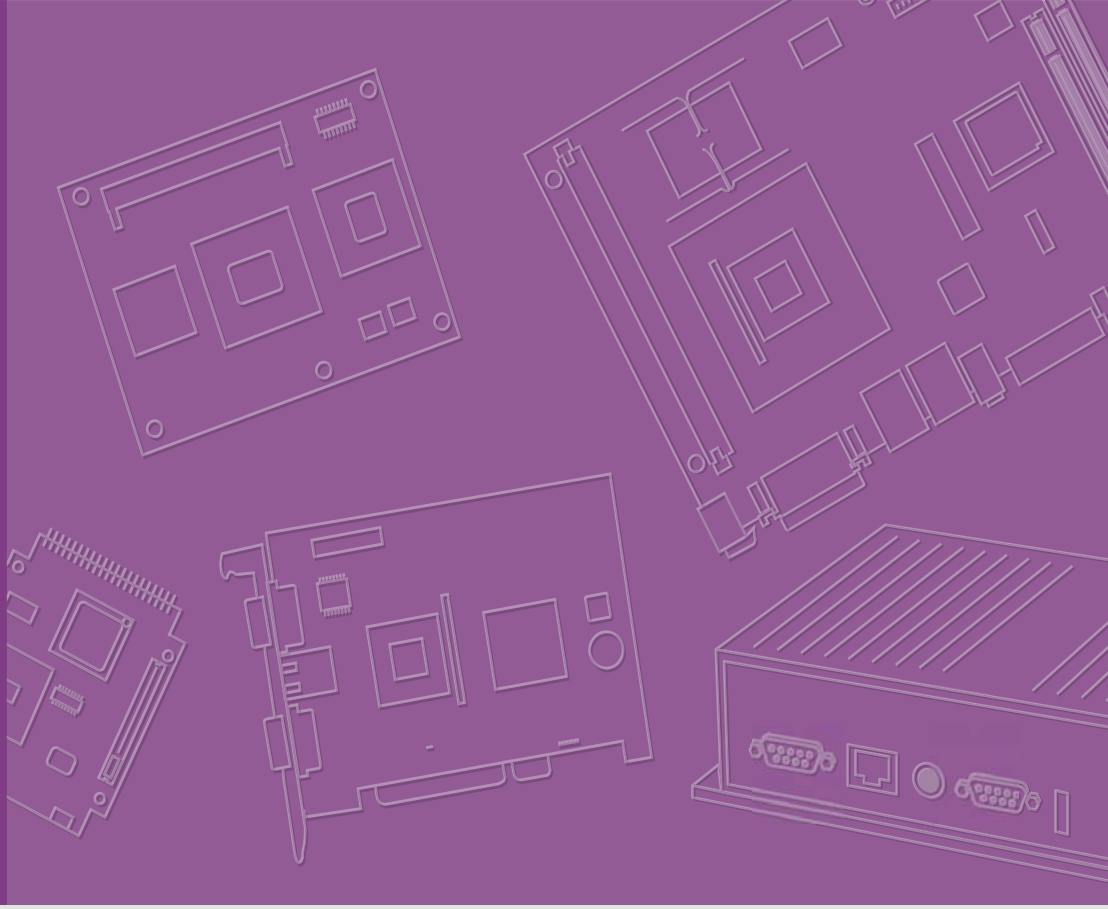

User Manual

IDK-2108 Series

8.4" SVGA Ultra High Brightness Display Kit with LED Backlight

ADVANTECH

Enabling an Intelligent Planet

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Part No. 2006210803 Edition 5

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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.

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FCC

This device complies with the requirements in part 15 of the FCC rules:

Operation is subject to the following two conditions:

- This device may not cause harmful interference
- This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this device in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense. The user is advised that any equipment changes or modifications not expressly approved by the party responsible for compliance would void the compliance to FCC regulations and therefore, the user's authority to operate the equipment.

Caution! *There is a danger of a new battery exploding if it is incorrectly installed. Do not attempt to recharge, force open, or heat the battery. Replace the battery only with the same or equivalent type recommended by the manufacturer. Discard used batteries according to the manufacturer's instructions.*

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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.

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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 an RMA (return merchandise authorization) 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 General Description

IDK-2108 series is a Color Active Matrix Liquid Crystal Display composed of a TFT-LCD panel, a driver circuit, and backlight system. The screen format supports an SVGA screen of 800 x 600 pixels (H x V) at 16.2M colors (RGB 8-bit) or 262k colors (RGB 6-bit). All input signals are LVDS interface compatible. Driver board backlight is included.

1.2 Specifications

1.2.1 LCD Panel

- **Display Size:** 8.4" LED backlight panel
- **Resolution:** 800 x 600
- **Viewing Angle (U/D/L/R):** 80°/60°/80°/80°
- **Brightness:** 1200 cd/m2
- **Contrast Ratio:** 600:1
- **Response Time (ms):** 30 ms
- **Colors:** 6-bit (262K)/8-bit (16.2M)
- **Voltage:** 3.3V
- **Power Consumption:** 5.85 W
- **Signal Interface:** 1 channel LVDS
- **Weight:** R series: 338.5 g
  N series: 260 g
- **Dimensions (W x H x D):** R series: 203 x 142.6 x 10.3 mm
  N series: 203 x 142.5 x 8.0 mm

1.2.2 LED Driver Board

- **Efficiency:** 90%
- **Output Current & Voltage:** 500 mA/8.9 V
- **Dimensions (W x H x D):** 60x16x5 mm

1.2.3 Touchscreen (R series)

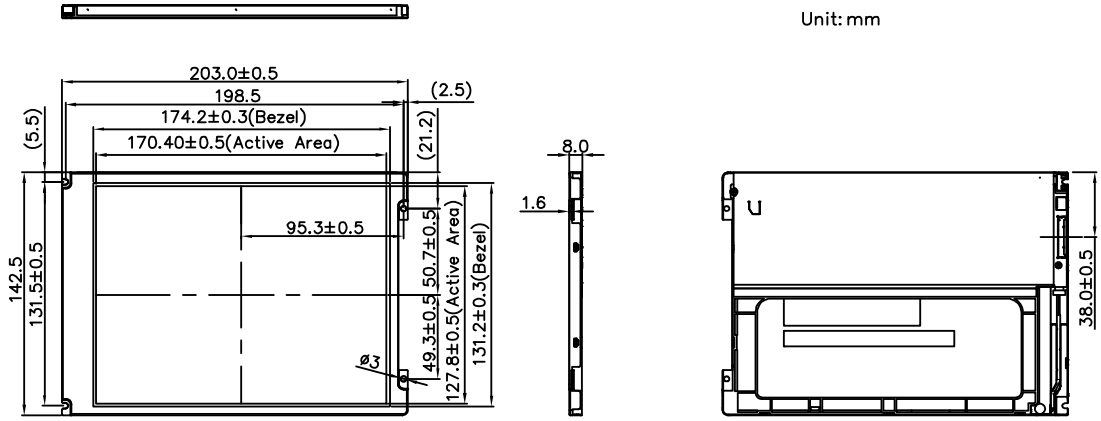
- **Touchscreen:** 4-Wire Resistive
- **Transparency:** 82.5% (Typ.)
- **Durability:** 1 million times

1.2.4 Environment

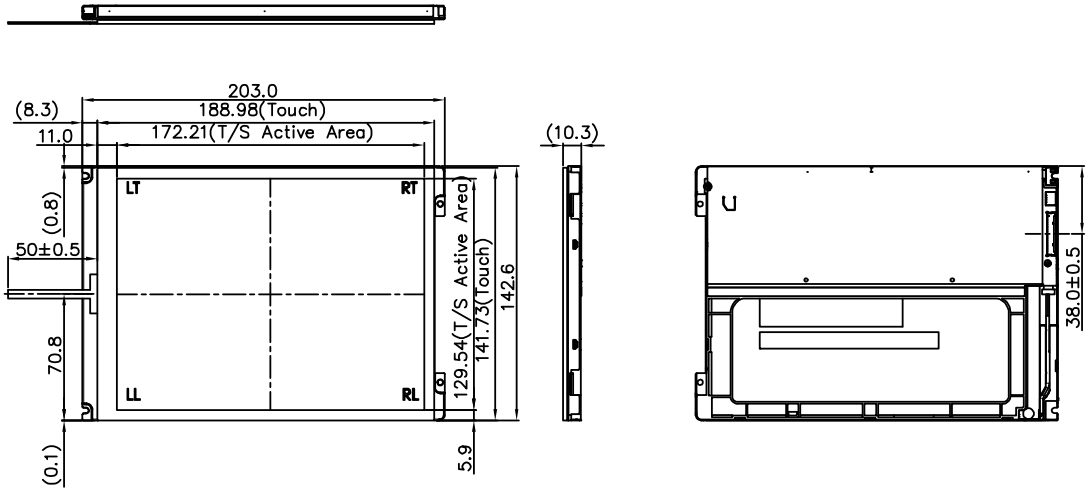
- **Operating Temperature:** -10 ~ + 60 °C (R- series)
- -20 ~ 70 °C (N- series)
- **Storage Temperature:** -30 ~ +70 °C (R- series)
- -30 ~ +85 °C (N- series)
- **Humidity:** 90% @ 39°C, non-condensing

1.3 Mechanical Characteristics

IDK-2108N Series



IDK-2108R Series



1.4 Functional Block Diagram

The following diagram shows the functional block of the 8.4 inch color TFT-LCD module:

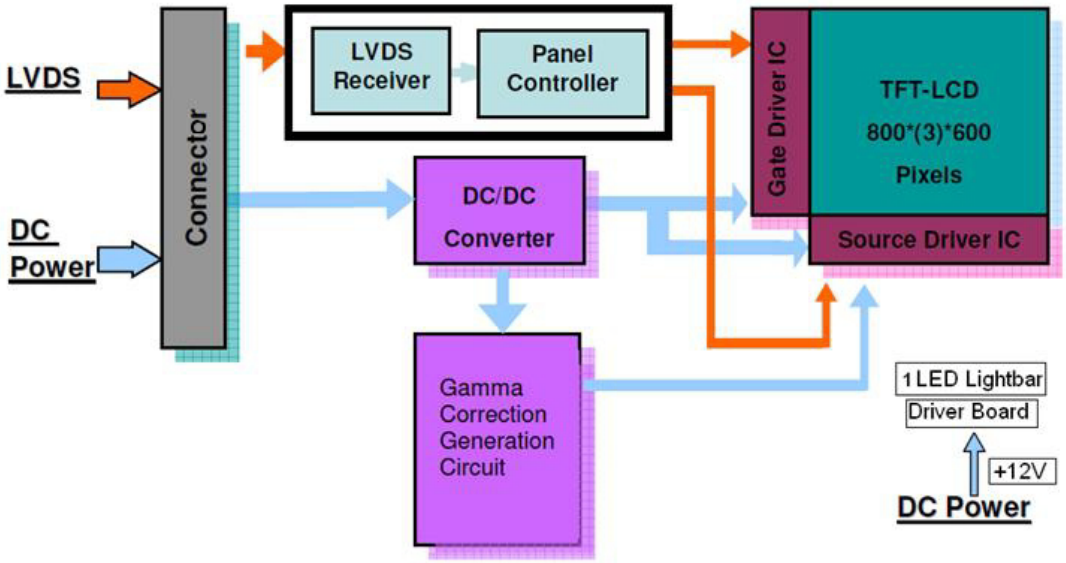


Figure 1.1 Function Block Diagram

1.5 Touchscreen Driver

The touchscreen driver is available on Advantech's website.

1.6 Absolute Maximum Ratings

Absolute maximum ratings of the module is as follows:

1.6.1 Absolute Ratings of TFT LCD Module

Item	Symbol	Min.	Max.	Unit	Conditions
Logic/LCD Drive Voltage	Vin	3	+3.6	[Volt]	Note 1, 2

1.6.2 Absolute Ratings of Backlight Unit

Item	Symbol	Min.	Max.	Unit	Conditions
LED Light Bar Current	Led	490	500	[mA]	Note 1, 2

1.6.3 Absolute Ratings for Environment

Item	Symbol	Min.	Max.	Unit	Conditions
Operating Temperature	TOP	10	+60	[oC]	For IDK-2108R-K2SVA2E only
Operating Humidity	HOP		90	[%RH]	
Storage Temperature	TST	-30	+70	[oC]	
Storage Humidity	HST		90	[%RH]	

Note 1: *Maximum Wet-Bulb should be 39°C and no condensation.*

Note 2: *Permanent damage to the device may occur if maximum values are exceeded.*

Note 3: *For quality performance, please refer to AUO IIS (Incoming Inspection Standard).*

Chapter 2

Electrical Characteristics

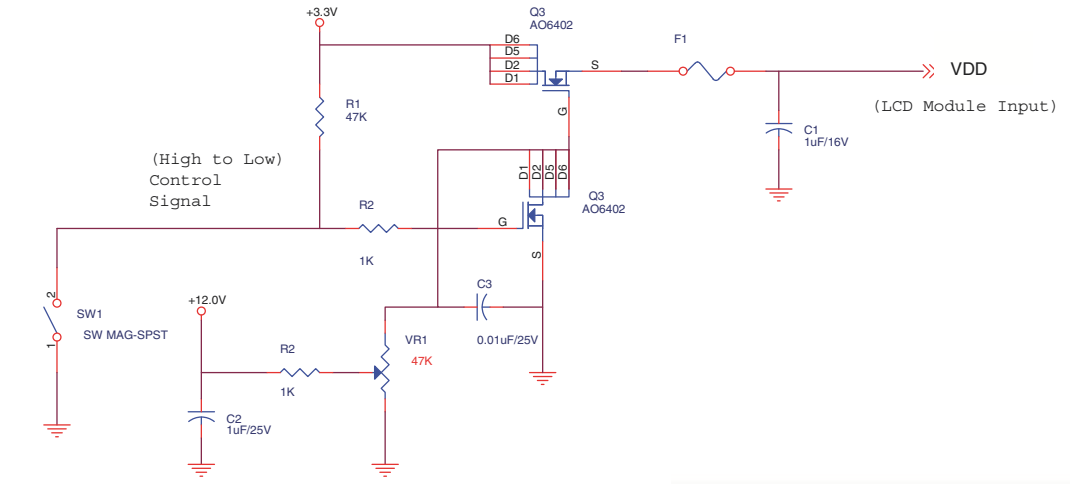
2.1 TFT LCD Power Specifications

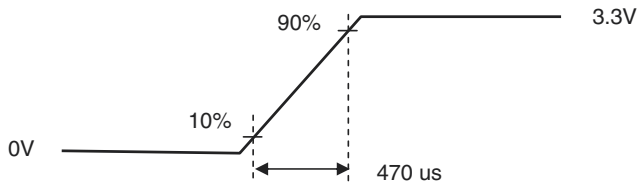
Input power specifications are as follows:

Table 2.1: Power Specifications

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	[Volt]	10%
IDD	Input Current	-	270	330	[mA]	64 Gray Bar Pattern (VDD=3.3V, at 60Hz)
PDD	VDD Power	-	0.9	1.2	[Watt]	64 Gray Bar Pattern (VDD=3.3V, at 60Hz)
Rush	Inrush Current	-	-	3	[A]	Note 1

Note 1: *Measurement condition:*





VDD rising time

64 Gray pattern

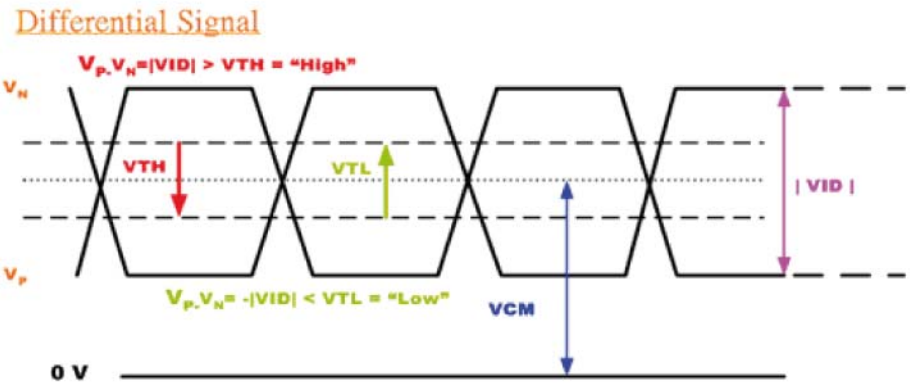
2.1.1 Signal Electrical Characteristics

Input signals shall be low or Hi-Z state when VDD is off.

Table 2.2: Signal Electrical Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
VTH	Differential Input High Threshold	-	-	100	[mV]	VCM=1.2V
VTL	Differential Input Low Threshold	-100	-	-	[mV]	VCM=1.2V
| VID |	Input Differential Voltage	100	400	600	[mV]	
VICM	Differential Input Common Mode Voltage	1.1	-	1.6	[V]	VTH / VTL = ±100mV

Note: *LVDS Signal Waveform.*



2.2 Backlight Driving Conditions

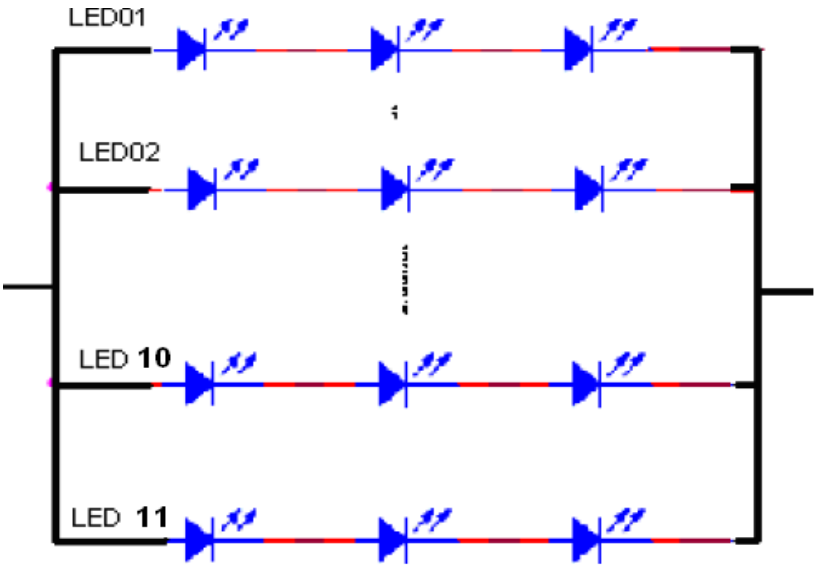
Parameter guidelines for LED light bar driver are under stable conditions at 25°C (Room Temperature):

Table 2.3: Backlight Driving Conditions

Item	Symbol	Values			Unit	Condition
		Min.	Typ.	Max.		
LED Voltage	VL	8.7		8.9	V	Note 2
LED Current	IL	490		500	mA	Note 2
LED Life Time	-	50,000	-	-	Hr	Note 1

Note 1: *"LED life Time" is defined as a module brightness decrease of 50% original brightness, and an ambient temperature of 25°C with typical LED current at 500mA.*

Note 2: *"LED Driving Condition" is defined for each LED module. (3 Serial LEDs, an LED includes 1 chip).*



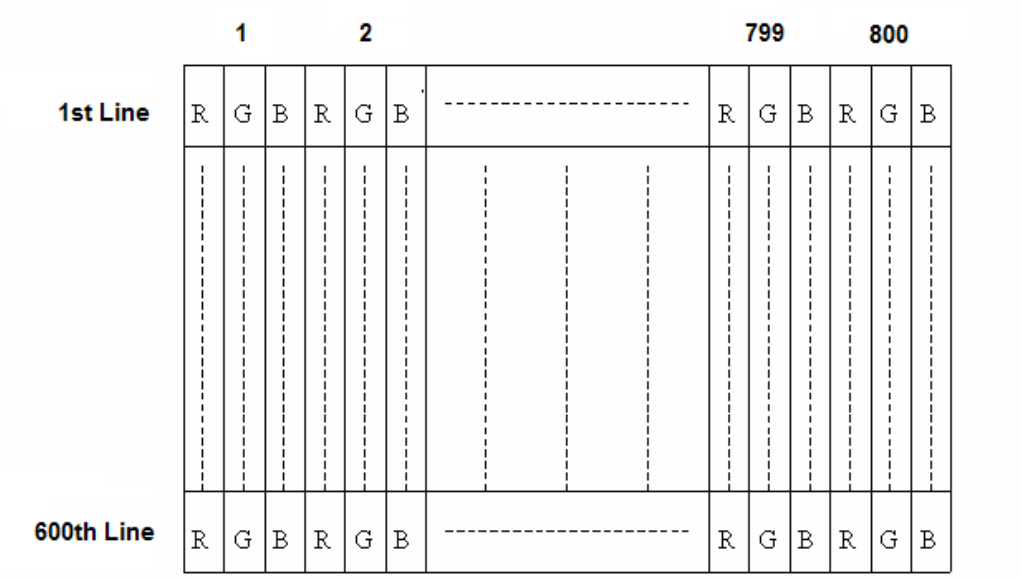
Note 3: *The LED Light Bar power consumption variance is 10%. Calculator value for reference (IL x VL = PLED)*

Chapter 3

Signal Characteristics

3.1 Pixel Format Image

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



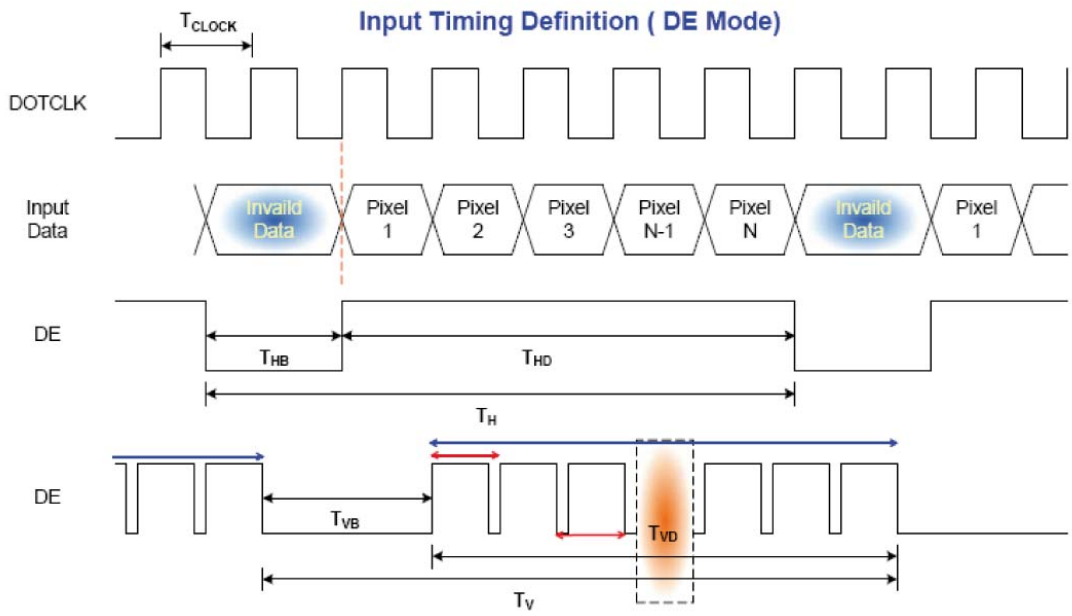
3.2 Signal Description

Table 3.1: Symbol Description

Pin No.	Symbol	Description
1	VDD	Power Supply, 3.3V (typical)
2	VDD	Power Supply, 3.3V (typical)
3	UD	Vertical Reverse Scan Control. Low or NC -> Normal mode, Height -> Vertical Reverse Scan (Note)
4	LR	Horizontal Reverse Scan Control. Low or NC -> Normal mode, Height -> Vertical Reverse Scan (Note)
5	RxIN1-	LVDS differential data input Pair 0
6	RxIN1+	
7	GND	Ground
8	RxIN2-	LVDS differential data input Pair 1
9	RxIN2+	
10	GND	Ground
11	RxIN3-	LVDS differential data input Pair 2
12	RxIN3+	
13	GND	Ground
14	RxCLKIN-	LVDS differential Co-lock input Pair
15	RxCLKIN+	
16	GND	Ground
17	SEL68	LVDS 6/8 bit select function control, Low or NC 6 Bit Input Mode. High 8-bit Input Mode (Node)
18	NC	NC
19	RxIN4-	LVDS differential data input Pair 3. Must be connected to Ground in 6-bit input mode.
20	RxIN4+	

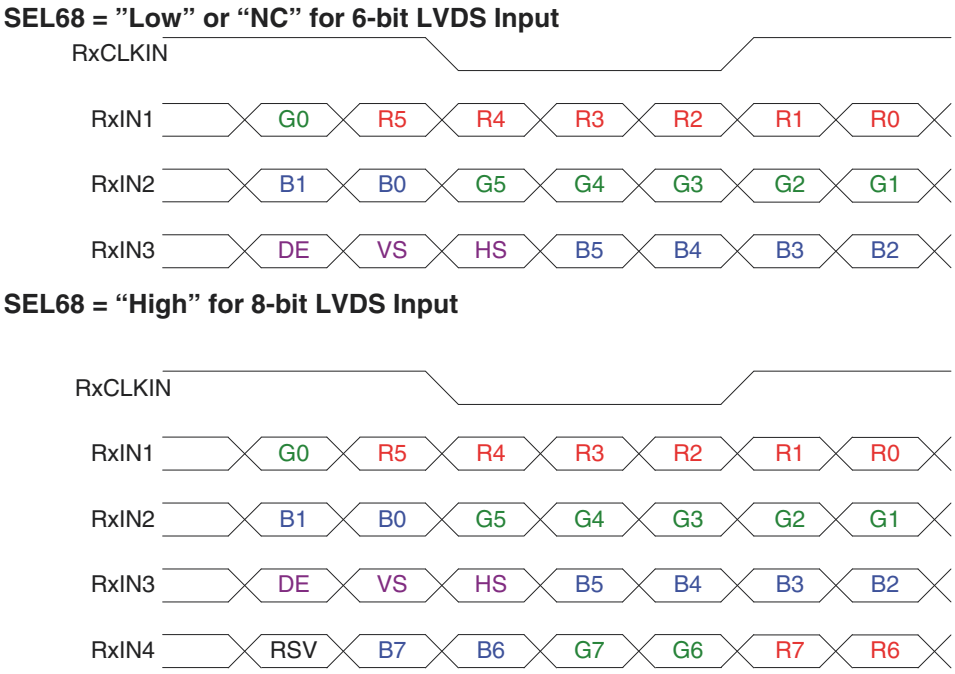
Note 1: *"Low" stands for 0V. "High" stands for 3.3V. "NC" stands for "No Connected."*

Note 2: *For reverse scan mode, please connect to 3.3V directly. A pull-up resistor on the input side will cause abnormal reverse scan.*



3.3 The Input Data Format

3.3.1 SEL68



Note 1: *Please follow PSWG.*

Note 2: *R/G/B data 7:MSB, R/G/B data 0:LSB*

Signal Name	Description	Remarks
R7	Red Data 7	Red-pixel Data, For 8-bit LVDS input, MSB: R5; LSB:R0
R6	Red Data 6	
R5	Red Data 5	
R4	Red Data 4	
R3	Red Data 3	
R2	Red Data 2	
R1	Red Data 1	
R0	Red Data 0	
G7	Green Data 7	Green-pixel Data, For 8-bit LVDS input, MSB: G7; LSB:G0
G6	Green Data 6	
G5	Green Data 5	
G4	Green Data 4	
G3	Green Data 3	
G2	Green Data 2	
G1	Green Data 1	
G0	Green Data 0	
B7	Blue Data 7	Blue-pixel Data, For 8-bit LVDS input, MSB: B7; LSB:B0
B6	Blue Data 6	
B5	Blue Data 5	
B4	Blue Data 4	
B3	Blue Data 3	
B2	Blue Data 2	
B1	Blue Data 1	
B0	Blue Data 0	
RxCLKIN	LVDS Data Clock	
DE	Data Enable Signal	When the signal is high, the pixel data is valid to be displayed.
VS	Vertical Synchronous Signal	
HS	Horizontal Synchro-nous Signal	

Note: *Output signals from any system shall be Low or Hi-Z state when VDD is off.*

3.4 Interface Timing

3.4.1 Timing Characteristics

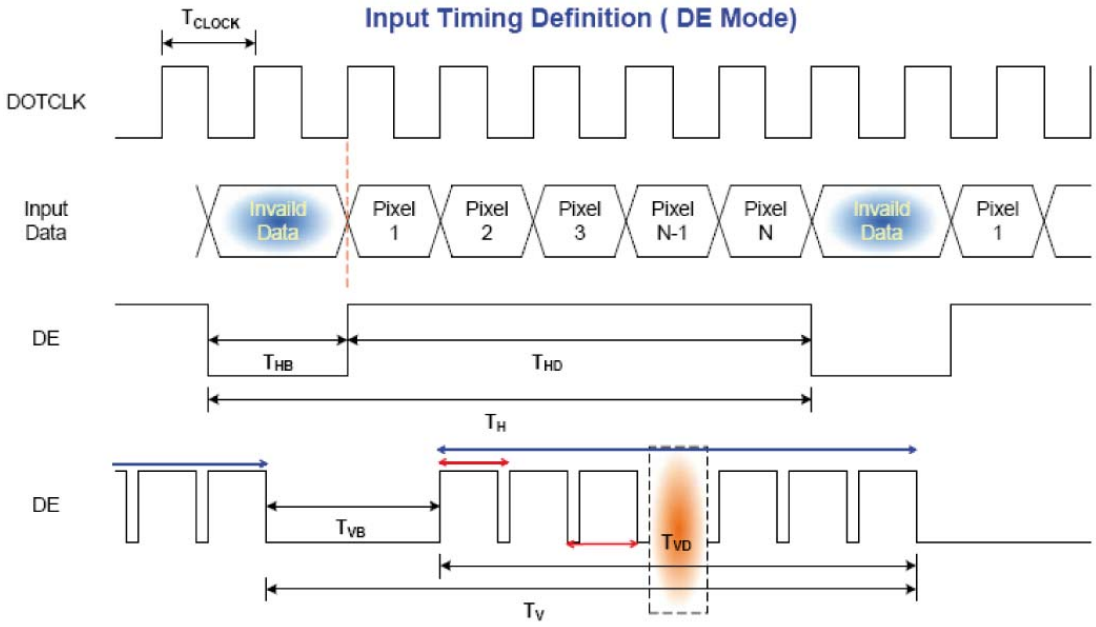
Table 3.2: Timing Characteristics **Table 3.3**

Signal	Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock Timing	Clock frequency		1/ T_{Clock}	33.6	39.8	48.3	MHz
Vsync Timing	Vertical Section	Period	T_V	608	628	650	T_H
		Active	T_{VD}	600	600	600	T_H
		Blanking	T_{VB}	8	28	50	T_H
Hsync Timing	Horizontal Section	Period	T_H	920	1056	1024	T_{Clock}
		Active	T_{HD}	800	800	800	T_{Clock}
		Blanking	T_{HB}	120	256	440	T_{Clock}

Note: *Frame rate is 60 Hz.*

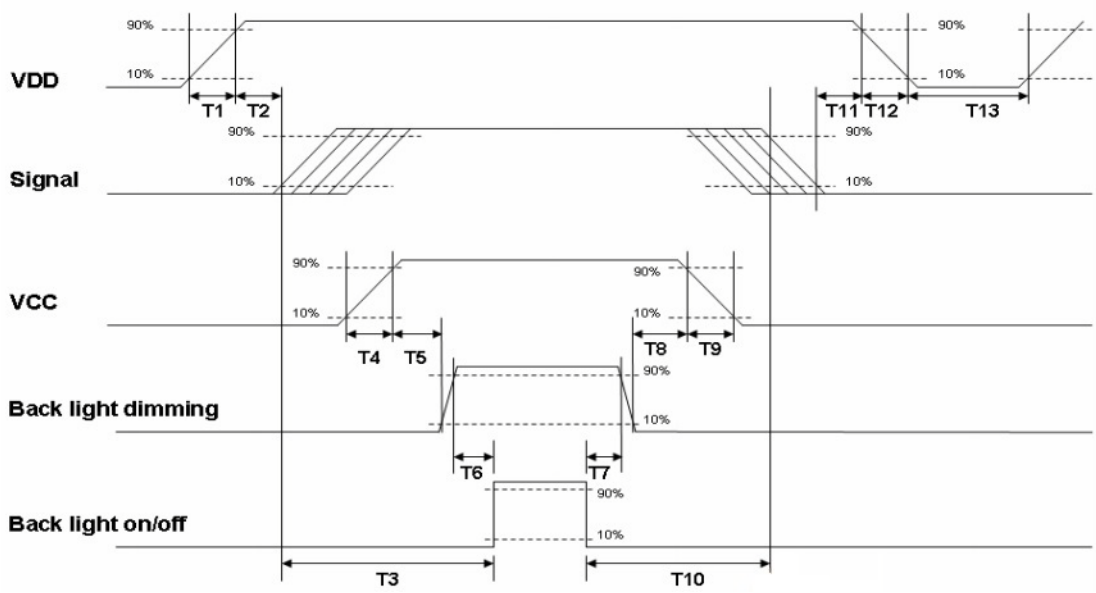
Note: *DE mode.*

3.4.2 Input Timing Diagram



3.5 Power ON/OFF Sequence

VDD power and Backlight on/off sequence is as follows. Interface signals are also shown in the chart. Signals from any system shall be Hi-Z state or low level when VDD is off.



Power Sequence Timing

Parameter	Value			Unit
	Min.	Typ.	Max.	
T1	0.5	-	10	[ms]
T2	30	40	50	[ms]
T3	200	-	-	[ms]
T4	0.5	-	10	[ms]
T5	10	-	-	[ms]
T6	10	-	-	[ms]
T7	0	-	-	[ms]
T8	10	-	-	[ms]
T9	-	-	10	[ms]
T10	110	-	-	[ms]
T11	0	16	50	[ms]
T12	-	-	10	[ms]
T13	1000		-	[ms]

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

Chapter 4

Connector & Pin Assignment

4.1 TFT LCD Module

The physical interface described is for the connector on module. These connectors are capable of accommodating the following signals and components listed.

4.1.1 Connector

Table 4.1: LVDS Connector

Connector Name / Description	Signal Connector
Manufacturer	STM or Compatible
Connector Model Number	STM-MSB24013P20HA or Compatible
Adaptable Plug	STM-P24013P20

4.1.2 Pin Assignment

Table 4.2: Pin Assignment

Pin No.	Signal Name	Pin No.	Signal Name
1	VDD	2	VDD
3	UD	4	LR
5	RxIN1-	6	RxIN1+
7	GND	8	RxIN2-
9	RxIN2+	10	GND
11	RxIN3-	12	RxIN3+
13	GND	14	RxCLKIN-
15	RxCLKIN+	16	GND
17	SEL68	18	NC
19	RxIN4-	20	RxIN4+

4.2 Backlight Unit

The physical interface described is for the connector on module. These connectors are capable of accommodating the following signals and components listed.

Connector Name / Designation	LED Light Bar Connector / Backlight Lamp
Manufacturer	JST or compatible
Type Part Number	WF-SMT90 1.5mm Wire to board Heater
Mating Type Part Number	NA

4.2.1 Signal for LED light bar connector

	Connector No.	Pin No.	Input	Color	Function
Lower	CN2	1	HI 2	Red	Power supply for backlight unit
		2	GND 2	Black	Ground for backlight unit

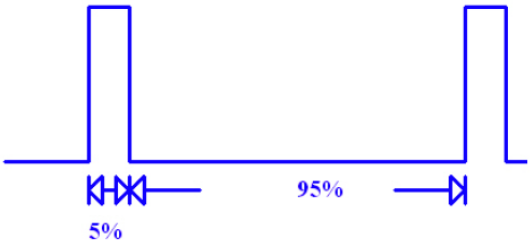
Cable Length : 250mm+/-10mm

4.2.2 LED Driver Board

4.2.2.1 Specifications:

Table 4.3: Specifications

Symbol	Characteristics	Condition	Min.	Typ.	Max.	Unit
Input	Voltage		11.2	12	13.2	V
	Efficiency			90		%
Output	Voltage		8.7	9	10.5	V
	Current		475	500	550	mA
	Current Accuracy			±5		%
Protection				OVP, UVLO		
Environment	Operating Temperature		-30		+85	°C
	Storage Temperature		-40		+105	°C
PWM Dimmer	Dimmer range (Note. 1)		5		100	%
	Dimmer VH			5		V
	Dimmer VL			0		V
	Dimmer Frequency		0.5		40	KHz
ON/OFF	Von		3		5	V
	Voff		0		0.8	V



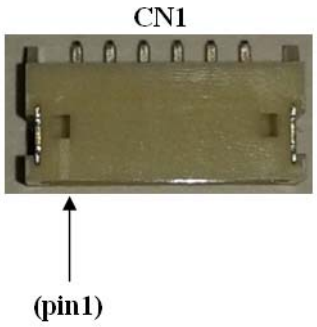
Note 1: *When the input PWM signals, the high-level digital output must be greater than the total output level at 5% output.*

4.2.2.2 Connector Model No & Brand

Connector No.	Connector Parts No	Brand	Remark
CN1	S6B-ZR-SM4	JST or compatible	
CN2	S2B-ZR-SM4	JST or compatible	
CN3	S3B-ZR-SM4	JST or compatible	
CN4	S2B-ZR-SM4	JST or compatible	

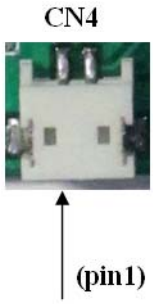
4.2.2.3 Input Connector Pin Definitions

Table 4.4: CN1 Input Connector Pin Definition	
Pin No.	**Pin Definition**
1	Vin (+12V)
2	Vin (+12V)
3	GND
4	GND
5	ON/OFF (ON:+3~5V, OFF=0~0.8V)
6	Dimming (PWM)



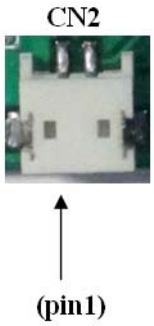
4.2.2.4 Output Connector Pin Definition

Table 4.5: CN4 Output Connector Pin Definition	
Pin No.	**Pin Definition**
1	VLED+
2	VLED-



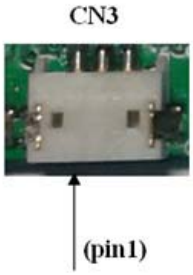
4.2.2.5 Light Sensor Connector Pin Definition

Table 4.6: CN2 Light Sensor Connector Pin Definition	
Pin No.	**Pin Definition**
1	Sensor High Voltage
2	SensorLow Voltage

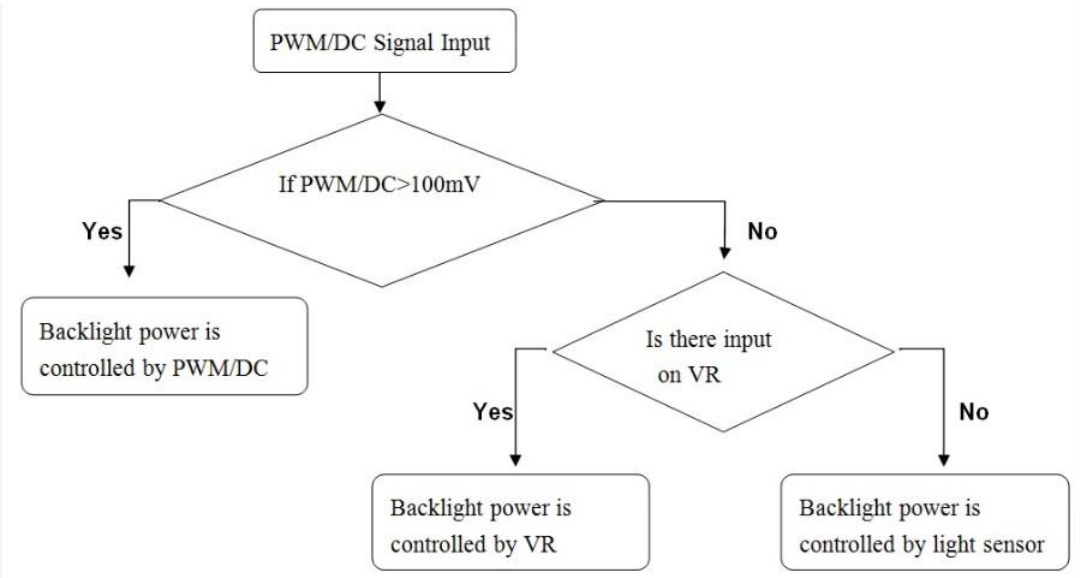


4.2.2.6 Variable Resistor Connector Pin Definition

Table 4.7: CN3 Variable Resistor Connector Pin Definition	
Pin No.	**Pin Definition**
1	VR High Voltage
2	VR
3	VR Low Voltage



4.2.2.7 Brightness Control Signal Flow Chart



4.2.2.8 Dimensions

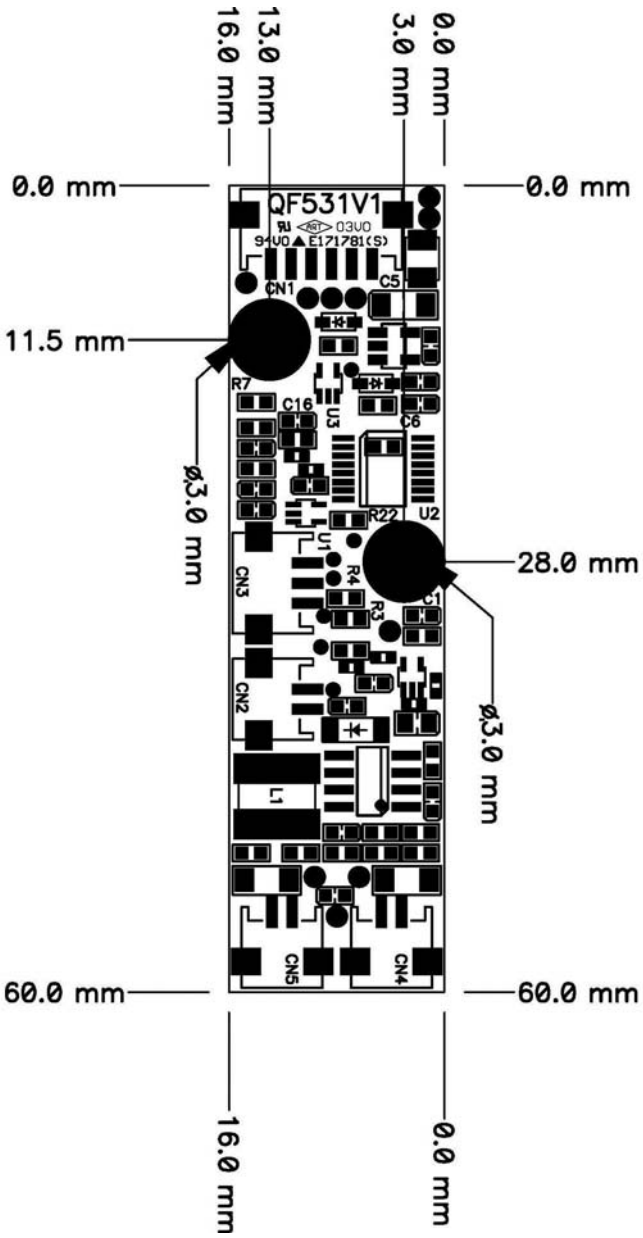


Figure 4.1 Dimensions

Chapter 5

Touchscreen & Touch Controller

5.1 Touchscreen (Optional: for IDK-2108R Only)

5.1.1 Touch Characteristics

The touch panel is a resistance type that customers use with flat displays like LCDs. Once an operator touches it, the circuit will send coordinate points to the PC from the voltage changes at the contact points.

5.1.2 Optical Characteristics

	Item	Specifications	Remarks
1	TRANSPARENCY	82.5% Typ. 80% Min. (Active area) (Inside of guaranteed active area)	JIS K-7105
2	HAZE	8.0% Typ. (Anti-glare)	JIS K-7105

5.1.3 Environmental Characteristics

	Item	Specifications	Remarks
1	Operational temperature	-10°C ~ 60°C	Max. wet temp is 38°C (No dew)
2	Storage temperature	-30°C ~ 70°C	
3	Operational Humidity	20% ~ 90%RH	
4	Storage temperature	10% ~ 90%RH	

5.1.4 Mechanical Characteristics

	Item	Specifications		Remarks
1	Hardness of surface	Pencil hardness 3H.		JIS K-5600-5-4 150gf, 45 degree
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	Operational 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(Glass side)	FPC connector
		Y axis: 100Ω ~ 800Ω(Film side)	
3	Linearity	±1.5%max initial value ±2.0%max (after environmental & life test)	Reference: 250gf
4	Chattering	20ms Max At connector pin	
5	Insulation Resistance	10MΩ @ (DC 25V) 10MΩ min (DC 25V)	

5.2 Touch Controller (Optional: for IDK-2108R Only)

5.2.1 Touch Controller Characteristics

Advantech ETM-RES05C Touch Control Board is the ultimate combo board. This touch panel controller provides optimized performance for your analog resistive touch panel 4-wire model. It communicates with the PC system directly through USB and RS-232 connector. The touch panel driver emulates mouse left and right button functions.

5.2.2 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 4-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.
- Support 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

5.2.3 Environmental Features

Reliability

- MTBF is 200,000 hours

Temperature Ranges

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

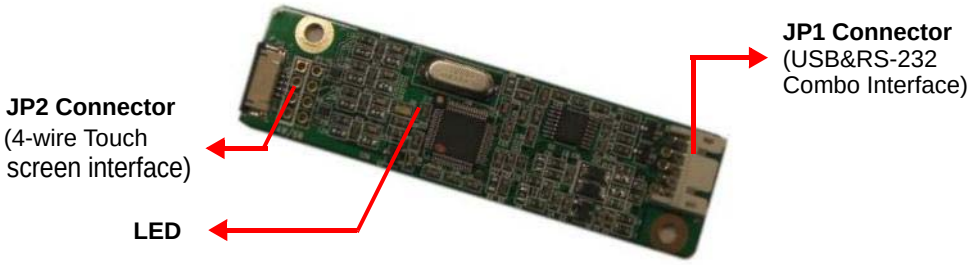
Relative Humidity

- 95% at 60°C, RH Non-condensing

Acquired RoHS certificate
Regulatory FCC-B, CE approvals
Dimension: 75 mm x 20 mm x 10 mm

5.2.4 Pin Assignment and Description

5.2.4.1 Connector and LED Location



5.2.4.2 Combo Interface Connector, JP1, Pins and Signal Descriptions

The combo interface connector, USB and RS-232, is a box 2.0mm 10-pins 90 degree, Male type with lock connector, 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
1	G	Ground
2	V	USB Power
3	G	Ground
4	D+	USB D+
5	D-	USB D-

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

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

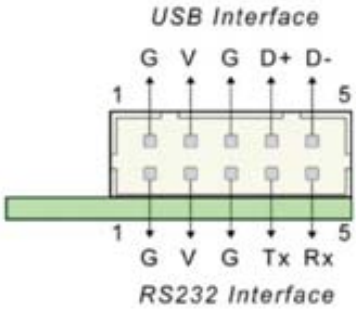
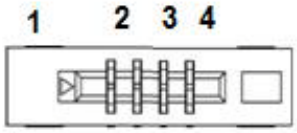


Figure 5.1 Board mounted header

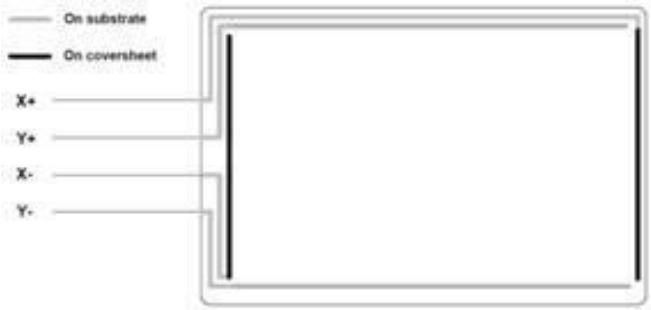
5.2.4.3 Touch Screen Connector, JP2, Pins and Signal Descriptions

The Touch Screen connector, JP2, is a FFC/FPC SMD 1.0mm 4-pins 90 degree, Female type connector. The pins are numbered as shown in the table below.

TS4 Pin #	Signal Name	Signal Description
1	YB	Bottom
2	XL	Left
3	YT	Top
4	XR	Right



4-Wire Touch Screen ZIF connector



4-Wire Screen viewed from coversheet side

Appendix A

Optical Characteristics

A.1 Optical Characteristics

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

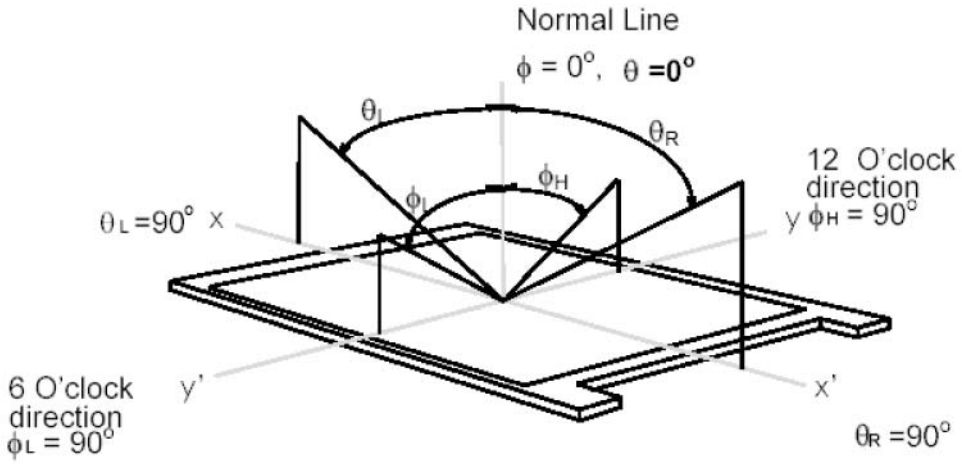
Table A.1: Optical Characteristics

Item	Unit	Conditions	Min.	Typ.	Max.	Note
Viewing Angle	[degree]	Horizontal (Right)		80	-	1
		CR = 10 (Left)		80		
		Vertical (Upper)		80	-	
		CR = 10 (Lower)		60		
Luminance Uniformity	[%]	9 Points	80	85	-	2, 3
Optical Response Time	[msec]	Rising	-	20	30	5
		Falling	-	10	20	
		Rising + Falling	-	30	50	
Color/Chromaticity Coordinates (CIE 1931)		White x	-	0.313	-	4
		White y	-	0.322	-	
Color Temp.	K		-	6500		
White Luminance	[cd/m^2]		1100	1200	-	4
Contrast Ratio			-	600	-	4

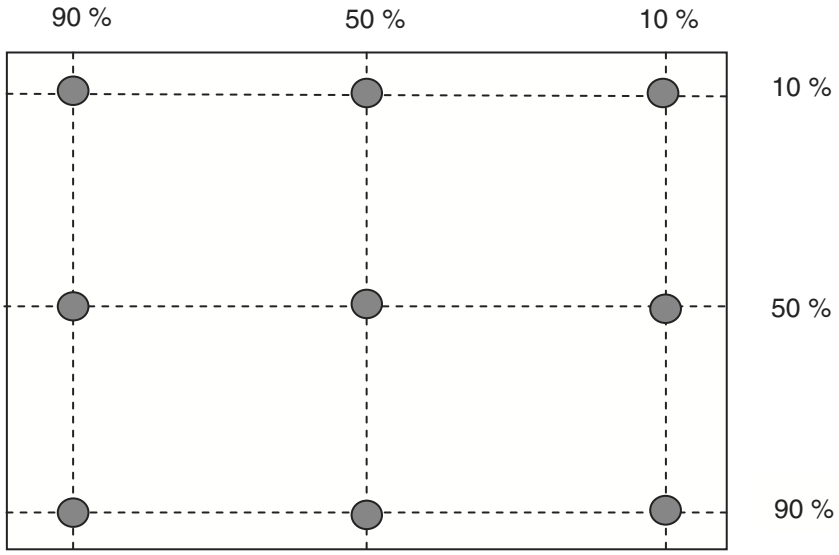
Note: *Optical Equipment: BM-7, DT-101, or equivalent*

Note 1: *Definition of viewing angle*

Viewing angle is the measurement of contrast ratio, 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 below: 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*

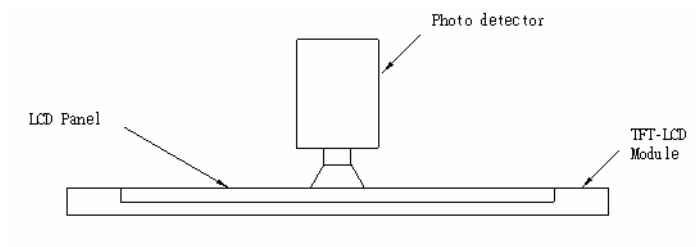


Note 3: *The luminance uniformity of 9 points is defined by dividing the maximum luminance values by the minimum test point luminance*

$$\delta_{W9} = \frac{\text{Minimum Brightness of nine points}}{\text{Maximum Brightness of nine points}}$$

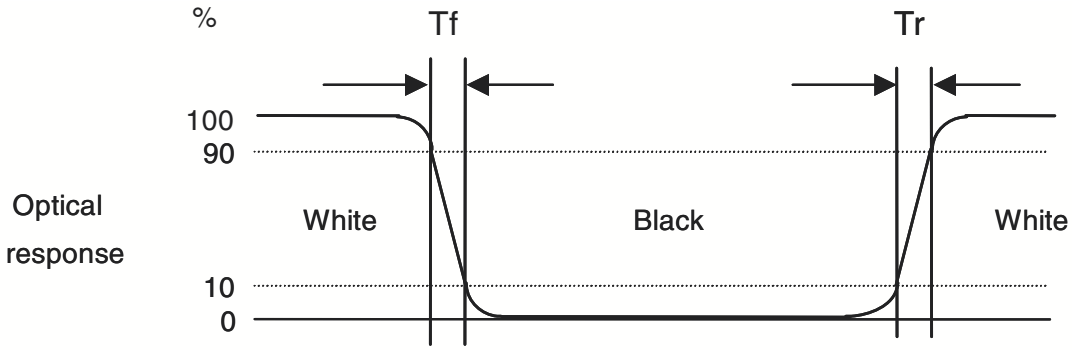
Note 4: *Measurement method*

The LCD module should be stabilized at a given temperature for 30 minutes to avoid abrupt temperature changes during measuring. In order to stabilize the luminance, the measurement should be executed after the backlight has been lit for 30 minutes in a stable, windless and dark room using 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 the interval between 10% and 90% of the amplitudes. Please refer to the figure below.



Appendix B

Handling Precautions

B.1 Optical Characteristics

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

1. Since the front polarizer is easily damaged, pay attention not to scratch it.
2. Be sure to turn off power supply when inserting or disconnecting from the input connector.
3. Wipe off water drops immediately. Long 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 CMOS LSI is used in this module, take care of static electricity and insure human earth 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 directions.
9. In case a module has to be put back into the packing container slot after it was taken out from the container, please press the far ends of the LED light bar reflector edge softly. Otherwise the TFT Module may be damaged.
10. At the insertion or removal of the Signal Interface Connector, be sure not to rotate nor 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 momentary. At designing the enclosure, it should be taken into consideration that no bending/twisting forces are applied to the TFT module from outside. Otherwise the TFT module may be damaged.
12. Small amount of materials having no flammability grades are used in the LCD module. The LCD module should be supplied with power complying with requirements of Limited Power Source (IEC60950 or UL1950), or have applied for exemption.

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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.