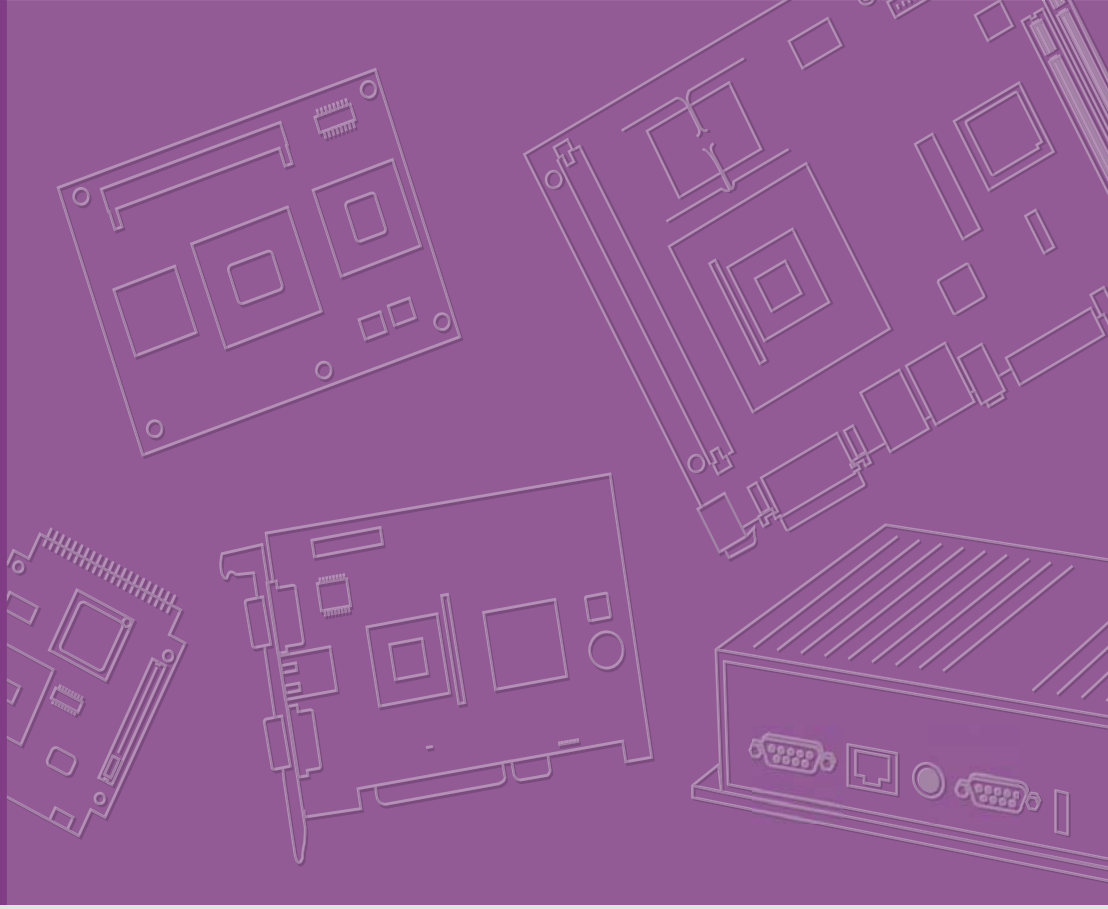

User Manual

IDK-1115P-40XGC1E

TFT-LCD 15” XGA
(LED Backlight)

ADVANTECH

Enabling an Intelligent Planet

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Acknowledgements

Part No. 2006111511 Edition 2

Printed in China Jan 2013

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.

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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.

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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.

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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 onscreen 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 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-1115P-40XGC1E is a Color Active Matrix Liquid Crystal Display composed of a TFT-LCD panel, a driver circuit, and backlight system. The screen format is intended to support the XGA (1024(H) x 768(V)) screen and 16.2M/262k colors (RGB). All input signals are LVDS interface compatible. Backlight driver board is included.

1.2 Display Characteristics

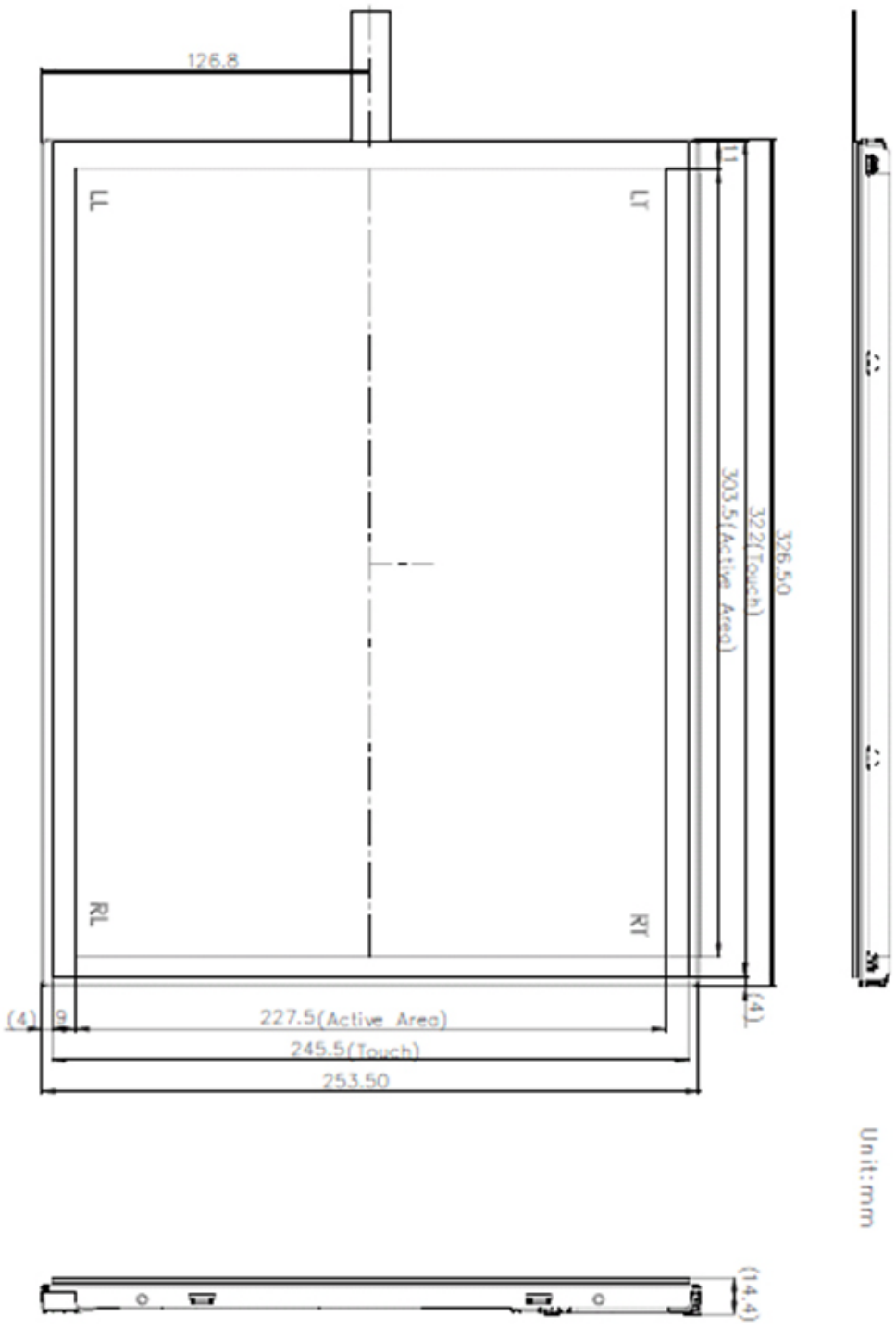
Standard characteristics at 25°C:

Item	Specifications	Unit	Note
Active Area	303.5(H) x 227.5(V) (15.0” diagonal)	mm	(1)
Bezel Opening Area	326(H) x 253.5(V)mm	mm	
Driver Element	a-Si TFT active matrix	-	-
Pixel Number	1024 x R.G.B x 768	pixel	-
Pixel Pitch	0.297(H) x 0.297(W)	mm	-
Pixel Arrangement	R.G.B. Vertical Stripe	-	-
Display Colors	16,194,277 / 262,144	color	-
Display Mode	Normally White	-	-
Surface Treatment	Hard Coating (3H), Anti-Glare (Haze 25)	-	-
Module Power Consumption	10.8 (Black pattern)	W	Typical

1.3 Mechanical Specifications

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	326	326.5	327	mm	
	Vertical (V)	253	253.5	254	mm	
	Depth (D)	-	14.4	-	mm	
Weight			1335	-	g	-

1.4 Mechanical Dimensions



1.5 Absolute Maximum Ratings

1.5.1 Absolute Environmental Ratings

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Operating Ambient Temperature	T_{OP}	-20	+70	°C	
Storage Temperature	H_{ST}	-40	+80	°C	(4)

Note: (1) Temperature and relative humidity range is shown in the figure below
(2) 90%RH Max. (Ta ≤ 40°C)
(3) Wet-bulb temperature should be 39° C Max. (Ta > 40°C).
(4) Humidity 8%~90%
(5) No condensation.

1.5.2 Electrical Absolute Ratings

1.5.2.1 TFT LCD Module

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	VCC	-0.3	4	V	(1)

1.5.2.2 Backlight Unit

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Converter Voltage	V_i	-0.3	18	V	(1),(2)
Enable Voltage	EN	-	5.5	V	
Backlight Adjust	ADJ	-	5.5	V	

Note: (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.
(2) Specified values are for lamp (Refer to 3.2 for further information).

1.6 Block Diagram

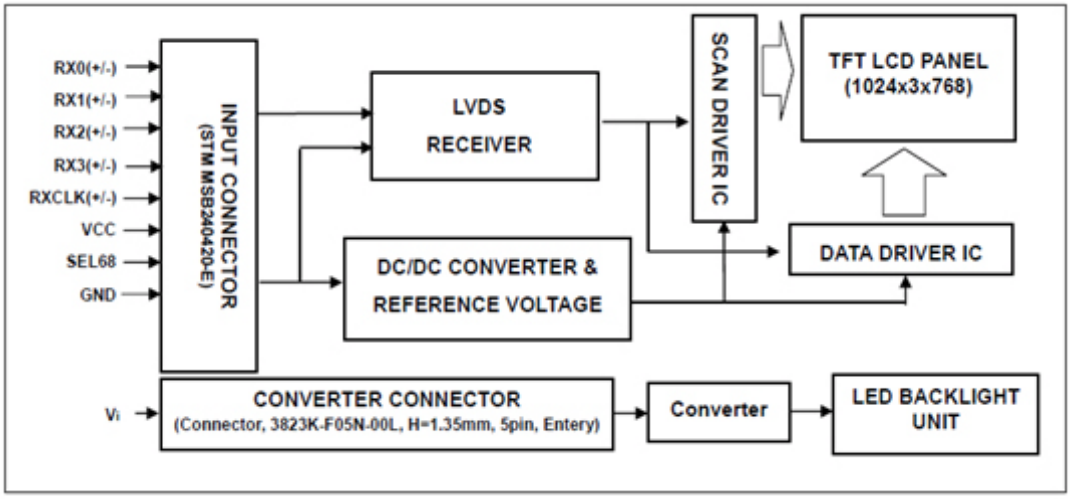


Figure 1.1 TFT LCD module

Chapter 2

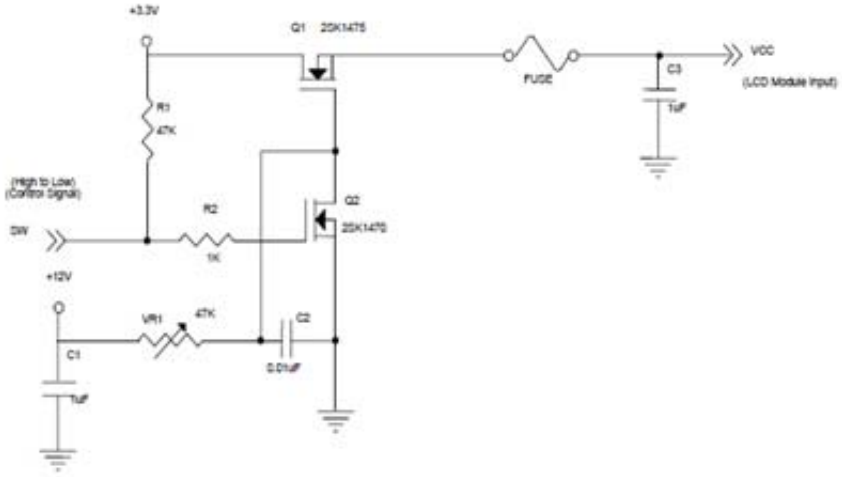
Electrical Characteristics

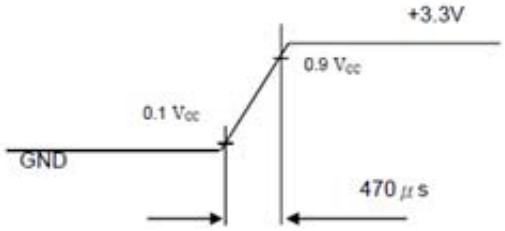
2.1 TFT LCD Module

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	1c	-	410	510	mA	(3)a
	Black	c	-	590	690	mA	(3)b
Differential Input Voltage for LVDS Receiver Threshold	"H" Level	V_{IH}	-	-	100	mV	-
	"L" Level	V_{IL}	-100	-	-	mV	-
Terminating Resistor		R_T		100	-	Ohm	-

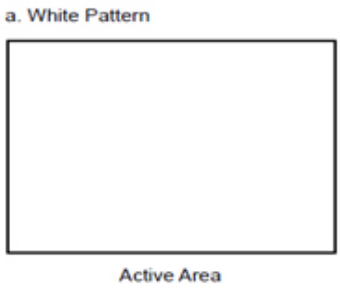
Note1: The module should be always operated within above ranges

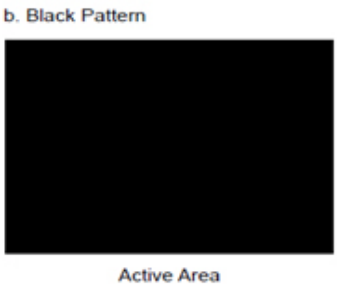
Note2: Measurement Conditions:





Note 3: The specified power supply current is under the conditions at V_{DD} =3.3 V, Ta = 25 ± 2°C, DC Current and f_v = 60 Hz, whereas a power dissipation check pattern below is displayed

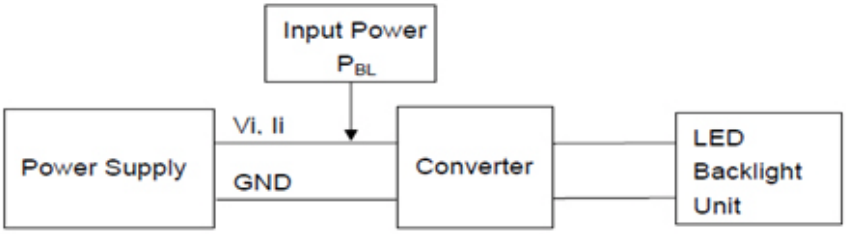




2.2 Backlight Unit

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Converter Power Supply Voltage		V_i	10.8	12.0	13.2	V	
Converter Power Supply Current		I_i	-	0.73	0.83	A	@ Vi = 12V
Backlight Power Consumption		P_{PBL}	-	8.76	-	W	@ Vi = 12V
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	-	0.15	V	
PWM Control Duty Ratio		-	1	-	100	%	@200Hz
PWM Control Frequency		f_{PWM}	190	200	20k	Hz	(2)
LED Life Time		L_L	50,000	-	-	Hrs	(3)

Note1: LED current is measured by utilizing a high frequency current meter as shown below



Note2: At 20k Hz PWM control frequency, duty ratio range is restricted from 20% to 100%

Note3: The lifetime of an LED is defined as the time when it continues to operate under the conditions at Ta = 25 ± 2°C and duty 100% until the brightness becomes ≤ 50% of its original value. Operating an LED under a high temperature environment will reduce its lifetime and lead to color shift.

Chapter 3

Input Terminal Pin Assignments

3.1 TFT LCD Module

Table 3.1: Symbol Description

Pin No.	Symbol	Description	Polarity	Note
1	VCC	Power Supply, 3.3V(typical)		
2	VCC	Power Supply, 3.3V(typical)		
3	GND	Ground		
4	NC	No Connection		
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	GND	Ground		
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	GND	Ground		
20	SEL68	LVDS 6/8 bit select function control, High: 6bit Input Mode Low or NC: 8bit Input Mode		Note (3)

Note1 Connector Part No.: STM MSB240420G, Enter 3804K-F20N-10L or equivalent.

Note2 User's connector Part No.: STM P240420, Enter H204K-D20N-02B or equivalent.

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

3.2 Backlight Unit (Converter Connector Pin)

Pin	Symbol	Description	Remark
1	V_i	Converter input voltage	12V
2	V_{GND}	Converter ground	Ground
3	EN	Enable pin	3.3V
4	ADJ	Backlight Adjust	PWM Dimming (Hi: 3.3VDC, Lo: 0VDC)
5	NC	Not Connect	

Note1 Connector Part No.: 3808K-F05N-03L (Enter) or equivalent.

Note2 User's connector Part No.: H208K-P05N-02B (Enter) or equivalent

3.3 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	R7	R6	G5	G4	G3	G2	G1	G0	R7	R6	B5	B4	B3	B2	B1	B0
Basic	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
Colors	Red Green	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Magenta	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
		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	Red(0) /	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scale	Dark	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Of Red	Red(1)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	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(252)	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(252)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(252)																								
Gray	Green(0)/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scale	Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Of	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	0
Green	Green(2)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	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(252)	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(252)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Green(252)																								
Gray	Blue(0) /	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scale	Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Of	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	0
Blue	Blue(2)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Blue(252)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0
	Blue(252)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Blue(252)																								

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

Chapter 4

Interface Timing

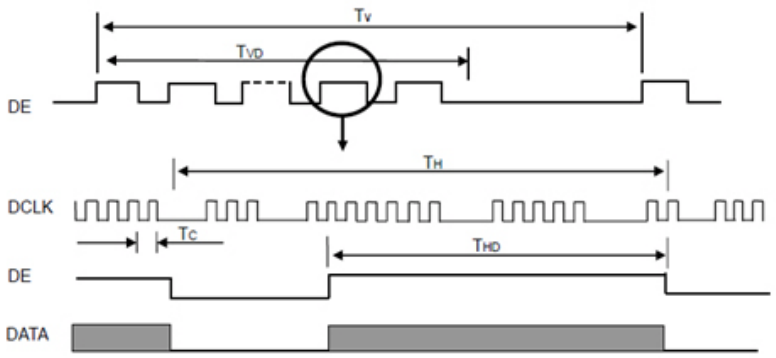
4.1 Input Signal Timing Specifications

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

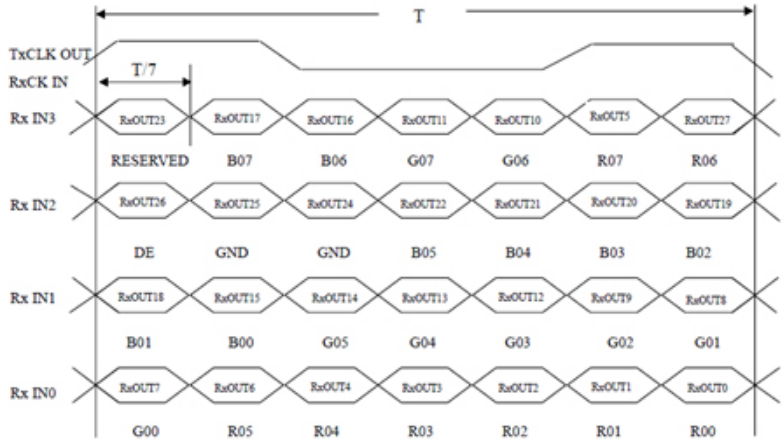
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK	Pixel Clock	$1/T_C$	-	65	80	MHz	-
DE	Vertical Total Time	T_V	780	806	1200	T_H	-
	Vertical Address Time	T_{VD}	768	768	768	T_H	-
	Horizontal Total Time	T_H	1140	1344	1600	T_C	-
	Horizontal Address Time	T_{HD}	1024	1024	1024	T_C	-

Note 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.

INPUT SIGNAL TIMING DIAGRAM

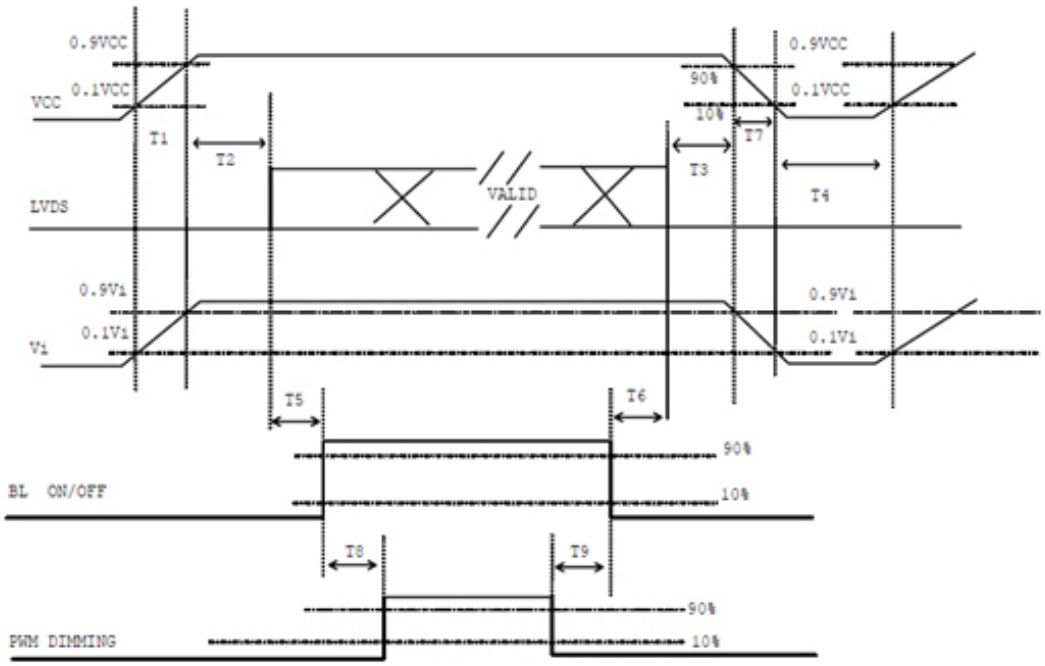


TIMING DIAGRAM of LVDS



4.2 Power On/Off Sequence

To prevent a latch-up or DC operation of LCD assembly, the power on/off sequence should be as per 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 The 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 for the logic and the interface signal to be invalid.

Parameter	Value			Unites
	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

Chapter 5

Touch Screen

5.1 Touch Characteristics

This specification is applied to the Projected Capacitive series.

5.2 Electrical Characteristics

Specification	Value
Maximum Voltage	DC6V
Recommended touch contact area	>=PHI 10mm

5.3 Mechanical Characteristics

Specification	Value
Operating Life	Input (finger) 50,000,000 hits
Light Transmittance	91% (typical value at full wavelength)
Surface Hardness	Over 5H (by JIS pencil hardness)
Electrode Matrix Pitch	Approximately 5-7mm

5.4 Environment Characteristics

Specification	Value
Operating Temperature	-20°C to 70°C (no condensation)
Operating Humidity	-20°C to 60°C Less than 90%RH (no condensation) Exceeding 60°C Less than 133.8g/m3 (no condensation)
Storage Temperature	-40°C to 75°C (no condensation)
Storage Humidity	-40°C to 60°C Less than 95%RH (no condensation) Exceeding 60°C Less than 142.9g/m3 (no condensation)
Chemical Resistance (top surface)	Toluene, Trichloroethylene, Acetone, Alcohol, Gasoline, Machine Oil, Ammonia, Glass Cleaner, Mayonnaise, Ketchup, Wine, Salad Oil, Vinegar, Lipstick, etc.

Temperature Condition Test

Following test are performed in the condition with no dew condensation:

Cold Test:	Tested after leaving the parts in -40°C±3°C for 240 hours and in the room temperature for 2 hours.
Heat Test:	Tested after leaving the parts in 75°C±3°C for 240 hours and in the room temperature for 2 hours.
Humidity Test:	Tested after leaving the parts in the temperature 60°C±3°C, humidity 90 to 95% for 240 hours and in the room temperature for 2 hours.
Cycle Test:	Tested after 5 cycles of leaving the parts in the temperature -30°C±3°C for 1 hour and in the room temperature for 0.5 hours, then leaving the parts in the temperature 70°C±3°C for 1 hour and in the room temperature for 0.5 hours.

Judgment: Must satisfy the following:
Function: Operate properly.
Appearance: Must satisfy the specification.

5.5 General Specification

	Item	Specification
1	Frame size	323.5±0.3 X 252.3±0.3 mm
2	View Area	306.6±0.3 X 232.2±0.3 mm
3	Active Area	305±0.3 X 229±0.3 mm
4	Total Thickness	2.35±0.3 mm
5	Tail length	60±0.3 mm

5.6 Mounting Notes

Projected capacitive touch screen detects the touched locations by measuring the increased amount of the capacitance value between its electrodes at inputs. Once it is built into a system, capacitance couplings are continually yielded among the touch screen, FPC tail, controller board and metal Chassis. When turned on, our projected capacitive touch screen will automatically adjust its sensitivity level to the surrounding environment at the standby state in order to avoid the affects by the surrounding capacitance couplings. If surrounding environment changes or materials to alter the electrical field (a large capacitor, power-supply unit, LCD panel, or materials with high dielectric constant) is near, these external factors will adversely affect the function of the touch screen to detect the correct input positions.

At structure design, please refer to the mounting notes below and ensure enough gap distances among each component in order to avoid the external factors described above.

5.6.1 Mounting

Fix the touch screen firmly so that the gap distances between the touch screen and other components will not be affected by touching or will not change with the passage of time. An unexpected input may be caused if the gap is too narrow.

The locations on which a certain gap distance is required are as follows.

- Between LCD panel and touch screen: L1
- Between touch screen and the surface of the bezel: L4
- Between touch screen and the back of the bezel: L2
- Between tail and LCD panel, tail and metal chassis: L3 & L5 (an insulating tape can be used) In case of using capacitive sensor outside, the moisture may cause the trouble

5.6.2 Mounting Touch screen on a display

It is recommended to use an insulating resin material for the bezel. Ensure the gap between the touch screen and front bezel (L4)

If a metal plate is used for the bezel, unintended capacitance couplings may occur on the periphery of the active area. If a metal material is used for bezel, ensure the gap of approximately 2mm between touch screen and bezel (L2).

In order to avoid the gap distance L1 from being changed with the passage of time, it is recommended to apply the adhesive tape onto all the 4 sides with no space (fully sealed) when gluing the touch screen.

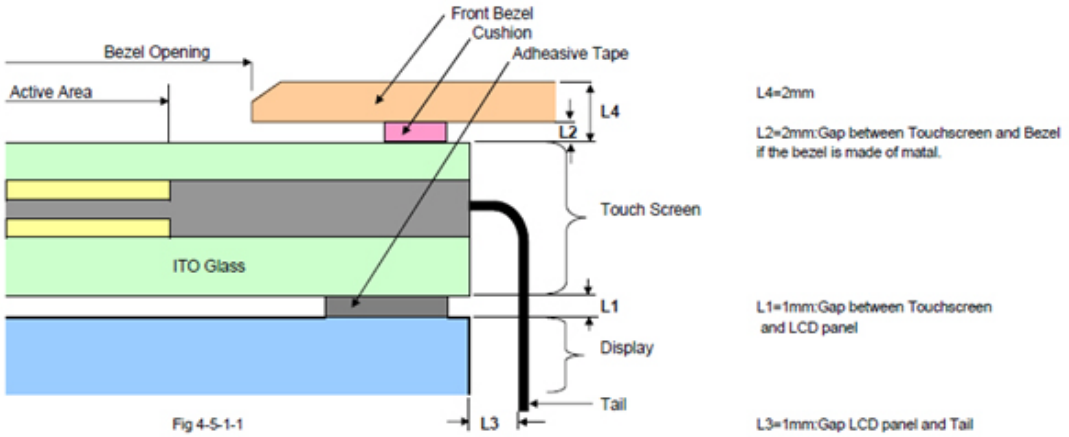


Fig 4-5-1-1

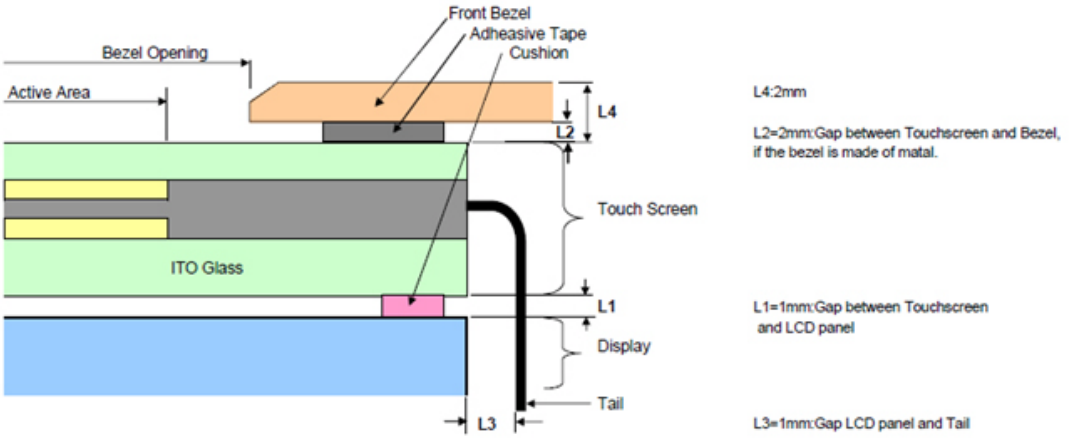
5.6.3 Mounting touch screen on back side of the bezel

It is recommended to use an insulating resin material for the bezel. Ensure the gap between the touch screen and front bezel (L4).

If a metal plate is used for the bezel, unintended capacitance couplings may occur on the periphery of the active area.

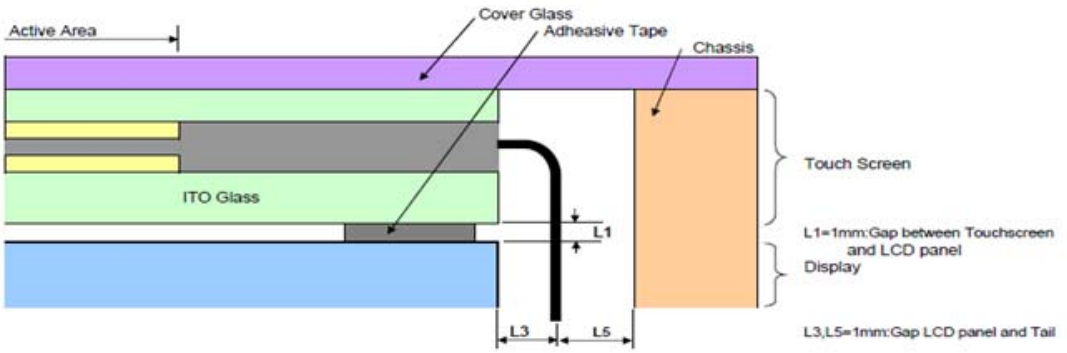
If a metal plate or any other metallic materials is used for the bezel, ensure the gap distance of approximately 2mm between the touch screen and bezel (L2).

Fix the touch screen firmly so that the gap distance L1 will not be affected.



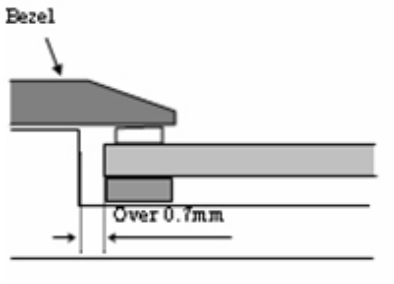
5.6.4 Flat Surface Design

If the Flat Surface Design is preferred, please consult with us before proceeding. Thickness of cover glass and capacitance couplings at the periphery of the touch screen must be considered for each individual case.



5.6.5 Tolerance

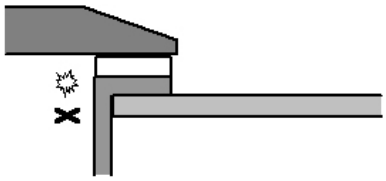
There is a tolerance of 0.2 to 0.3mm for the dimensions of the touch screen and tail. A gap must be made in the case and the connector to absorb the tolerance.



5.6.6 Tail

The tail must not be forcibly stressed or bent too hard.

The conduction in the insulated area and wire breaking may be caused



Chapter 6

Touch Controller

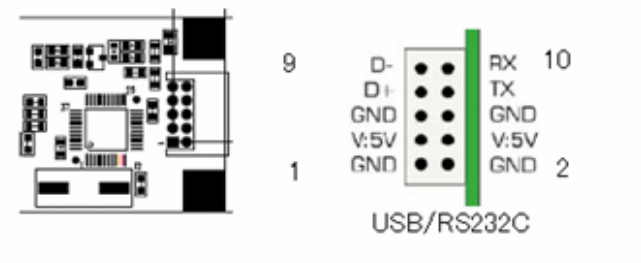
9680014728 is a controller board that works as a coordinate-generator for projected capacitive touch screen. This controller board supports both USB and RS232C. 9680014728 is lead-free and compliant with RoHS.

6.1 Specifications

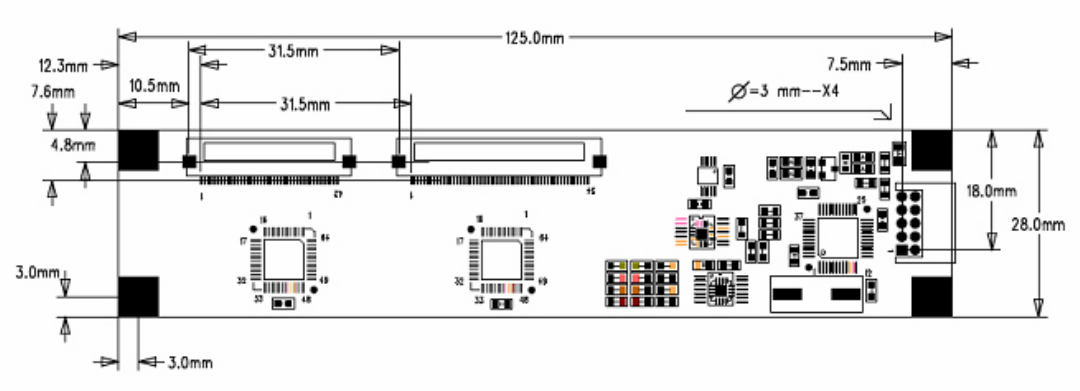
Item		Rating	Remarks
Operating Temp.		-20°C to +80°C	No dew condensation
Storage Temp.		-20°C to +85°C	No dew condensation
Relative Humidity		95% at 60°C, RH	Non-condensation
Supply Voltage		DC 5.0V +/-5%	50mV peak to peak maximum ripple and noise
Consumption Current		50mA (typ)	
Interface /RS232C	Format	Asynchronous Serial	
	Transfer Rate	57,600bps	
	Data Format	8bit	
	Stop Bit	1bit	
	Parity	None	
Interface /USB	Spec	USB Specification 1.1 Full Speed	
	Device class	HID Digitizer Device	Communicating to Windows®7
		Vendor definition	Communicating to other computers
Coordinate Output Rate (point/sec)		200p/s Single touch 50set/s 2 point touch (2point/set)	Dual touch is supported
Coordinate Resolution		11bit (2048 x 2048)	
The origin of theoretical coordinate		Left side of the top	“X=0,Y=0”
Max height of components		5.5 mm	Top side of the board
EXC7237	Matrix	52 x 40	Channels of wire
	Dimension	125 x 28 mm	
Supported Operating System		Windows®7	HID Digitizer device / USB
		Windows® 2000,Xp,Vista,7 CE, Embedded	USB/RS232C
		Linux	USB/RS232C
		Mac	USB
		QNX	RS232C

6.2 Touch controller physical specification

6.2.1 Interface / Connection to the Host Computer

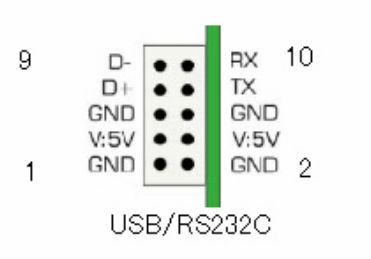


6.2.2 9680014728 dimension



CN	Terminal	Name	Function	Remarks
Connection to the Host Computer PN: Compatible with JST S10B-PHDSS	1	GND	Ground	For USB
	3	V:5v	+5v Power or USB Vbus	
	5	GND	Ground	
	7	D+	USB D+	
	9	D-	USB D-	
	2	GND	Ground	For RS232C
	4	V:5v	+5v Power	
	6	GND	Ground	
	8	TX	RS232C TXD (EXC72** > Computer)	
	10	RX	RS232C RXD (EXC72** < Computer)	
J1			Connection to the Touch Screen	
J2			Connection to the Touch Screen	

9680014728 has both serial and USB interfaces and can support either communication port. USB and serial interfaces cannot be used simultaneously.


9
1
D-
D+
GND
V:5V
GND
RX
TX
GND
V:5V
GND
10
2
USB/RS232C

Appendix A

Optical Characteristics

A.1 Test Conditions

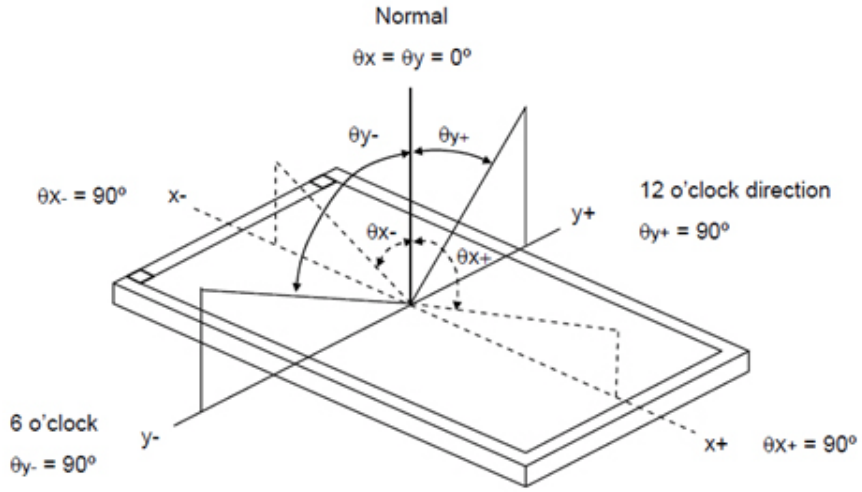
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V_{CC}	3.3	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Converter Voltage	V_i	12	V
Converter Duty		100%	

A.2 Optical Specifications

The relative measurement methods of optical characteristics are shown below. The following items should be measured under the test conditions and stable environment shown in Note 5.

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit	Note
Color Chromaticity	Red	Rx	$\theta_X = 0°, \theta_Y = 0°$ CS-1000T	Typ - 0.05	0.604	Typ+ 0.05	-	(1), (5)
		Ry			0.356			
	Green	Gx			0.338			
		Gy			0.590			
	Blue	Bx			0.148			
		By			0.098			
	Green	Wx			0.313			
		Wy			0.329			
Center Luminance of White		L_C		300	400		cd/m^2	(4),(5)
Contrast Ratio		CR		450	700		-	(2),(5)
Response Time		T_R	$\theta_X = 0°$, = 0°	-	8	13	ms	(3)
		T_F		-	17	22		
White Variation		δW	$\theta_X = 0°, \theta_Y = 0°$	-	1.25	1.4	-	(5),(6)
Viewing Angle	Horizontal	θX+	CR ≥ 10 USB2000	70	80	-	Deg.	(1),(5)
		θX-		70	80	-		
	Vertical	θY+		60	70	-		
		θY-		60	70	-		

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.

Contrast Ratio (CR) = L255 / L0

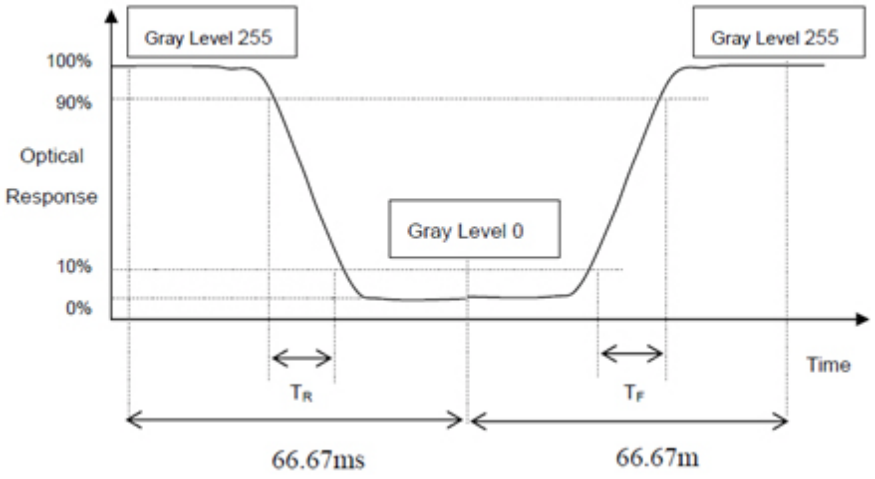
L255: Luminance of gray level 255

L0: Luminance of gray level 0

CR = CR (5)

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

Note 3 Definition of Response Time (TR, TF):



Note 4 Definition of Luminance of White (LC):

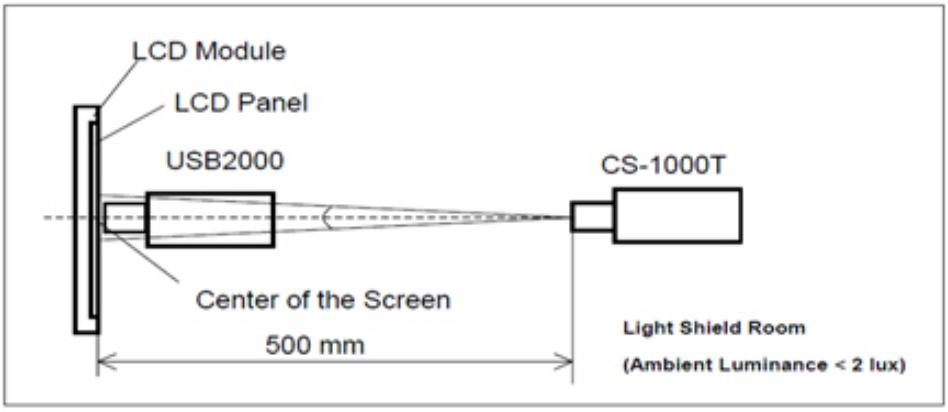
Measure the luminance of gray level 255 at center point

LC = L (5)

L (x) is corresponding to the luminance of the point X at Figure in Note (6).

Note 5 Measurement Setup:

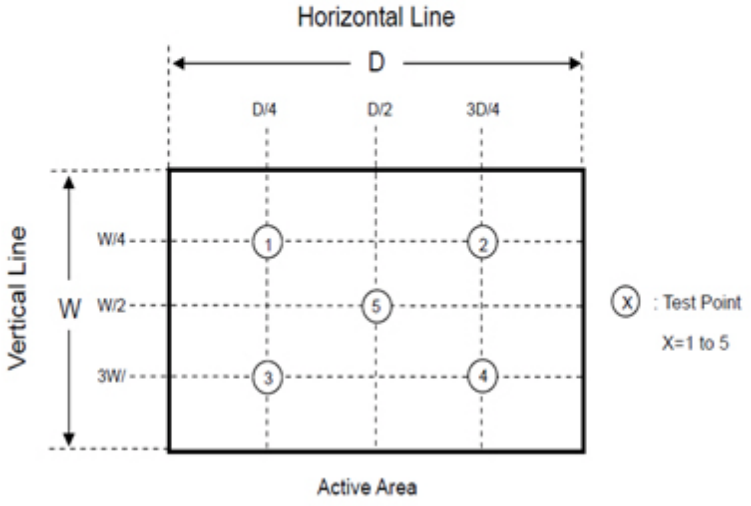
The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



Note 6 Definition of White Variation (δW):

Measure the luminance of gray level 255 at 5 points

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



Appendix B

Handling Precautions

B.1 Handling Precautions

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

1. Since front polarizer is easily damaged, be careful not to scratch it.
2. Be sure to turn off power supply when inserting or disconnecting from input connector.
3. Wipe off water droplets 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 a hard surface.
6. Since CMOS LSI is used in this module, take care of static electricity and insure people are earthed when handling.
7. Do not open or modify the Module Assembly.
8. Do not press the reflector sheet at the back of the module to any directions.
9. In case a Module has to be put back into the packing container slot after once it was taken out from the container, please press at the far end of the LED light bar reflector edge lightly. 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 momentarily. When designing the enclosure, it should be taken into consideration that no bending/twisting forces are applied to the TFT Module from the outside, otherwise the TFT Module may be damaged.
12. A small amount of materials having no flammability grade is used in the LCD module. The LCD module should be supplied with power complying with requirements of Limited Power Source (IEC60950 or UL1950), or an exemption applied for.

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