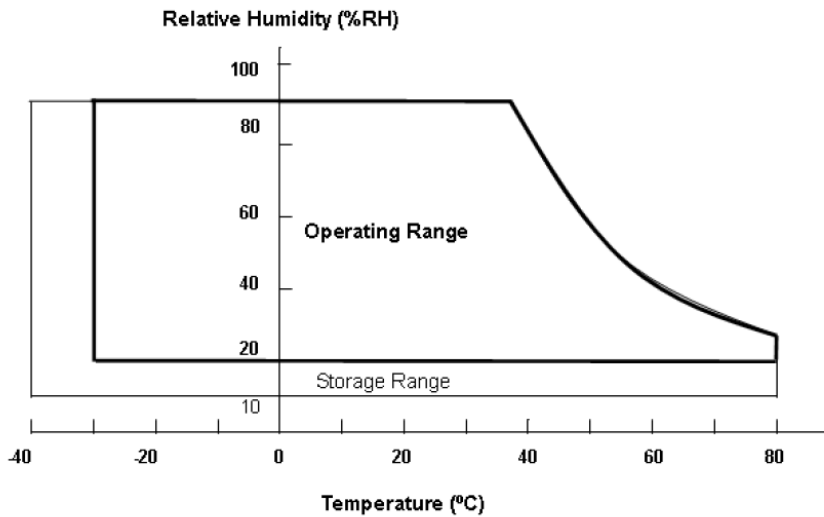
- **Touchscreen:** 5-Wire Resistive
- **Light Transmission:** 80 ± 3%
- **Durability:** 10 millions times

1.2.4 Environment

- **Operating Temperature:** -20~70 °C
- **Storage Temperature:** -25~80°C

Note! Temperature and relative humidity range is shown in the figure below.

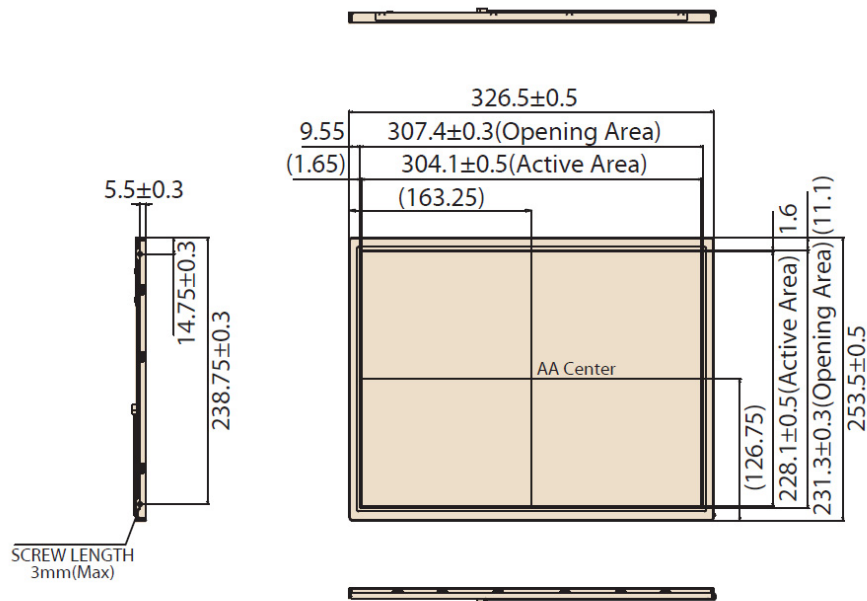




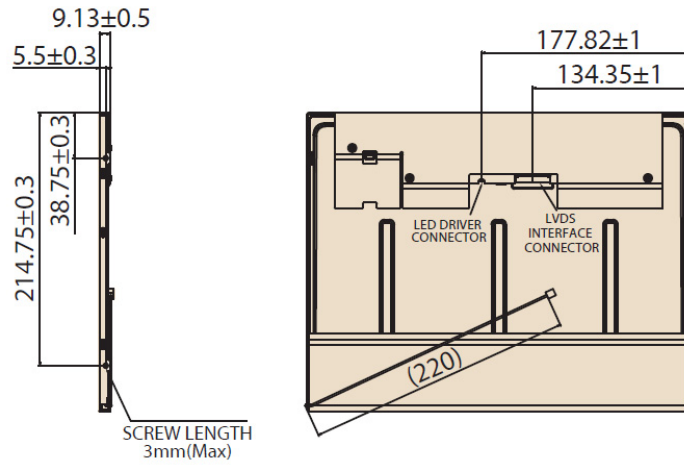
1.3 Mechanical Characteristics

1.3.1 IDK-2115N Series

Front View

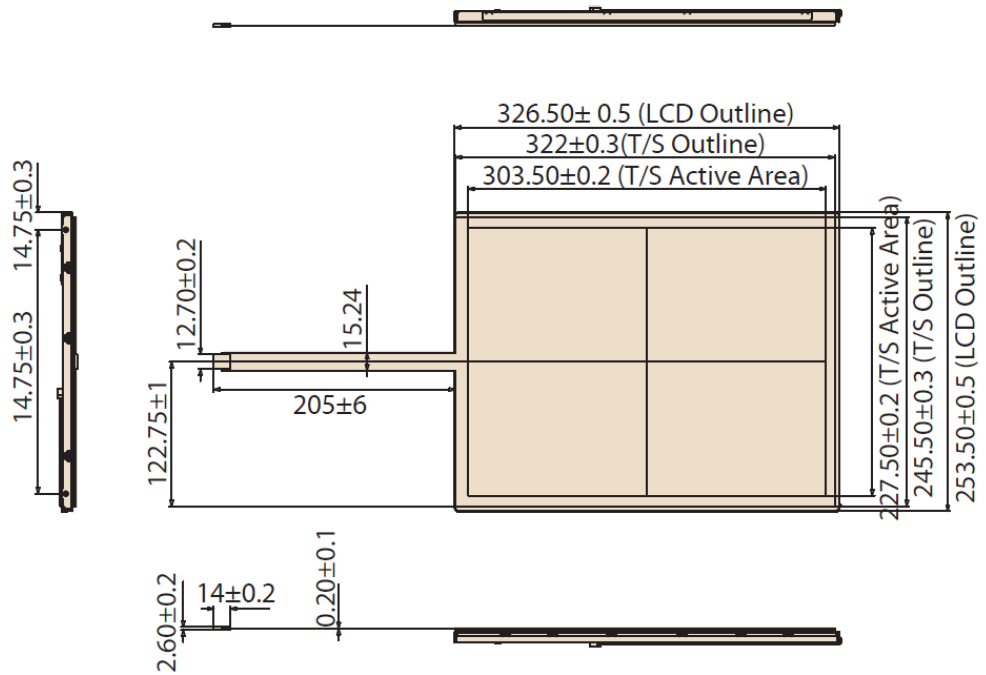


Rear View

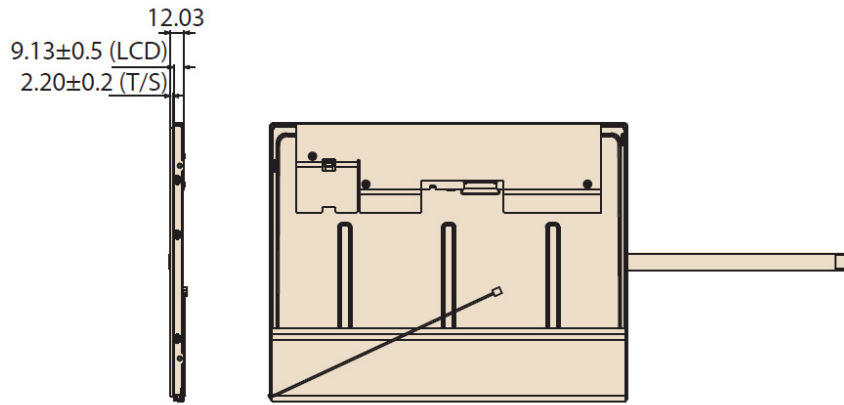


1.3.2 IDK-2115R Series

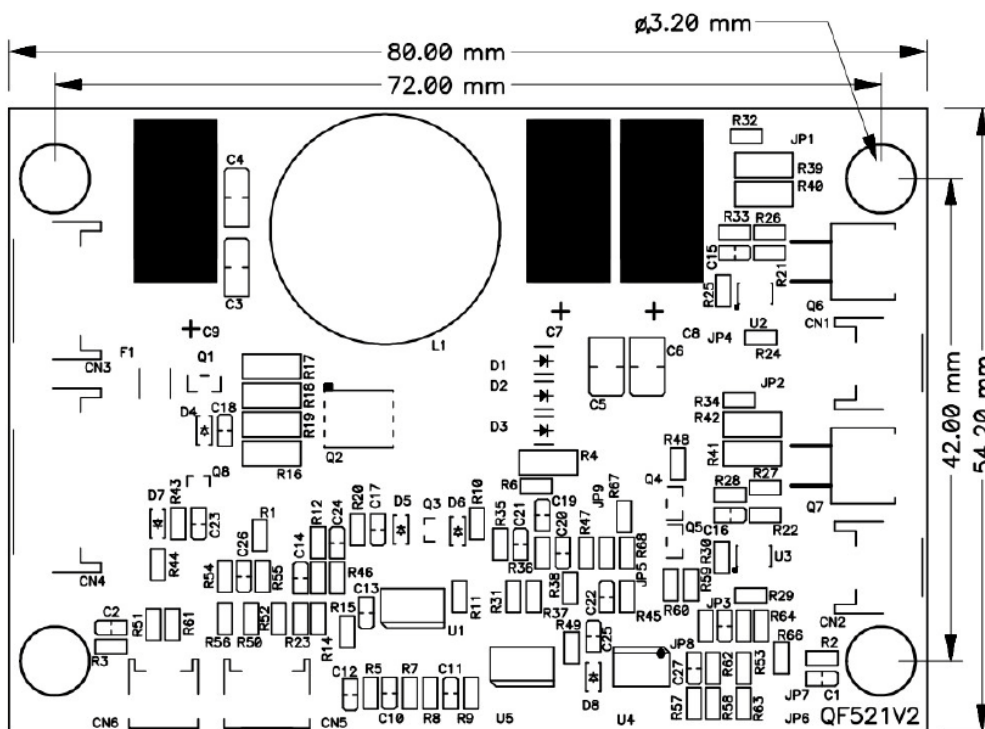
Front View



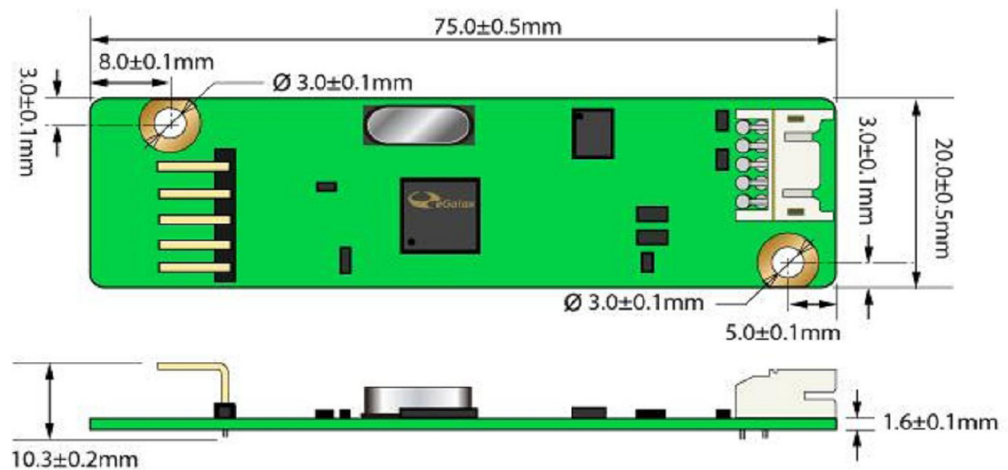
Rear View



1.3.3 LED Driver Board



1.3.4 Touch Control Board (For IDK-2115R Series)



1.4 LCD Function Block Diagram

The following diagram shows the function block of the 15 inch color TFT-LCD module:

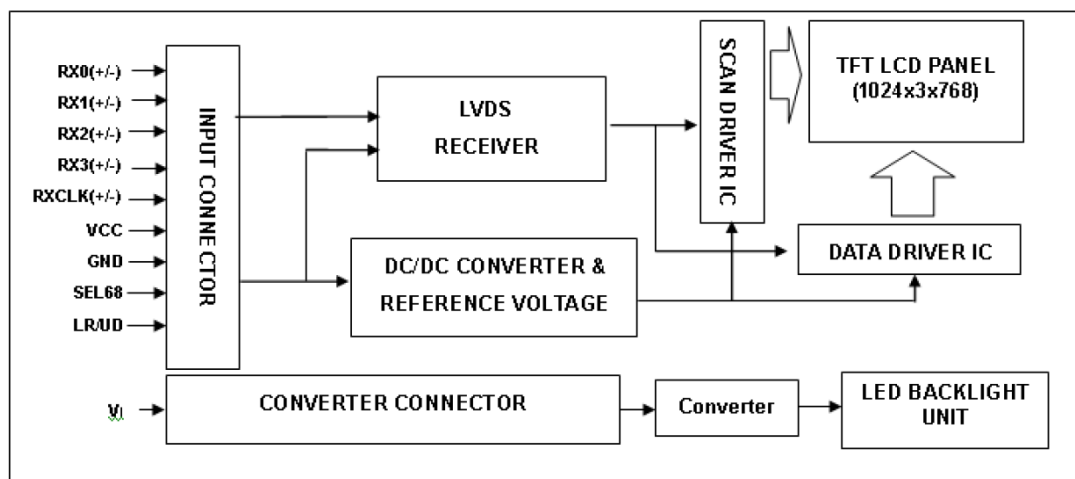


Figure 1.1 Function Block Diagram

1.5 Touchscreen Driver

Please download the touchscreen driver from the Advantech website.

Chapter 2

LCD Electrical
Characteristics

2.1 Power Specifications

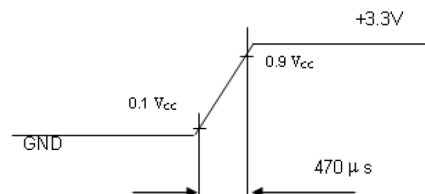
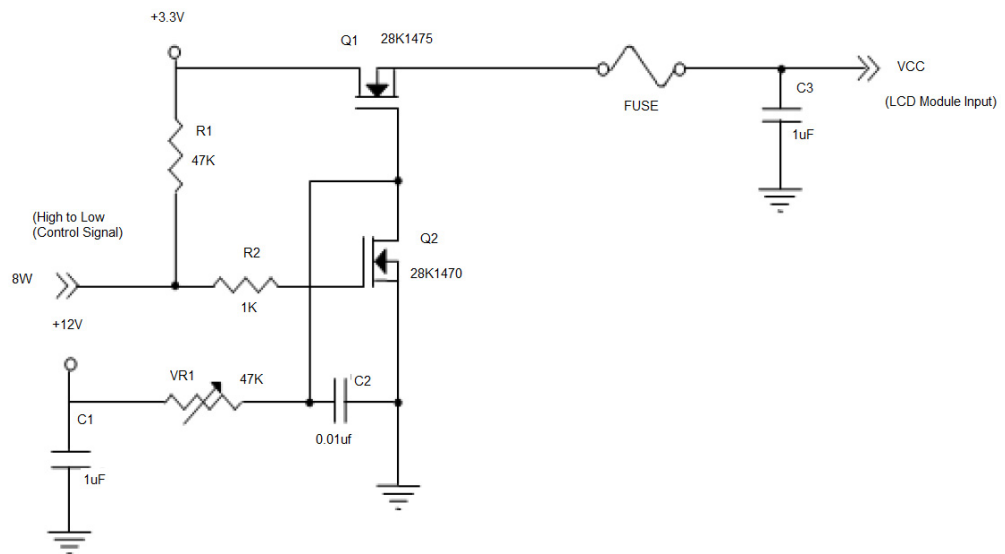
Input power specifications are as follows:

Table 2.1: Power Specifications

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	V_{CC}	3.0	3.3	3.6	V	-
Ripple Voltage	V_{RP}	-	-	100	mVp-p	-
Rush Current	I_{RUSH}	-	-	2.0	A	(2)
Power Supply Current	White	I_{CC}	-	800	mA	(3)a
	Black		-	670	mA	(3)b
LVDS Differential Input Voltage	V_{id}	200	-	600	mV	-
LVDS Common Input Voltage	V_{ic}	1.0	1.2	1.4	V	-
Differential Input Voltage for "H" Level	V_{IH}	-	-	100	mV	-
LVDS Receiver Threshold	"L" Level	V_{IL}	-100	-	mV	-
Terminating Resistor	R_T		100	-	Ohm	-

Note(1): The module should be always operated within above ranges.

Note(2): Measurement condition:



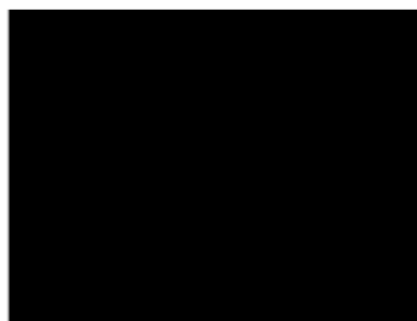
Note(3): The specified power supply current is under the conditions at $V_{DD} = 3.3V$, $T_a = 25 \pm 2^\circ C$ DC Current and $f_v = 60$ Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern



Active Area

2.2 Backlight Unit (LED Driver Board)

Parameter guidelines for LED Light Bar Driver is operation under stable conditions at 25°C (Room Temperature):

Table 2.2: Backlight Driver Conditions

Item	Symbol	Values			Unit	Condition
		Min.	Typ.	Max.		
Input Voltage	Vin	10.8	12	13.2	V	
Input Current (Low Brightness)	IinL	40	80	100	mA	CV=0V
Input Current (High Brightness)	IoutL	-	1.31	-	A	CV=5V
Working Frequency		115	125	135	KHZ	
Dimming		5%	-	100%		
Brightness Control	CV	0	-	5	V	
LED Life Time		50,000	-	-	Hr	Note

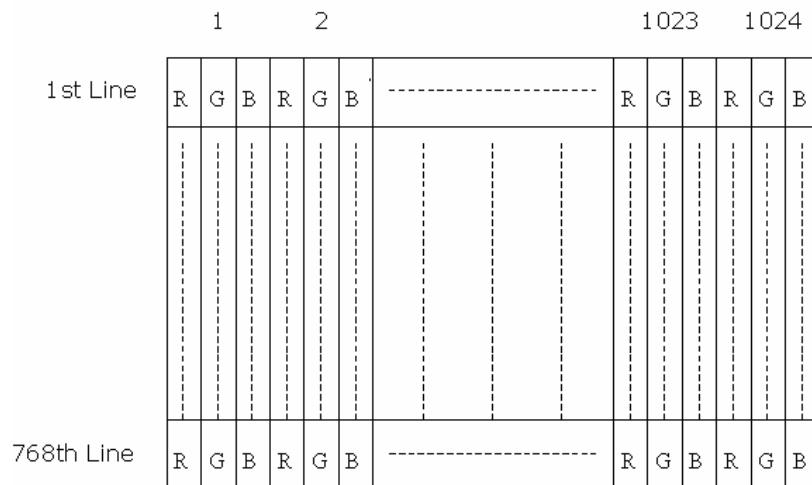
Note: "LED Life Time" is defined for module brightness decrease to 50% original brightness with an ambient temperature of 25°C and typical LED Current at 400mA.

Chapter 3

LCD Signal
Characteristics and
Pin Assignments

3.1 Pixel Format Image

The following figure shows the relationship between the input signal and LCD pixel format.



3.2 TFT LCD Module Pin Assignment and Connectors

Table 3.1: Pin Description

Pin No.	Symbol	Function	Polarity	Note
1	VCC	Power Supply +3.3V(typical)		
2	VCC	Power Supply +3.3V(typical)		
3	NC	No Connection		(4)
4	LR/UD	Reverse Scan Control H or NC = Normal Mode. L = Horizontal/ Vertical Reverse Scan		(3)
5	RX0-	LVDS Differential Data Input	Negative	
6	RX0+	LVDS Differential Data Input	Positive	
7	GND	Ground		
8	RX1-	LVDS Differential Data Input	Negative	
9	RX1+	LVDS Differential Data Input	Positive	
10	NC	No Connection		(4)
11	RX2-	LVDS Differential Data Input	Negative	
12	RX2+	LVDS Differential Data Input	Positive	
13	GND	Ground		
14	RXCLK-	LVDS Differential Data Input	Negative	
15	RXCLK+	LVDS Differential Data Input	Positive	
16	GND	Ground		
17	RX3-	LVDS Differential Data Input	Negative	
18	RX3+	LVDS Differential Data Input	Positive	
19	NC	No Connection		(4)

Table 3.1: Pin Description

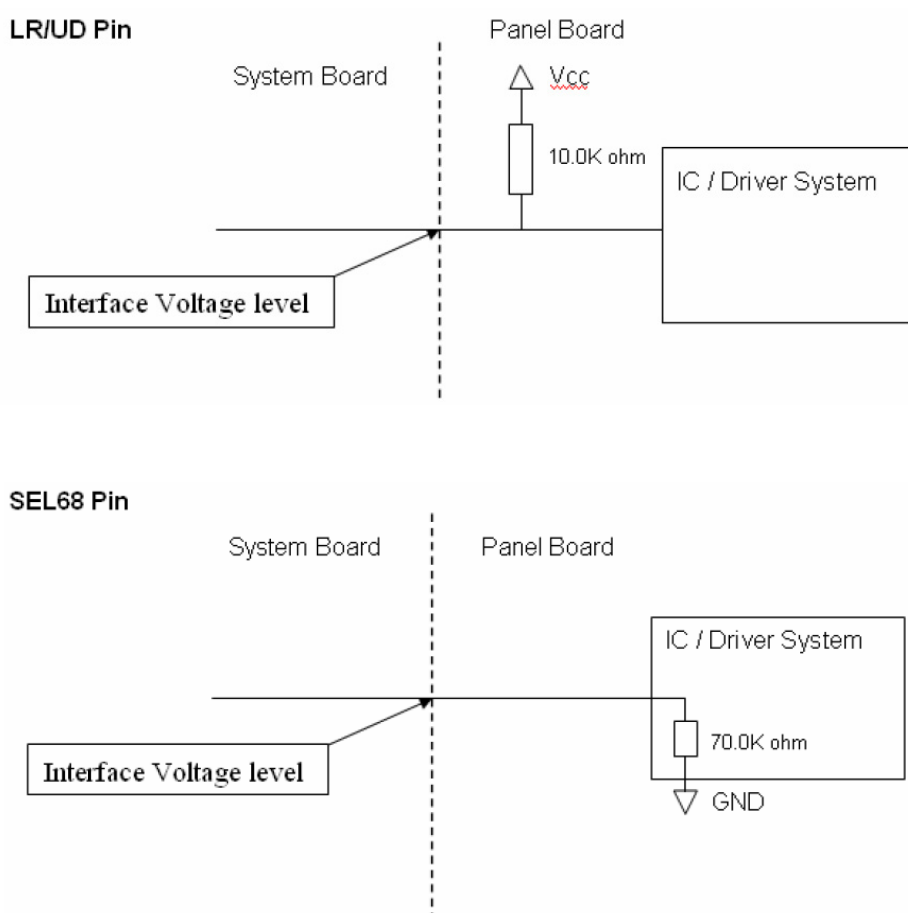
20	SEL68	LVDS 6/8-Bit Select Function Control, High -> 6-Bit Input Mode Low or NC -> 8-Bit Input Mode	(3)
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Note(1): Connector Part No.: Cvilux CID520D1HR0-NH or equivalent.

Note(2): User's connector Part No.: Hirose DF14-20S-1.25C or equivalent.

Note(3): "Low" stands for 0V. "High" stands for 3.3V. "NC" stands for "No Connection".

Note(4): Pin3, Pin10, Pin19 input signals should be set to no connection or ground, this module will operate normally.

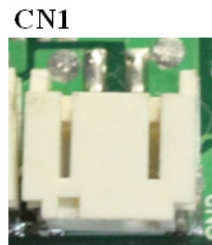


3.3 Backlight Unit (LED Driver Board)

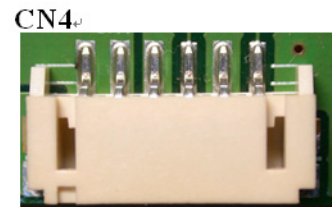
3.3.1 Connectors

These connectors are capable of accommodating the following signals and consist of the following components.

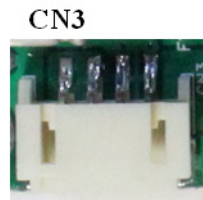
No.	Connector Name	Manufacturer	Part Number
CN1	Output Connector	JST or Compatible	S2B-PH-SM4
CN2	Output Connector	JST or Compatible	S2B-PH-SM4
CN3	Input Connector	JST or Compatible	S4B-PH-SM4
CN4	Input Connector(Optional)	JST or Compatible	S6B-PH-SM4
CN5	Input Connector (Optional)	JST or Compatible	S3B-ZR-SM4
CN6	Input Connector (Optional)	JST or Compatible	S2B-ZR-SM4



↑ S2B-PH-SM4
(pin1)



↑ S6B-PH-SM4
(pin1)



↑ S4B-PH-SM4
(pin1)



↑ S3B-ZR-SM4
(pin1)



↑ S2B-ZR-SM4
(pin1)

3.3.2 Pin Assignment

Table 3.2: CN1, CN2 Output Connector

Pin No.	Symbol	Description
1	Output	High Voltage
2	Output	Low Voltage

Table 3.3: CN3 Input Connector

Pin No.	Symbol	Description
1	Vin	Input Voltage 12V
2	Vin	Input Voltage 12V
3	GND	Ground
4	GND	Ground

Table 3.4: CN4 Input Connector

Pin No.	Symbol	Description
1	Vin	Input Voltage 12V
2	Vin	Input Voltage 12V
3	GND	Ground
4	GND	Ground
5	Control	ON/OFF control (ON=+1.5~5V OFF=0~0.8V)
6	PWM	Brightness control (0V Min ~ 5V Max)

Table 3.5: CN5 Input Connector (Optional for VR Adjustment Brightness)

Pin No.	Symbol	Description
1	Variable Resistor	VR High Voltage
2	Variable Resistor	VR
3	Variable Resistor	VR Low Voltage

Table 3.6: CN6 Input Connector (Optional for Light Sensor Auto Dimming)

Pin No.	Symbol	Description
1	Light sensor	Sensor High Voltage
2	Light sensor	Sensor Low Voltage

3.4 Color Data Input Assignment

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 the assignment of color versus data input.

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	
	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	
	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	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	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	
	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	
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		
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	
	Green(1)	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	1	0	0	0	0	0	0	0	0	0	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	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	
	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	
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		
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	
	Blue(1)	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	1	0	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	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	
	Blue (254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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		

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

Chapter 4

LCD Interface Timing

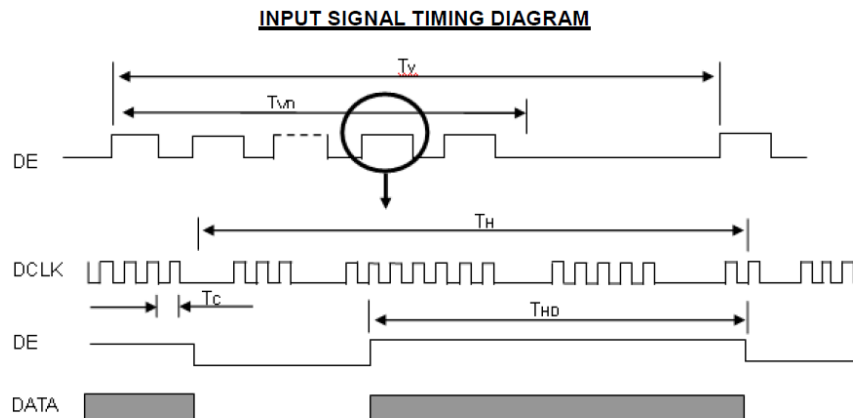
4.1 INPUT SIGNAL TIMING SPECIFICATIONS

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

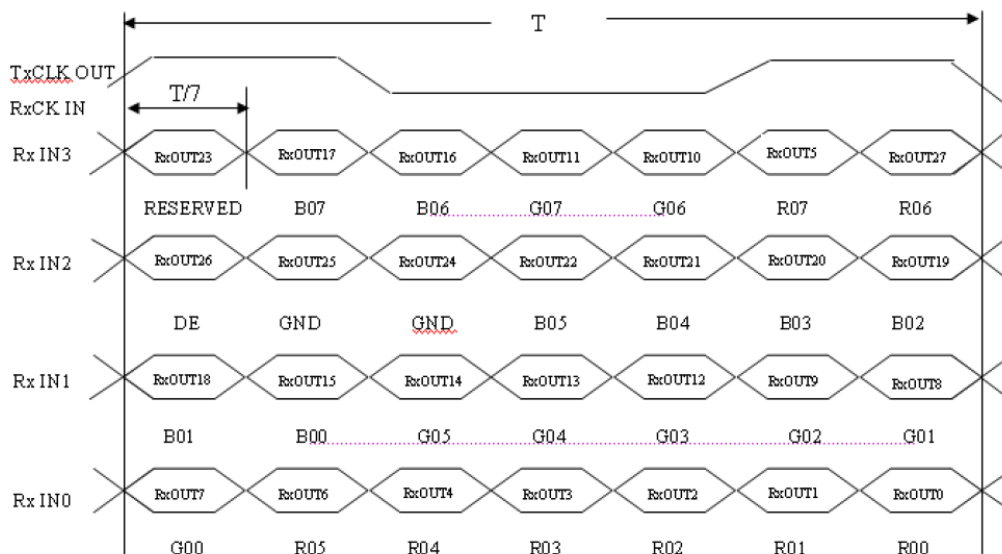
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	Fc	53.35	65	80	MHz	
	Period	Tc	12.5	15.38	18.75	ns	
	Input Cycle to Cycle Jitter	T _{rcl}	-	-	200	ns	(a)
	Input Clock to Data Skew	TLVCCS	-0.02*Tc	-	0.02*Tc	ns	(b)
	Spread Spectrum Modulation Range	F _{clk_{in}_mod}	-	-	1.02*Fc	MHz	(c)
	Spread Spectrum Modulation Frequency	F _{SSM}	-	-	200	KHz	
Vertical Display Term	Frame Rate	Fr	55	60	70	Hz	Tv=Tvd+Tvb
	Total	Tv	780	806	840	Th	-
	Active Display	Tvd	768	768	768	Th	-
Horizontal Display Term	Blank	Tvb	Tv-Tvd	38	Tv-Tvd	Th	-
	Total	Th	1240	1344	1360	Tc	Th=Thd+Thb
	Active Display	Thd	1024	1024	1024	Tc	-
	Blank	Thb	Th-Thd	320	Th-Thd	Tc	-

Note(1): Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module will operate abnormally.

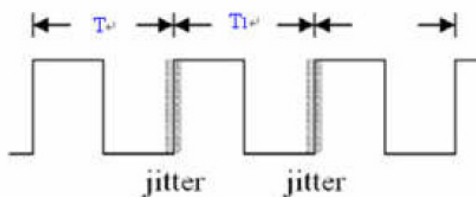
Note(2): The Tv(Tvd+Tvb) must be integer, otherwise, the module will operate abnormally.



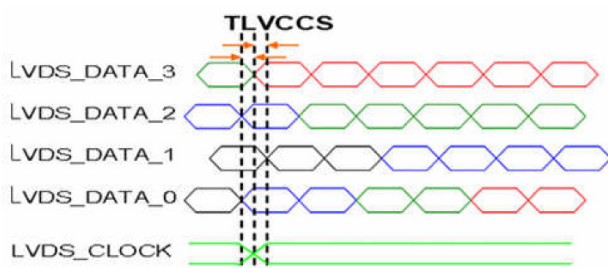
TIMING DIAGRAM of LVDS



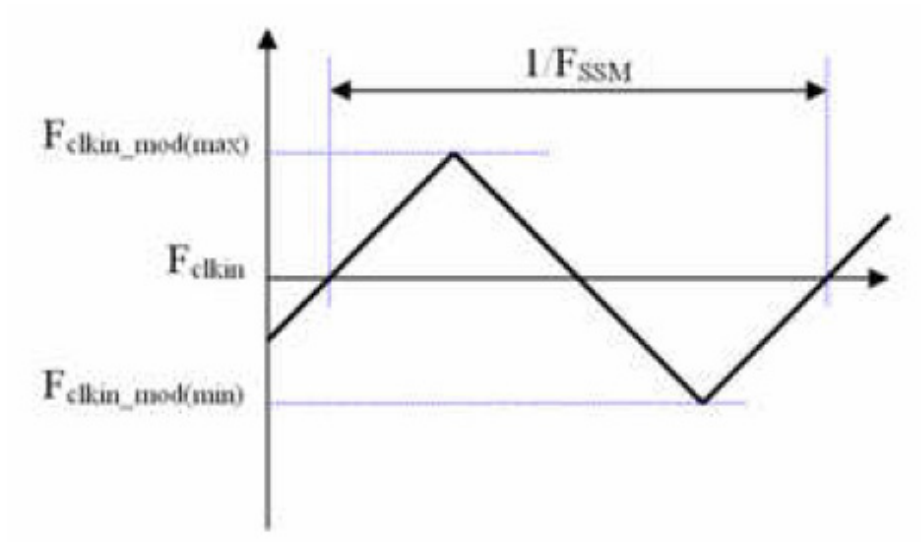
Note (a): The input clock cycle-to-cycle jitter is defined in the below figures. $Trcl = |T1 - Tl|$



Note (b): Input clock to data skew is defined in the below figures.

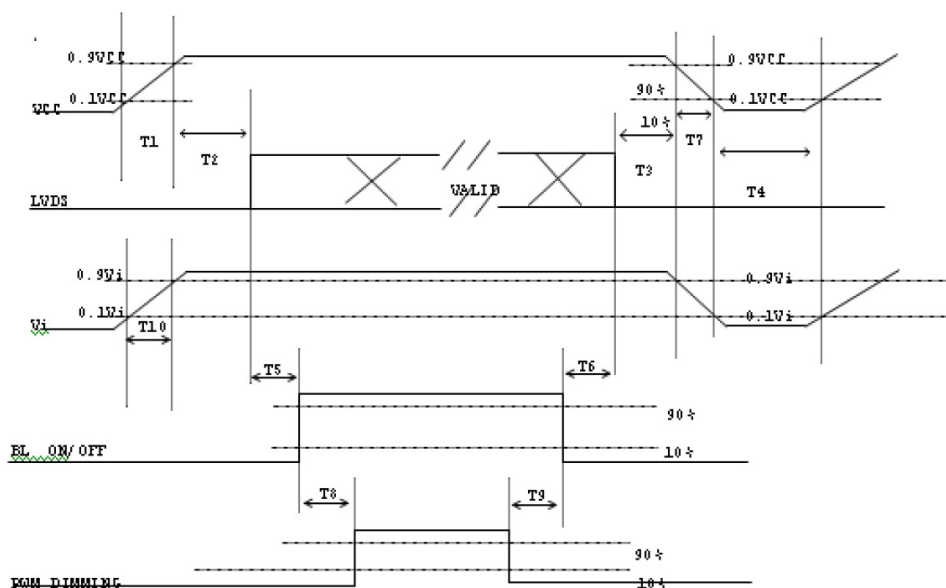


Note (c): The SSCG (Spread spectrum clock generator) is defined in the below figures.



4.2 POWER ON/OFF SEQUENCE

To prevent a latch-up or DC operation of the LCD assembly, the power on/off sequence should be as the diagram below.



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): Backlight converter power must be turned on after the power supply for the logic and the interface signal to be valid. The backlight converter power must be turned off before the power supply or the logic and the interface signal is invalid.

Parameter	Value			Unit
	Min.	Typ.	Max.	
T1	0.5	-	10	[ms]
T2	0	-	50	[ms]
T3	0	-	50	[ms]
T4	500	-	-	[ms]
T5	200	-	-	[ms]
T6	200	-	-	[ms]
T7	5	-	300	[ms]
T8	10	-	-	[ms]
T9	10	-	-	[ms]
T10	20	-	50	[ms]

Chapter 5

Touchscreen and
Touch Controller

5.1 Touchscreen (Optional: For IDK-2115R Only)

5.1.1 Touch Characteristics

The touch panel is a resistance type that a customer uses with flat displays like an LCD. Once the operator touches it with a stylus or finger, the circuit for the touch panel sends coordinate points to a PC from the voltages at the contact points.

5.1.2 Optical Characteristics

Item	Specifications	Remarks
1 TRANSPARENCY	80% ± 3%	BYK-Gardner
2 HAZE	8.0% ± 3%	BYK-Gardner

5.1.3 Environment Characteristics

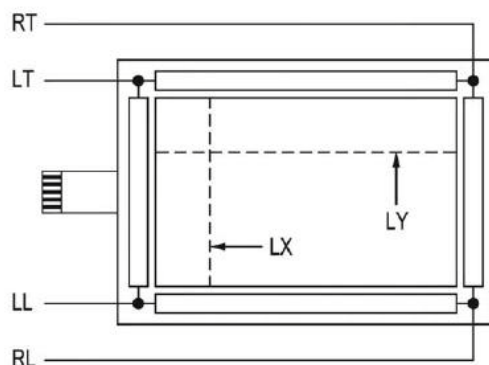
Item	Specifications	Remarks
1 Operation Temperature	-20°C ~ 70°C	Note: All terms under 1 atmosphere
2 Storage Temperature	-40°C ~ 80°C	
3 Operation Humidity	20% ~ 80%RH	
4 Storage Temperature	20% ~ 90%RH	

5.1.4 Mechanical Characteristics

Item	Specifications	Remarks
1 Hardness of Surface	Pencil Hardness 3H.	JIS K-5600-5-4 150gf, 45 degrees
2 FPC Peeling Strength	1) 5N (5N Min.) 2) 19.6N (19.6N Min.)	1) Peeling Upward by 90° 2) Peeling Downward by 90°
3 Operation Force	Pen Finger 0.05N~1.96N (5~200gf)	Dot-Spacer Within “guaranteed active area”, but not on the age and Dot-Spacer

5.1.5 Electronic Characteristics

Item	Specification	Remarks
1 Rated Voltage	DC 7V max.	
2 Resistance	X axis: 200Ω ~ 1000Ω (Figure as Below) Y axis: 200Ω ~ 800Ω (Figure as bellow)	FPC Connector
3 Linearity	X ≤1.5% (Figure as Below) Y ≤1.5% (Figure as Below)	Reference: 250gf
4 Chattering	≤ 20ms Max	
5 Insulation Resistance	≥ 20MΩ min (DC 25V)	

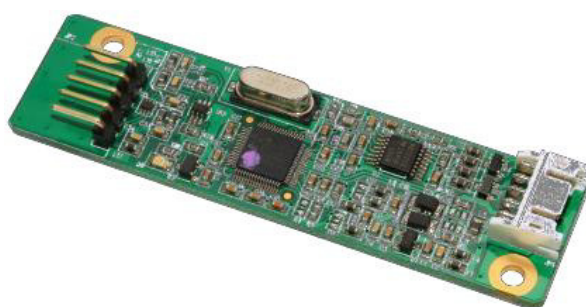


5.1.6 General Specifications

Item	Specifications
1 Frame Size	322.00±0.30 X 245.50±0.30 mm
2 View Area	309.00±0.30 X 233.50±0.20 mm
3 Active Area	303.00±0.30 X 227.50±0.20 mm
4 Total Thickness	2.20±0.20 mm
5 Tail Length	205.00±6.00 mm

5.2 Touch Controller (Optional: For IDK-2115R Only)

Advantech's ETM-RES04C Touch Control Board is the ultimate combo board. This touch panel controller provides optimal performance for 5-wire analog resistive touch panels. It communicates with a PC system directly through USB and RS-232 connectors. The superior design is sensitive, accurate and, friendly to operate. The touch panel driver emulates mouse left and right button functions.



5.2.1 Touch Controller Characteristics

5.2.1.1 Specifications

Electrical Features

- +5 Vdc/ 100 mA typical, 50mV peak to peak maximum ripple and noise.
- Bi-directional RS-232 serial communication and USB 1.1 full speed
- Report rate of RS-232 is 180 points/sec (max.). And, USB is 200 points/sec (max.)
- Unaffected by environmental EMI
- Panel resistance of 5-wire resistive model is from 50 to 200 ohm (Pin to pin on same layer)

- Touch resistance under 3K ohm

Serial Interface

- EIA 232E (Serial RS-232)
- No parity, 8 data bits, 1 stop bit, 9600 baud (N, 8, 1, 9600)
- Support Windows 2000/ Vista/ XP/ 7, Windows CE 5.0/ 6.0/ 7.0, Windows NT4, Linux, DOS, QNX

USB Interface

- Conforms to USB Revision 1.1 full speed.
- If the USB is connected to the controller, the controller will communicate over the USB, and will not communicate over the serial port.
- Supports Windows 2000/ Vista/ XP/ 7, Windows CE 5.0/ 6.0/ 7.0, Linux, QNX

Touch Resolution

- 2,048 x 2,048 resolution

Response Time

- Max. 20 ms

5.2.1.2 Environmental Features

Reliability

- MTBF is 200,000 hours

Temperature Ranges

- Operating : -25°C ~ 85°C
- Storage : -25°C ~ 85°C

Relative Humidity

- 95% at 60°C, RH Non-condensing

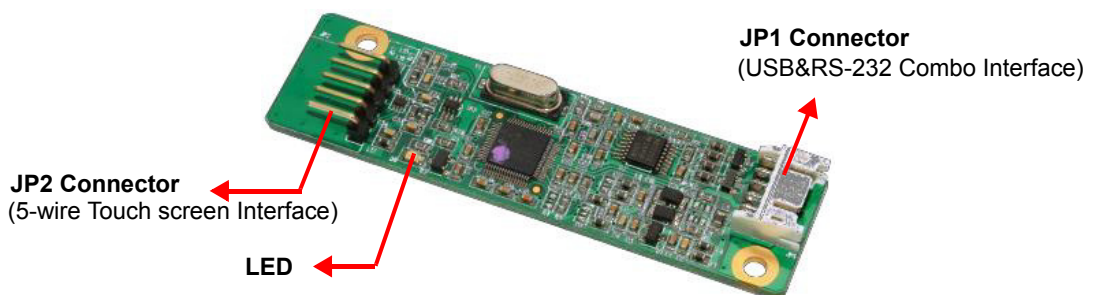
Acquired RoHS Certificate

Regulatory FCC-B, CE Approvals

Dimension: 75 mm x 20 mm x 10 mm

5.2.2 Pin Assignment and Description

5.2.2.1 Connector and LED Location



5.2.2.2 Combo Interface Connector, JP1, Pins and Signal Descriptions

The combo interface connector for USB and RS-232 is a 2.0mm, 10-pin, 90 degree box; male type with lock connector. It is intended to be used with single wired pins in 5+5 pins header. The pins are numbered as shown in the table below.

USB Pin #	Signal Name	Signal Function	RS-232 Pin #	Signal Name	Signal Function
1	G	Ground	1	G	Ground
2	V	USB Power	2	V	Power
3	G	Ground	3	G	Ground
4	D+	USB D+	4	TxD	Serial Port
5	D-	USB D-	5	RxD	Serial Port

Signal Name	DB-9 pin #	RS-232 pin #	Sourced by	Signal Description
RxD	2	5	ctrl	serial data from controller to host
TxD	3	4	host	serial data from host to controller

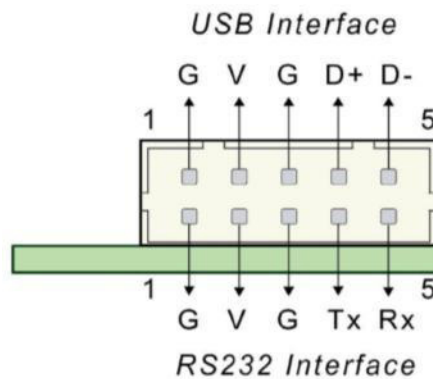
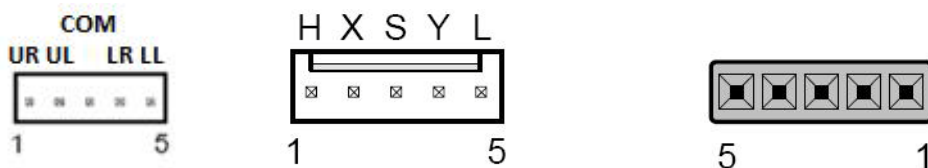


Figure 5.1 Board Mounted Header

5.2.2.3 Touch Screen Connector, JP2, Pins and Signal Descriptions

The touchscreen connector, JP2, is a single row, 2.54mm, 5-pins, 90 degrees; male type connector. The pins are numbered as shown in the table below.

JP2 Pin #	Signal Name	Signal Description
1	H / UR	Drive signal attached to the touchscreen substrate upper right corner when viewed from a user's perspective.
2	Y / UL	Drive signal attached to the substrate upper left corner.
3	COM	-
4	X / LR	Drive signal attached to the substrate lower right corner.
5	L / LL	Drive signal attached to the substrate lower left corner.



Appendix **A**

LCD Optical
Characteristics

A.1 LCD Optical Characteristics

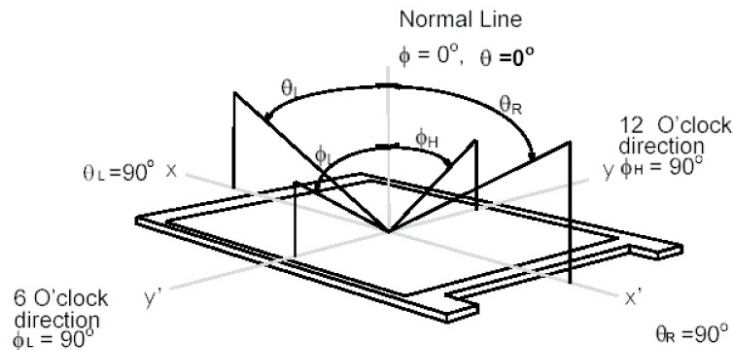
The optical characteristics are measured under stable conditions at 25°C (Room Temperature):

Table A.1: Optical Characteristics

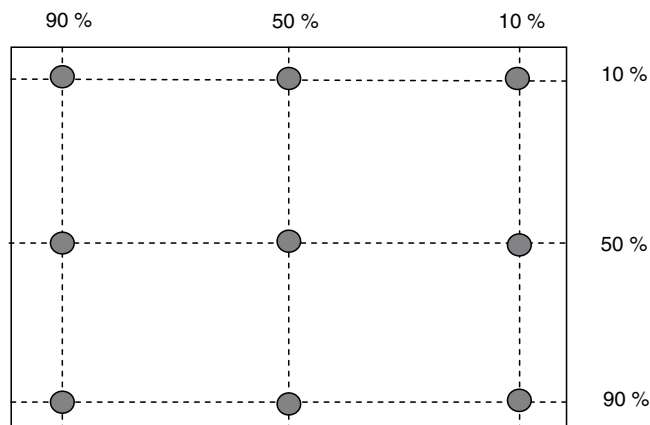
Item	Unit	Conditions	Min.	Typ.	Max.	Note
Viewing Angle	[degree]	Horizontal (Right)	80	88	-	(1)
		CR = 10 (Left)	80	88	-	
		Vertical (Upper)	80	88	-	
		CR = 10 (Lower)	80	88	-	
Luminance Uniformity	[%]	9 Points	70	75	-	(2), (3)
Optical Response Time	[msec]	Rising	-	16	21	(5)
		Falling	-	7	14	
		Rising + Falling	-	23	35	
Color/Chromaticity Coordinates (CIE 1931)		White x	-	0.313	-	(4)
		White y	-	0.329	-	
White Luminance	[cd/m ²]		1100	1200	-	(4)
Contrast Ratio			1800	2500	-	(4)

Note(1): Definition of viewing angle

Viewing angle is the measurement of contrast ratio R10, at the screen center, over a 180° horizontal and 180° vertical range (off-normal viewing angles). The 180° viewing angle range is broken down as: 90° (θ) horizontal left and right, and 90° (Φ) vertical high (up) and low (down). The measurement direction is typically perpendicular to the display surface with the screen rotated to its center to develop the desired measurement viewing angle.



Note(2): 9-point position

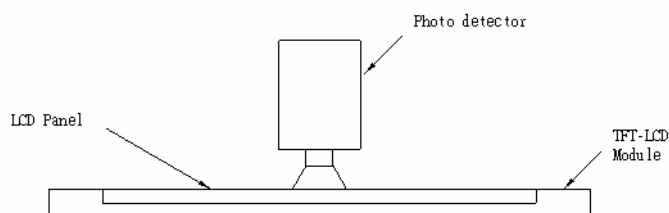


Note(3): 9-point luminance uniformity is defined by dividing the maximum luminance values by the minimum test point luminance

$$\delta_{w9} = \frac{\text{Minimum Brightness of nine points}}{\text{Maximum Brightness of nine points}}$$

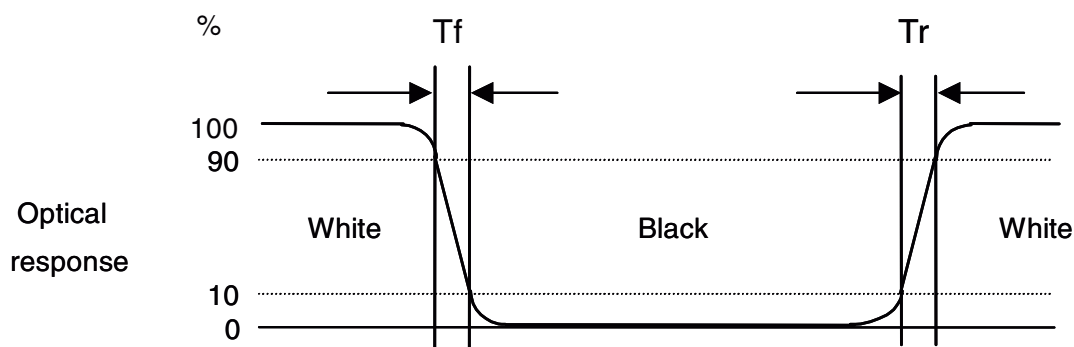
Note(4): Measurement method

The LCD module 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 stable, windless and dark room. Optical Equipment: DT-100, or equivalent



Note(5): Definition of response time

The output signals of the photo detector are measured when the input signals are changed from "Full Black" to "Full White" (rising time), and from "Full White" to "Full Black" (falling time), respectively. The response time is an interval between 10% and 90% of amplitudes. Please refer to the figure below.



Appendix **B**

Safety Precautions

B.1 Safety Precautions

The optical characteristics are measured under stable conditions at 25°C (room temperature).

1. Since front polarizer is easily damaged, pay attention not to scratch it.
2. Be sure to turn off power supply when inserting or disconnecting from input connector.
3. Wipe off water drops immediately. Lengthy contact with water may cause discoloration or spots.
4. When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
5. Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface.
6. Since a CMOS LSI is used in this module, be aware of static electricity and insure equipment and personnel are properly grounded when handling.
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. If a module has to be put back into the packing container slot after having been taken out, please press the far ends of the LED light bar reflector edge softly. Otherwise the TFT Module may be damaged.
10. During insertion or removal of the Signal Interface Connector, be sure not to rotate or tilt the Interface Connector of the TFT Module.
11. After installation of the TFT Module into an enclosure, do not twist nor bend the TFT Module even momentarily. When designing the enclosure, care should be taken not to bend/twist the TFT Module from outside. Otherwise the module may be damaged.
12. Small amounts of inflammable materials are used in the LCD module. The LCD module should be supplied by power that complies to requirements for a Limited Power Source (IEC60950 or UL1950) or an exemption should be applied for.

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