Touch Revolution

fusion™ 10 TOUCH DISPLAY

MODEL: Fusion 10

P/N: F10A-0102

PRODUCT SPECIFICATION

Version 1.6

REVISION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Alan Dragon	October 6, 2010	Mark Hamblin	October 6, 2010	Rev 1.0 Release
1.1	Alan Dragon	October 7, 2010	Mark Hamblin	October 7, 2010	Update Reliability and Testing
1.2	Alan Dragon	October 21, 2010	Mark Hamblin	October 21, 2010	Define signals on touch panel connector
1.3	Chris Graham	May 26, 2011	Mark Hamblin	April 4, 2012	Updated Mechanical DWG / Doc Cosmetic changes
1.4	Chris Graham	August 25, 2011	Mark Hamblin	April 4, 2012	Revised document and DWG
1.5	Chris Graham	April 4, 2012	Mark Hamblin	April 4, 2012	Updated Mechanical DWG
1.6	Chris Graham	May 15, 2012	Matt Rosenthal	May 15, 2012	Updated LCD Specifications

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While this specification is intended to assist customers in identifying an appropriate product for their intended application, it does not constitute a warranty that the product is suitable for any specific use. It is the customer's responsibility to determine that the product is suitable for its intended application

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1 INTRODUCTION

The Fusion 10 is an integrated projected capacitive touch display incorporating a 10.1", 1024 x 600 (WSVGA) LCD with a LED backlight. The touch portion of the module consists of a glass sensor optically bonded to 1.1 mm cover glass with an FPC (Flexible Printed Circuit) attached for communicating with the touch panel. The touch panel (sensor plus cover glass) is bonded to the LCD frame.

Interfacing to the touch panel is done through an I2C protocol communicating with the controller incorporated onto the FPC. The touch panel can provide accurate and responsive touch performance capable of sensing up to two unambiguous points. The integrated configuration of the Fusion touch display gives the user the ability to develop a touch user interface with a minimum of time and design effort.

2 TOUCH MODULE

2.1 GENERAL SPECIFICATIONS

Table 1 - Touch Performance Specification

Parameter		Value	Unit	Remarks
Linearity	Center	1	mm	Note 1, Appendix A
	Within 5mm of the edge	2		
Touch Sensor Resolution		2275 x 1275	Detectable Resolution	
Report Rate	Single Touch	80	Serviced Interrupts/second	Note 2, Appendix A
	Dual Touch	50		
Minimum Touch Diameter		7	mm	Note 4, Appendix A
Minimum Detectable Separation		15	mm	
Number of unique detectable concurrent touches		2		

2.2 ELECTRICAL – TOUCH PANEL

Table 2 - Electrical Specification

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max	
Supply voltage	VCC	TBD	5.0	TBD	V
Current (no touch)	ICC	-	12.5	20.0	mA
Current (1 touch)	ICC1	-	14.5	20.0	mA
Current (2 touch)	ICC2	-	13.7	20.0	mA

2.3 ENVIRONMENTAL

Table 3 - Environmental Specification

Parameter	Value	Unit
Operating Temperature	0 to +50	°C
Storage Temperature	-20 to +60	°C

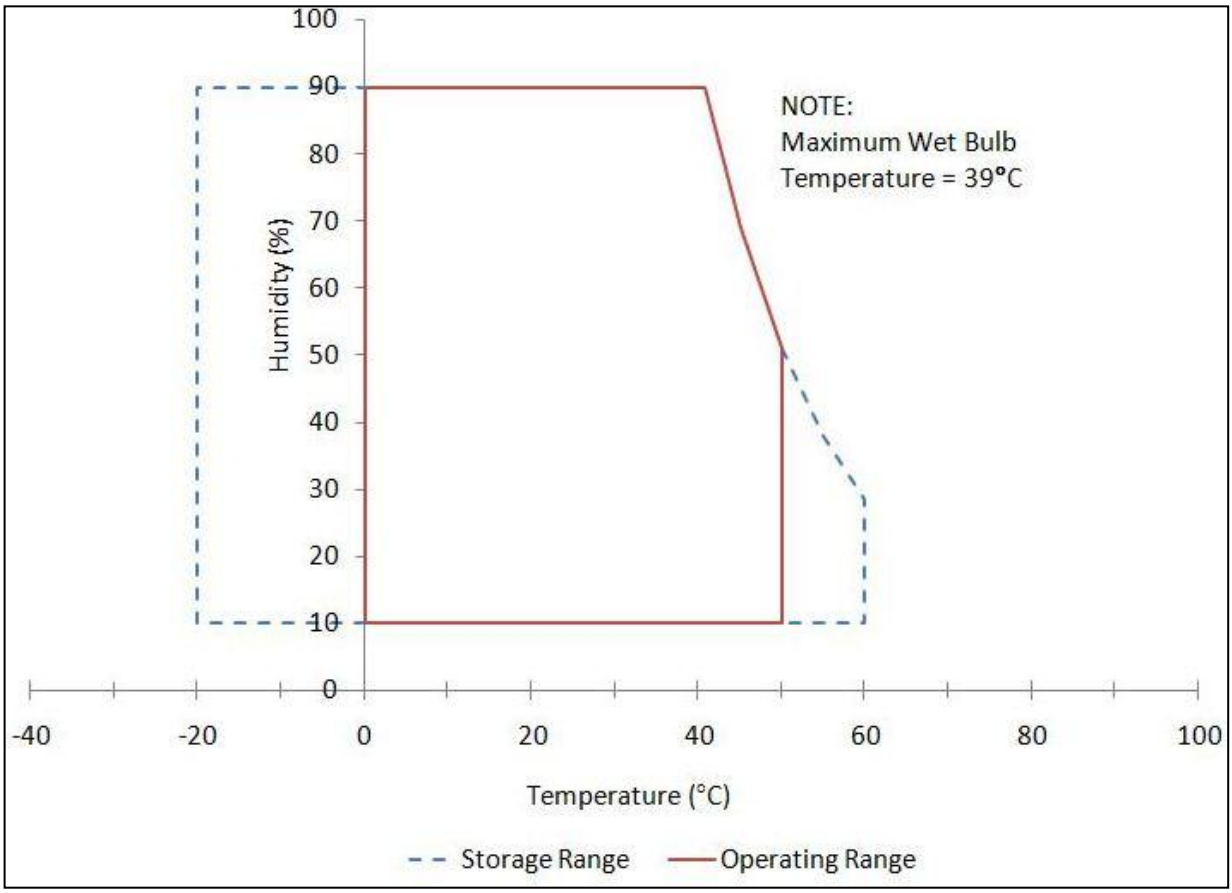


Figure 1 - Operating Temperature and Humidity Range

2.4 OPTICAL PERFORMANCE

Table 4 - Optical Performance Specification

Parameter			Value		Unit	Remarks
Optical Transmittance of Touch Panel			>89		%	Note 5, Appendix A
Light Output without touch panel			Min.=160	Typ.=200	cd/m²	Center of the Panel
Light Output with Touch Panel			Min.=140	Typ.=175	cd/m²	Center of the Panel
Viewing Angle	Hor.	θ_R	Min.=40	Typ.=40	Deg.	Note 6, Appendix A
		θ_L	Min.=40	Typ.=40		
	Vert.	Φ_T	Min.=15	Typ.=15	Deg.	
		Φ_D	Min.=30	Typ.=30		

2.5 MECHANICAL

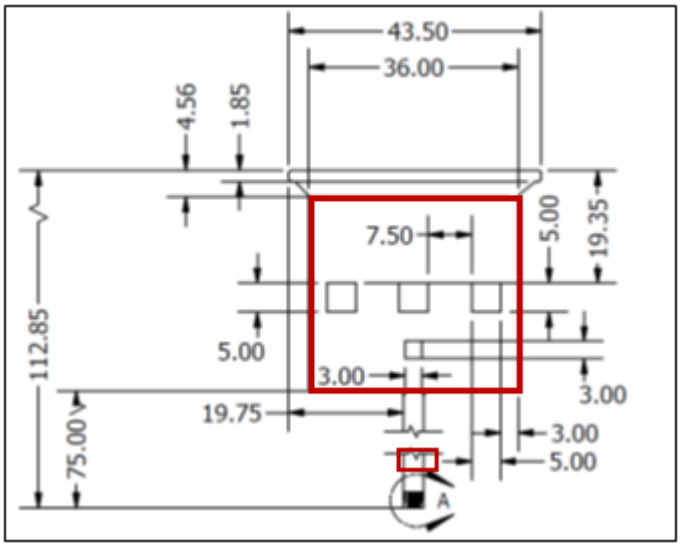
Table 5 - Mechanical Specification

Parameter	Value	Unit	Remarks
Outline Dimension	249.12 x 151.70 x 7.65	mm	
Active Area	222.72(H) x 125.28(V)	mm	LCD, Touch Sensor
Weight	356 (Typ)	g	
First Surface Hardness	>9H	Pencil Hardness	See Note 7, Appendix A

2.6 FPC SPECIFICATION

The flexible segment (any portion without a stiffener) of the signal FPC from the touch panel has a minimum bend radius > 1.0mm. The image below shows the FPC with the stiff areas outlined in red. Stiff areas are not designed to be bent or deformed.

Figure 2 - FPC Stiffner Areas



3 COMMUNICATION INTERFACE

3.1 INTRODUCTION

The touch panel communicates with a host processor through an I2C interface. An edge sensitive interrupt output indicates when new touch points have been detected. In a normal system setup the rising edge of the interrupt will cause the host processor to read the coordinate data through the I2C bus. The coordinate data is stored in a register mapped array that is defined section 3.6.2.

3.2 I2C INTERFACE SPECIFICATION

The touch panel supports a NXP compliant I2C interface[1]. The slave address for the touch controller is 7 bit 0x10, followed by the R/W bit. The I2C bus supports the standard bus speed of 100 kHz and fast 400 kHz.

External pull up resistors are required on the I2C clock and data lines. Refer to UM10204[1] I2C-Bus Specification and User Manual when selecting pull-up resistor values to ensure proper operation.

3.3 TOUCH PANEL CONNECTOR

The recommended touch panel connector is: Kyocera-Elco 6-pin 04-6298-006000883. The pin out for the Kyocera connector is as noted in the following table.

Table 6 - Touch Panel Connector Pinout – Refer to Mechanical Drawings for Pin 1 Orientation

Pin No.	Symbol	Description
1	VCC	Power supply
2	RST	Reset
3	INT	Interrupt
4	SDA	I2C data line
5	SCL	I2C clock line
6	GND	Ground

[1] The specification for the NXP compliant I2C interface is *UM10204 I2C-Bus Specification and User Manual, Rev. 03—19 June 2007*. It is available from NXP Semiconductor at http://www.nxp.com/documents/user_manual/UM10204.pdf.

3.4 SIGNAL DEFINITIONS

- VCC - Power supply for the touch controller.
- RST - Reset for the touch controller. Should be connected to a reset line. This reset is asserted low (0V). When not asserted it should be raised to VCC.
- INT - Interrupt from the touch controller. This should be connected to an interrupt enabled IO. This output is asserted high to VCC when touch data is ready. This interrupt should be treated as an edge sensitive signal.
- SDA - Data line of I2C connection. This signal should be connected to the data line of an I2C bus. This I2C bus should have pull-up resistors to VCC. The touch controller does not contain pull-ups resistors
- SCL - Clock line of I2C connection. This signal should be connected to the clock line of an I2C bus. This I2C bus should have pull-up resistors to VCC. The touch controller does not contain pull-ups resistors.
- GND - Digital Ground.

3.5 COMMUNICATIONS PROTOCOL

The Touch controller is designed to work in an interrupt driven protocol. When the Touch panel is touched and data is ready for the host processor it asserts the interrupt line to the processor. The processor should then read the data registers and once it is finished it must clear the interrupt in the controller by writing a 0 to the scan complete bit of the Handshaking control register.

The I2C data will not change until the scan complete bit is cleared by the host processor. Once the scan complete bit is cleared the controller will resume scanning the sensor.

3.6 REGISTER MAPPED INTERFACE

3.6.1 Description

A set of logical registers is defined and exposed by the touch panel controller. The host communicates with the controller by reading and writing the exposed registers via physical I2C transactions. All registers are 8 bits in length. Multi-byte data words are spread across multiple registers. An 8-bit I2C address is used to uniquely identify each register.

3.6.2 Register Map

The following table defines the location of each value in the register map.

Table 7 - Register Map

Address	Purpose	Accessibility
0x00 – 0x00	Data Information Register	R
0x01 - 0x06	First Touch Point Information Registers	R
0x07 – 0x0C	Second Touch Point Information Registers	R
0x0D – 0x0D	Register Map Version	R
0x0E – 0x0F	Firmware Version Register	R
0x10 – 0x10	Reset Control Register	W
0x11 – 0x11	Scan Complete Register	R/W
0x12 – 0x13	Reserved	R
0x14 – 0x14	Firmware Update Control Register	W

This table corresponds to Register Map Version = 0x02.

3.7 REGISTER DEFINITIONS

3.7.1 Touch Coordinate Registers

3.7.1.1 Data Information Register (0x00)

	7	6	5	4	3	2	1	0
0x00	-	-	-	-	-	-	Number of Fingers	

- Bits [1:0] indicate the number of fingers touching the panel at the time of the last interrupt.
  - {00} = 0 fingers
  - {01} = 1 finger
  - {10} = 2 fingers
  - {11} = not defined

Note: After the first touch, this register does not indicate when there are no fingers touching the sensor because interrupts are not triggered on the finger-up or '0 finger' event. The data remaining in this register is the number of fingers touching the sensor at the time of the most recent interrupt. It will always be 1 or 2 after the first interrupt after power-up or reset. To determine if there are no fingers touching the sensor use the tip switch value in register 0x06.

3.7.1.2 First Touch Point Information Registers (0x01 – 0x06)

	7	6	5	4	3	2	1	0
0x01	X0 Position (bits 15:8)							
0x02	X0 Position (bits 7:0)							
0x03	Y0 Position (bits 15:8)							
0x04	Y0 Position (bits 7:0)							
0x05	First Touch Point Pressure Value							
0x06	Touch ID				Tip Switch			

All touch point information registers are read only.

- Registers 0x01 – 0x04
  - The coordinates for the first touch point are in registers 0x01 – 0x04 as defined above.
  - The value is reported as a 16 bit value with the maximum value equal to the resolution of the sensor.
- Register 0x05
  - This register returns a pressure value for the touch point. The pressure value is representative of the diameter of the contact area touching the sensor.
  - This value is an 8 bit number. The value is not normalized so it should be interpreted as a relative number.
- Register 0x06

	7	6	5	4	3	2	1	0
0x06	Touch ID				Tip Switch			

- Bits 3:0 indicate if the current touch point is touching the screen. This field should be used to determine when a touch point is detected and also when it is lifted from the screen.
  - {0000} = This value indicates the finger is not touching the screen for the current coordinate point.
  - {0001} = This value indicates the finger is touching the screen for the current coordinate point.
  - All other combinations are not defined.
- Bits 7:4 represent a unique ID to differentiate between 2 different fingers under the case where the data for the fingers switches between the first touch point and the second touch point. This can be used to maintain tracking information between 2 different fingers.

3.7.1.3 Second Touch Point Information Registers (0x07 – 0x0C)

	7	6	5	4	3	2	1	0
0x07	X1 Position (bits 15:8)							
0x08	X1 Position (bits 7:0)							
0x09	Y1 Position (bits 15:8)							
0x0A	Y1 Position (bits 7:0)							
0x0B	Second Touch Point Pressure Value							
0x0C	Touch ID				Tip Switch			

The coordinates of the second touch point are reported via registers 0x07 to 0x0C. These registers are Read-Only and only valid when more than one finger is reported in the Data Information Register and the Tip Switch is asserted.

- Registers 0x07 – 0x0A
  - The coordinates for the second touch point are in registers 0x07 – 0x0A as defined above.
  - The value is reported as a 16 bit value with the maximum value equal to the resolution of the sensor.
- Registers 0x0B
  - This register returns a pressure value for the touch point. The pressure value is representative of the diameter of the contact area touching the sensor.
  - This value is an 8 bit number. The value is not normalized so it should be interpreted as a relative number.

- Registers 0x0C

	7	6	5	4	3	2	1	0
0x0C	Touch ID				Tip Switch			

- Bits 3:0 indicate if the current touch point is touching the screen. This field should be used to determine when a touch point is detected and also when it is lifted from the screen.
  - {0000} = This value indicates the finger is not touching the screen for the current coordinate point.
  - {0001} = This value indicates the finger is touching the screen for the current coordinate point.
  - All other combinations are not defined.
- Bits 7:4 represent a unique ID to differentiate between 2 different fingers under the case where the data for the fingers switches between the first touch point and the second touch point. This can be used to maintain tracking information between 2 different fingers.

3.7.1.4 Register map version (0x0D)

	7	6	5	4	3	2	1	0
0x0D	Register map version (7:0)							

This register dictates the register map. This register can be queried by the host to determine which register values are located at which register offsets. For the register map corresponding to this document the value will be 0x02.

3.7.1.5 Firmware Version Register (0x0E - 0x0F)

	7	6	5	4	3	2	1	0
0x0E	Product Info		Year		Month			
0x0F	Day					Firmware Version		Release

Firmware releases are numbered by the following format: yyyymmddx where yyyymmdd is the date of release and x is the running number of the release in case there are multiple releases on a given day.

To store the version information, two registers (0x0D – 0X0E) are used and defined as follows:

- Register 0x0E

Bits 7:6 represent Product Information (Read Only)

- {00} = 43Z6 = 4.3” Panel
- {01} = 70Z7 = 7” Panel
- {10} = 10Z8 = 10.1” Panel
- {11} = Reserved

Bits 5:4 represent the Year (Read Only)

- {00} = 2010
- {01} = 2011
- {10} = 2012
- {11} = 2013

Bits 3:0 represent the Month (Read Only)

- {0x1} = January
- {0x2} = February
- {0x.} = ……..
- {0x.} = ……..
- {0xC} = December

- Register 0x0F

  Bits 7:3 represent the Day (Read Only)

  - {0x01} = 1
  - {0x02} = 2
  - {0x.} = ……..
  - {0x.} = ……..
  - {0x1F} = 31

  Bits 2:1 represent the Firmware Version (Read Only)

  - {00} = v1.0 Firmware Architecture
  - {01} = v1.4 Firmware Architecture

  Bit 0 represents the Release (Read Only)

  - {00} = First release of the day.
  - {11} = Second release of the day.

Note: More than 2 releases are not expected in one day.

3.7.2 Control Registers

3.7.2.1 Reset Control Register (0x10)

	7	6	5	4	3	2	1	0
0x10	Reset	-	-	-	-	-	-	-

This register can be used to trigger a software initiated reset. This reset will clear out all data in the sensor. The busy register will be reset to 0x00. During a software initiated reset the device will not be available on the I2C bus and the interrupt pin will stay low. The system will be available 125 ms after the reset is triggered.

- Register 0x10
  - Bit 7 = reset bit. This bit is write only. Writing a 1 to this bit initiates the reset.
  - Bits 6:0 = reserved.

3.7.3 Scan Complete Register (0x11)

	7	6	5	4	3	2	1	0
0x11	-	-	-	-	-	-	-	Scan Complete

This register is used to indicate that data is ready for the Host processor to read. When data is ready to be read the touch controller will not update the data until the host processor indicates it has completed gathering all data for this interrupt.

- Registers 0x11
  - Bit 0 represents Scan Complete(Read and Write)
  - {0} indicates that there is no new data for the Host processor. When this bit is {0} the touch controller is continually scanning the touch panel for new touch events.
  - {1} indicates current scan cycle has been completed and new data is ready for the Host processor.
  - This bit will mimic the interrupt output of the touch controller.
  - The Host should clear this bit (Write “0”) to indicate that a data transfer has been completed and subsequent scan can be started.

3.7.4 Reserved (0x12 – 0x13)

3.7.5 Firmware Update Control Register (0x14)

	7	6	5	4	3	2	1	0
0x14	Enter Firmware Update-							

- Register 0x14
  - Bits 7:0 represents Enter Firmware Update (Write Only)
    Host should write 0x4C to register 0x14 to set a flag which will force the controller to boot into firmware update mode on its next power cycle, soft reset or hard reset.

4 LCD

4.1 GENERAL DESCRIPTION

4.1.1 Introduction

The Fusion 10 incorporates a color active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This LCD is composed of a TFT LCD panel, a driving circuit, and LED backlight system. This model has a 10.1" inch diagonally measured active display area with a 1024H x 600V (WSVGA) display format that can display 262,144 colors.

4.1.2 LCD Model

Manufacturer - Chunghwa Picture Tubes (CPT)

Model - CLAA101NC05

4.1.3 Features

- 10.1" inch diagonal configuration
- 1024H x 600V (WSVGA) Pixel Format
- Three Channel LVDS Interface
- 262K colors using a 6 bit R.G.B. signal input

4.1.4 General Specifications

Table 8 – LCD Specifications

Parameter	Specifications(LCD Only)
Display Area	222.72(H)×125.28(V)(mm) (10.1-inch diagonal)
Number of Pixels	1024×3(H)×600 (V)
Pixel Pitch	0.2175 (H)×0.2088 (V) (mm)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	Normally white
Number of Colors	262,144(6bits) (LVDS)
Gamut	(45)%(Min)/ (50)%(Typ)
Optimum Viewing Angle	6 o'clock
Response Time	(20)ms (Typ)/(40) ms(Max)
Surface Treatment	Anti Glare 3H
Viewing Angle	40°、40° / 15° 、30°(Min)
Brightness	(160) cd/m2 (5point) (Min)/(200) cd/m2 (Typ) (5point)
Uniformity	5point：80%(Min) - 13point：70 %(Min)
Consumption of Power	(2.1) W (Typ)
Module Size	235.5 (W)×143.5 (H)×5.2 (D) (mm) (Max)
Module Weight	(190) g (Max)

4.1.5 Optical Performance

Table 9 – LCD Optical Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max	Unit	Note
Contrast Ratio	CR	θ=ψ=0°	400	500	--	--	1,2
Luminance (5P)	L	θ=ψ=0°	160	200	--	cd/m^2	1,3
Uniformity (5P)	ΔL	θ=ψ=0°	80	--	--	%	1,3
Uniformity(13P)	ΔL	θ=ψ=0°	70	--	--	%	1,3
Response Time	Tr	θ=ψ=0°	--	20	40	ms	5
Response Time	Tf	θ=ψ=0°	--	20	40	ms	5
Cross Talk	CT	θ=ψ=0°	--	--	1	%	6
View Angle – Horizontal	ψ	CR≧10	40/-40		--	o	4
View Angle - Vertical	θ	CR≧10	15/-30		--	o	4
W Color Coordinate	X	θ=ψ=0°	0.283	0.313	0.343		3
W Color Coordinate	Y	θ=ψ=0°	0.299	0.329	0.359		3
R Color Coordinate	X	θ=ψ=0°		0.581			3
R Color Coordinate	Y	θ=ψ=0°		0.340			3
G Color Coordinate	X	θ=ψ=0°		0.340			3
G Color Coordinate	Y	θ=ψ=0°		0.588			3
B Color Coordinate	X	θ=ψ=0°		0.154			3
B Color Coordinate	Y	θ=ψ=0°		0.111			3
Gamut		θ=ψ=0°	45	50	--	%	
Gamma	γ	GL	2.0	2.2	2.4		7

Note: Color coordinate and color gamut are measured by SRUL1R, response time is measured by TRD-100, and all the other items are measured by BM-5A (TOPCON). All these items are measured under the dark room condition (no ambient light). Measurement Condition: IL= 20mA (each LED)

Notes of these measurement items is as follows:

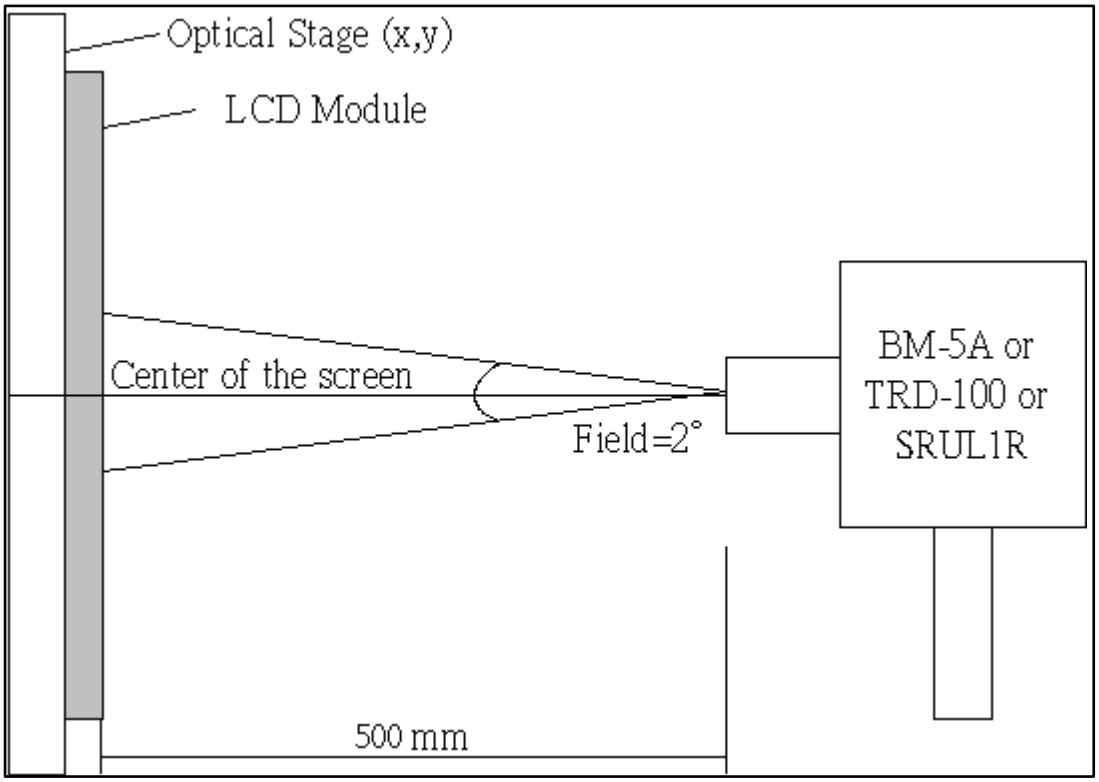
1) **Setup of Measurement Equipment**

The LCD module should be turn-on to a stable luminance level to be reached. The measurement should be executed after lighting Backlight for 20 minutes and in a dark room.

2) **Definition of Contrast Ratio**

CR=ON (White) Luminance/OFF (Black) Luminance

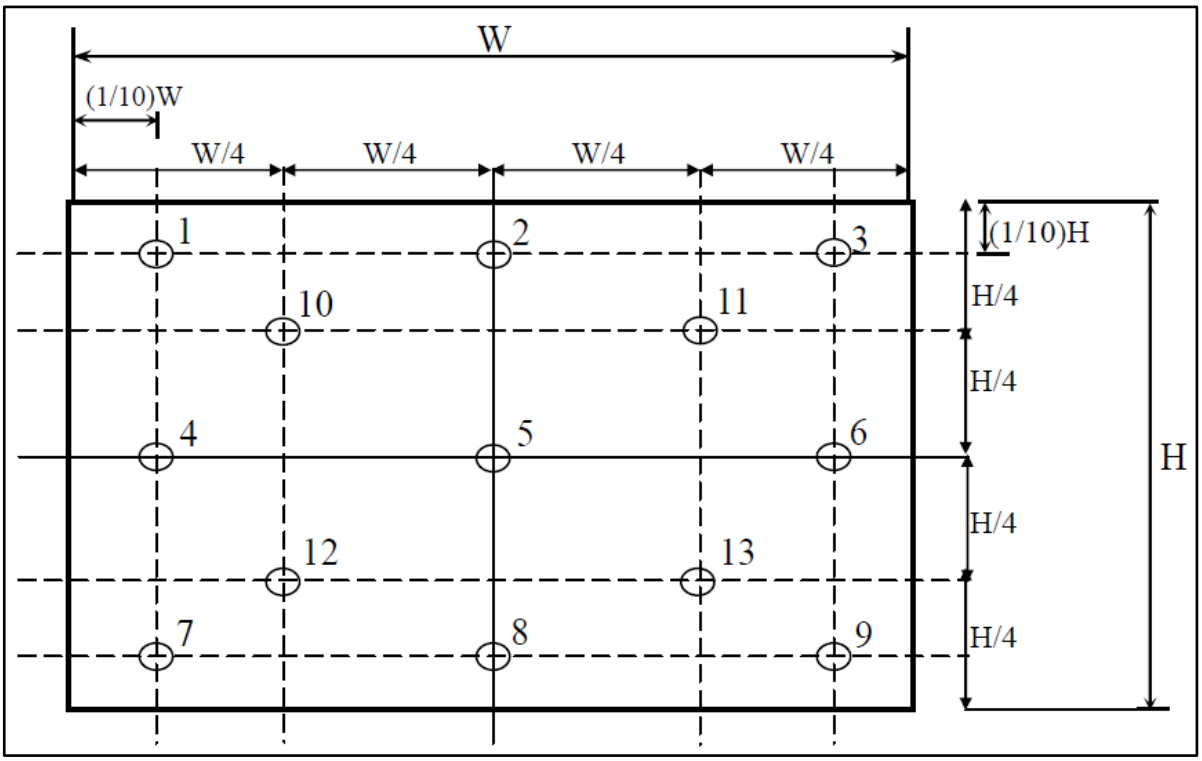
Figure 3 - Optical testing configuration



3) **Definition of Luminance and Luminance uniformity**

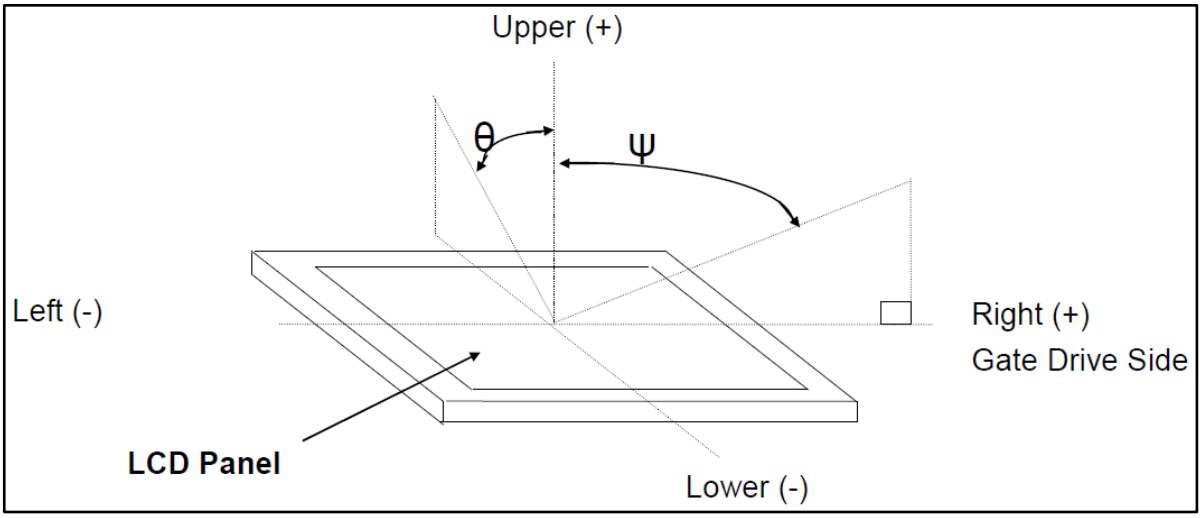
- Central luminance : The white luminance is measured at the center position "5" on the screen, see Figure below.
- 5P Luminance (AVG): The white luminance is measured at measuring points 5、10、11、12、13. see Figure below.
- 5P Uniformity: Δ L = (Lmin / Lmax) ×100%
- 13P Uniformity: Δ L = (Lmin / Lmax) ×100%

Figure 4 - Uniformity testing locations



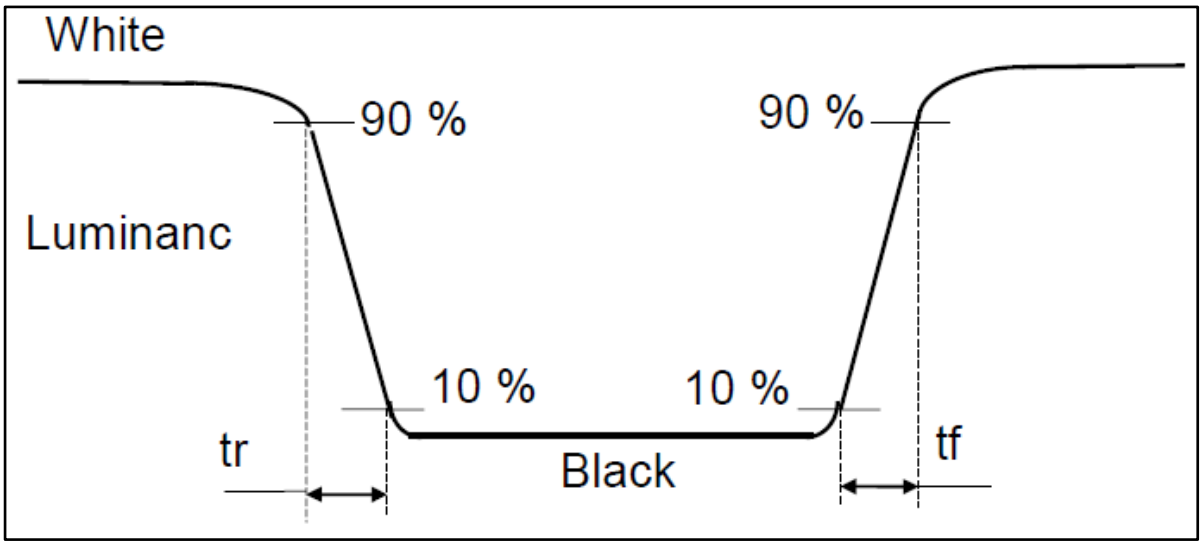
4) **Definition of view angle(θ , ψ)**

Figure 5 - View Angle definition



5) **Definition of response time**

Figure 6 - Response Time



6) **Crosstalk Modulation Ratio**

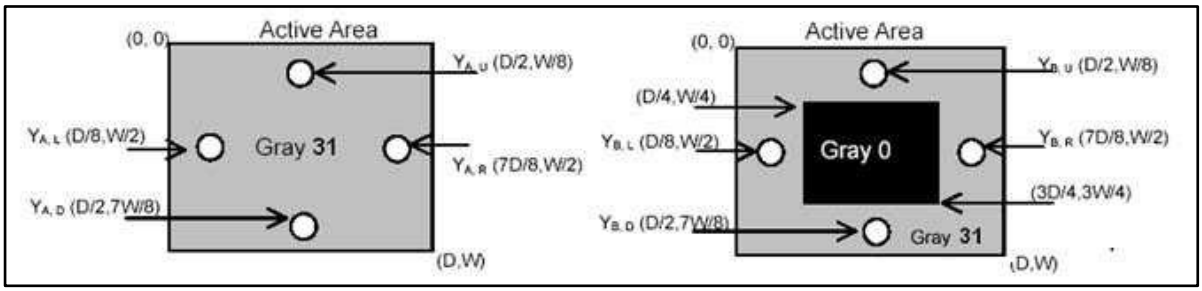
$CT=|Y_B-Y_A| / Y_A \times 100\%$

Y_A、Y_B measure position and definition

Y_A means luminance at gray level 31(exclude gray level 0 pattern)

Y_B means luminance at gray level 31(include gray level 0 pattern)

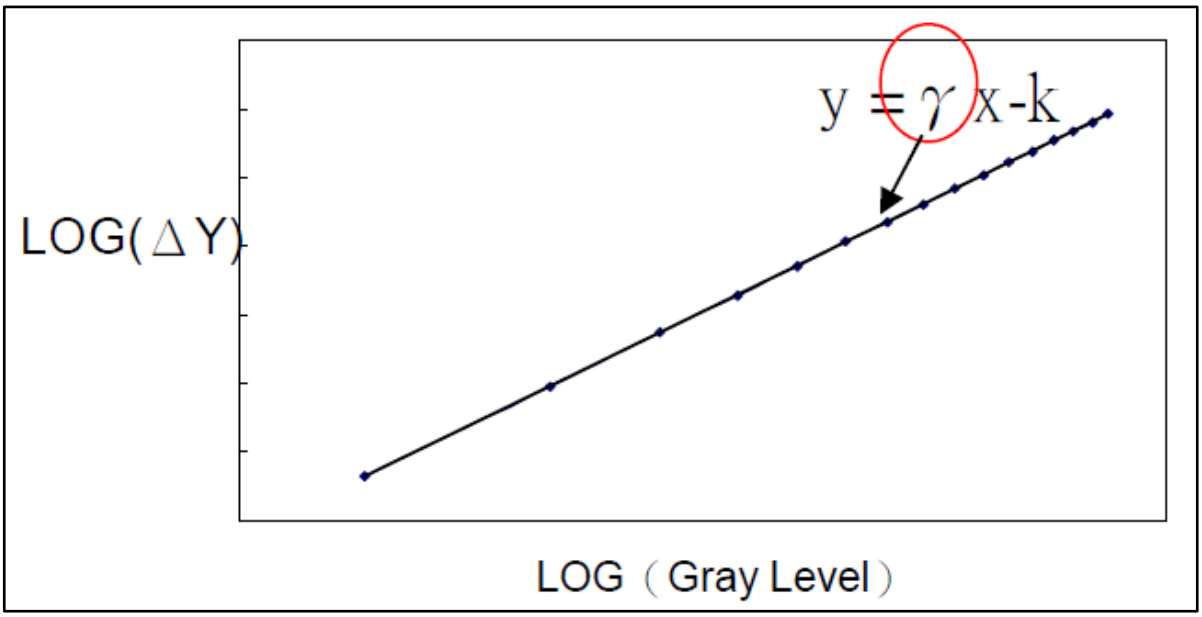
Figure 7 - Luminance Definition



7) **Definition of Gamma (VESA)**

Based on Customer Sample, take the average value as a standard center value and the variation range of gamma value caused by loop voltage error should be between +/- 0.2. the bellow figure shows how to obtain the gamma curve and γ (from gray level: 0、4、8-----60、63).

Figure 8 - Gamma Definition



4.2 ABSOLUTE MAXIMUM RATINGS

Table 10 – LCD and LED Maximum Ratings (GND = 0V)

Item	Symbol	Min.	Max.	Unit	Note
LCD Power Voltage	VCC	0	4.0	V	
Operation Temperature	Top	0	50	^{o}C	1,2,3,4
Storage Temperature	Tstg	-25	65	^{o}C	1,2,3

4.3 LCD ELECTRICAL CHARACTERISTICS

4.3.1 Recommended Operating Conditions

Table 11 – LCD Recommended Operating Conditions

Parameter		Symbol	Min.	Typ.	Max.	Unit	Note
LCD Power Voltage		VCC	3.0	3.3	3.6	-	1
LCD Power Current		ICC	-	160	170	mA	2
Rush Current		Irush	-	-	2	A	4
Logic Input Voltage (LVDS: IN+, IN-)	Common Voltage	VCM	$\frac{\lvert VID \rvert}{2}$	-	$2.4-\frac{\lvert VID \rvert}{2}$	V	3
	Differential Input Voltage	|VID|	200	-	600	mV	3
	Threshold Voltage (High)	VTH	-	-	100	mV	3 - When VCM = +1.2V
	Threshold Voltage (Low)	VTL	-100	-	-	mV	3 - When VCM = +1.2V

Note 1. Power Sequence :

0.50 ms <= t1 <= 10 ms

0.01 ms <= t2 <= 50 ms

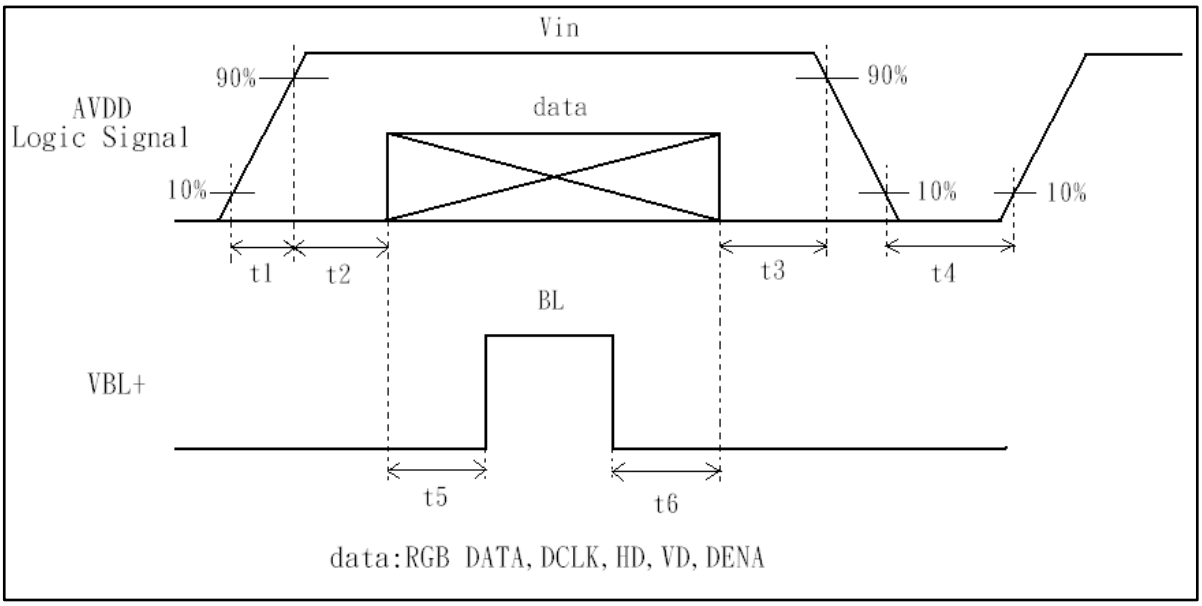
0.01 ms <= t3 <= 50 ms

500 ms<=t4

200 ms<=t5

200 ms<=t6

Figure 9 - Power on Sequence

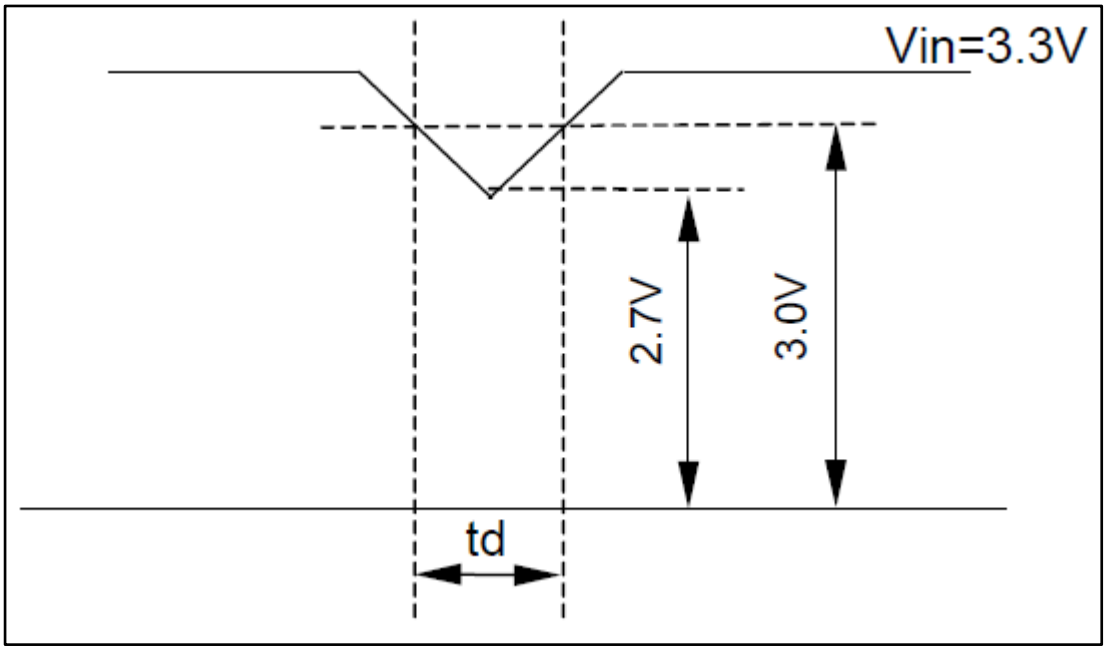


VCC-dip state

(1)when 3.0V > VCC >= 2.7V, td <= 10 ms.

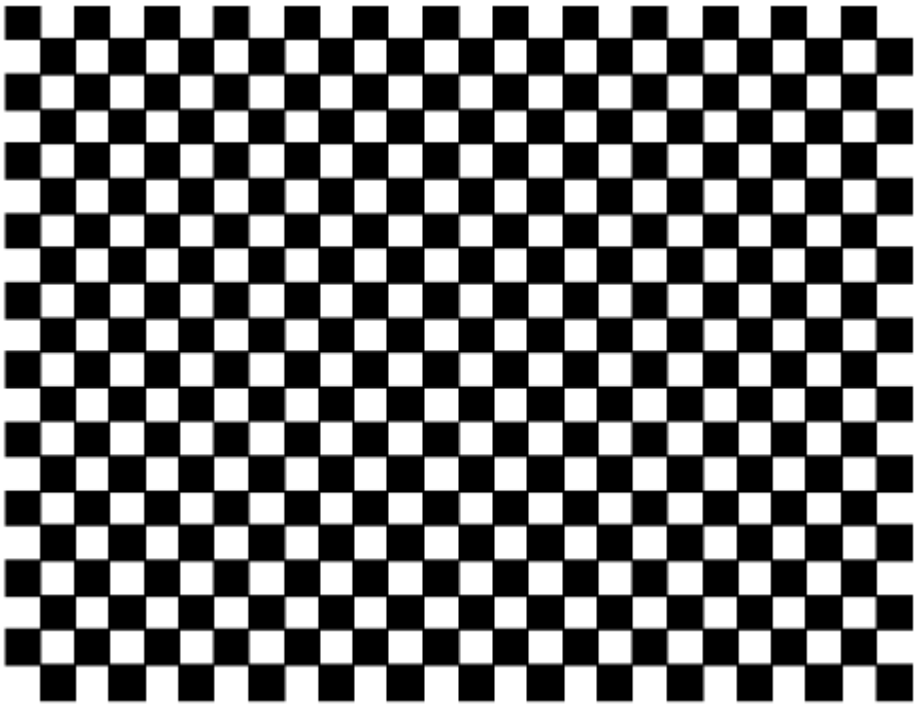
(2)when VCC < 2.7V , VCC-dip condition should as the VCC-turn-off condition.

Figure 10 - VCC Dip Condition



Note 2. Typical value is Mosaic (32*36 Checker board) Pattern：768 line mode.

Circuit condition (Typ)：VCC=3.3 V，f_V=60 Hz，f_H=48.35 kHz，f_{CLK}=58.03 MHz.

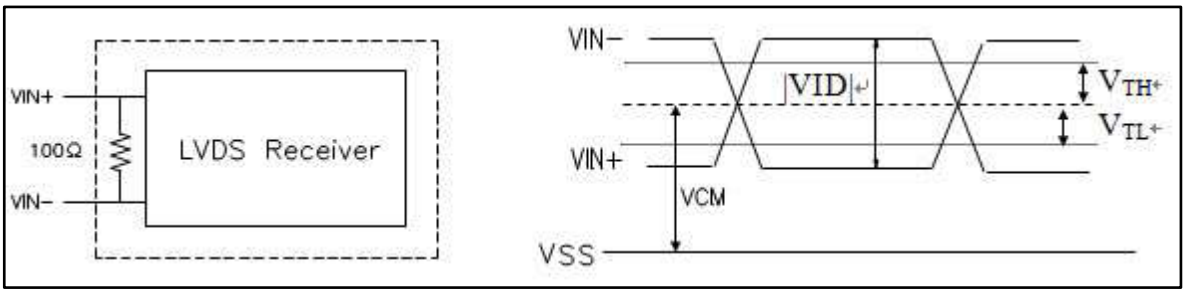


Max value is Black Pattern：768 line mode.

Circuit condition (Max)：VDD=3.3 V，f_V=60 Hz，f_H=48.35 kHz，f_{CLK}=58.03 MHz.

Note 3. LVDS Signal Definition

Figure 11 - LVDS Signal Definition

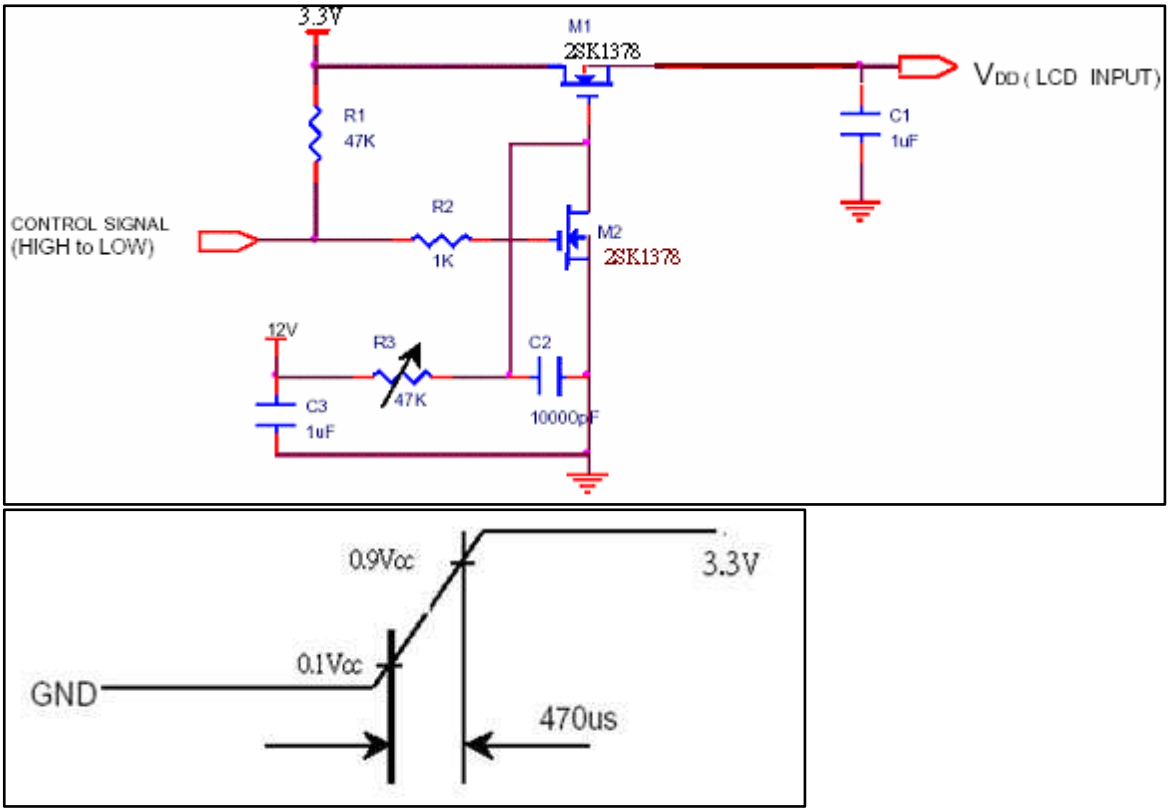


VIN+ : Positive differential DATA & CLK Input

VIN- : Negative differential DATA & CLK Input

Note 4: Irush measure condition

Figure 12 - Irush current measurement



4.3.2 Backlight Electrical Characteristics

Table 12 – Backlight Electrical Characteristics (Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
LED Driver Input Voltage	VBL+	5	12	19	V	
LED Driver Input Current	IBL+	-	133	360	mA	1
Forward Voltage	V_F	2.9	3.2	3.5	V	2 - IF = 20 mA
Forward Current	I_F	19.5	20	20.5	mA	2 - IF = 20 mA
Power Consumption	PLED	1.43	1.58	1.73	W	2,3 - IF = 20 mA
PWM Frequency	PWM_BL	180	200	220	Hz	
Duty ratio	Dim	5	-	100	%	

Note 1.

Typical value；VBL+ =12V， Duty=100%。

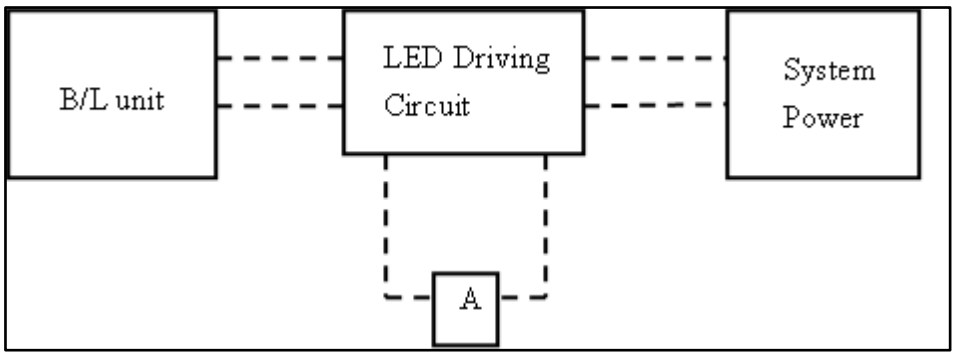
Max value；VBL+=5V， Duty=100%

Note 2.

Measure method：a. LED current is measured by utilizing a current meter as show below.

b. Set up system power input voltage at 12v to measurement PLED.

Figure 13 - LED driving measurement condition



Note 3.

Calculator value for reference IF*VF=PLED

4.3.3 Backlight LED Life Time

Table 13 – LED Life Time Characteristics

Parameter	Condition	Min.	Typ.	Max.	Units	Note
Life Time	I_F=20mA - Ta=25℃	15000			hrs	1

Note 1.

Life time means that estimated time to 50% degradation of initial luminous intensity.

4.3.1 LCD Signal Cable Definition

Table 14 – LCD Signal Definition

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	NC	No Connection	21	NC	No Connection
2	VCC	3.3V Power Supply	22	GND	Ground
3	VCC	3.3V Power Supply	23	NC	No Connection
4	V-EDID	EDID 3.3V Power Supply	24	NC	No Connection
5	NC	No Connection	25	GND	Ground
6	CLK-EDID	EDID Clock	26	NC	No Connection
7	DATA-EDID	EDID Data	27	NC	No Connection
8	RXIN0-	LVDS Signal- channel0-	28	GND	Ground
9	RXIN0+	LVDS Signal+ channel0+	29	NC	No Connection
10	GND	Ground	30	NC	No Connection
11	RXIN1-	Data Input channel1-	31	VLED - GND	LED Ground
12	RXIN1+	Data Input channel1+	32	VLED - GND	LED Ground
13	GND	Ground	33	VLED - GND	LED Ground
14	RXIN2-	Data Input channel2-	34	NC	No Connection
15	RXIN2+	Data Input channel2+	35	PWM	PWM Signal for LED Dimming control
16	GND	Ground	36	LED-EN	LED Enable Pin (+3V Input)
17	RXCLKIN-	Data Input CLK-	37	NC	No Connection
18	RXCLKIN+	Data Input CLK+	38	VLED	LED Power Supply, 5-21V
19	GND	Ground	39	VLED	LED Power Supply, 5-21V
20	NC	No Connection	40	VLED	LED Power Supply, 5-21V

4.3.1.1 LCD Signal Mating Connector

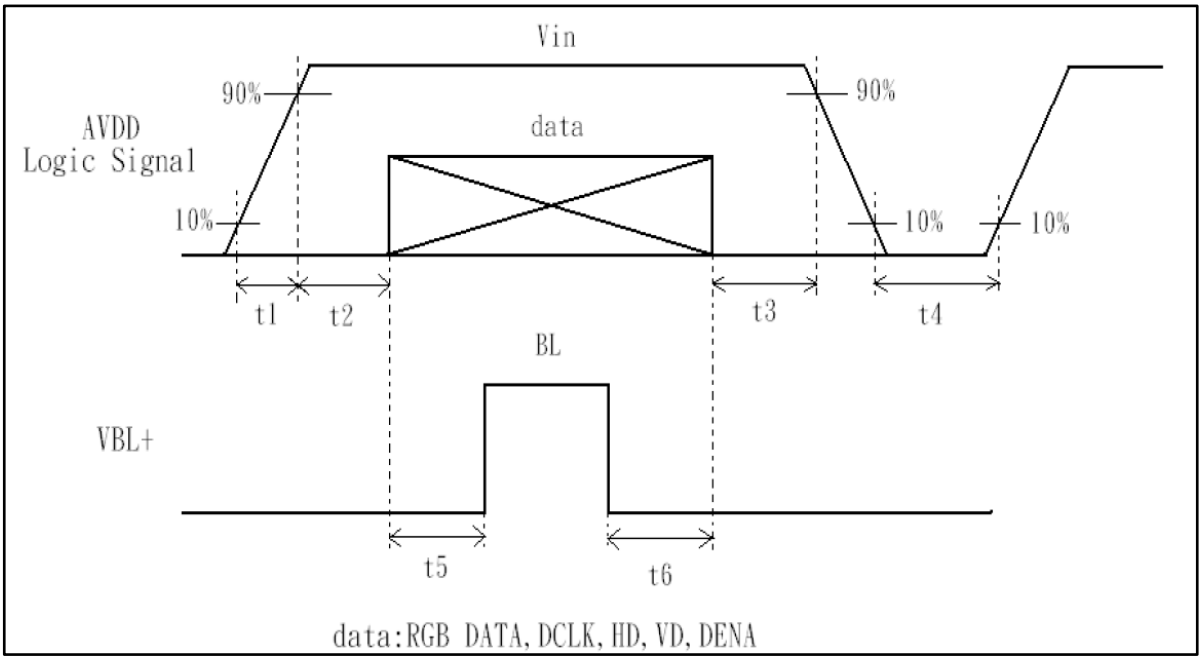
LCD Connector PN: **IPEX-20455-040E-12** or equivalent.

Mating Connector PN: **IPEX-20453-040T-01** or equivalent.

4.4 POWER ON/OFF SEQUENCE

4.4.1 LCD Power ON/OFF Sequence

Figure 14 - LCD Power On / Off Sequence



LCD Power Sequence :

0.50 ms <= t1 <= 10 ms

0.01 ms <= t2 <= 50 ms

0.01 ms <= t3 <= 50 ms

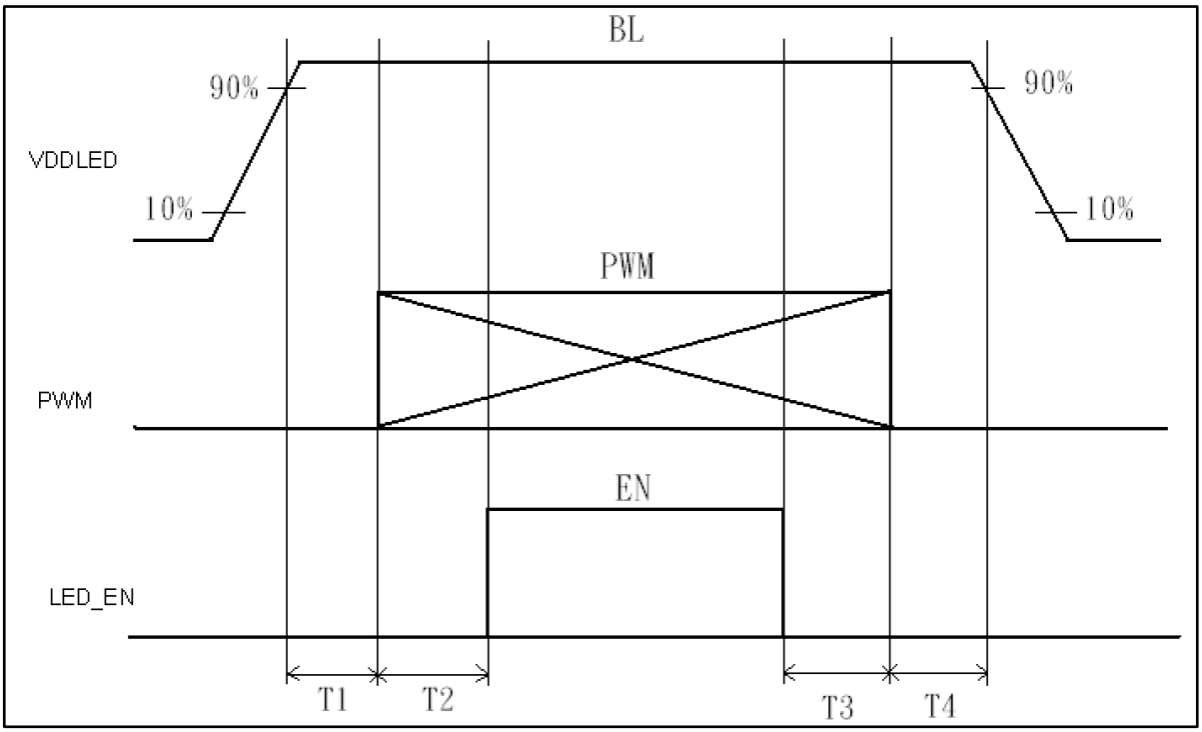
500 ms<=t4

200 ms<=t5

200 ms<=t6

4.4.2 Backlight LED Power On/Off Sequence

Figure 15 – LED Power On/Off Sequence



LED Power Sequence :

10ms <= T1

10ms <= T2

0ms <= T3

10ms <= T4

4.5 LCD TIMING INTERFACE REQUIREMENTS

4.5.1 Interface Timing Chart

Table 15 – LCD Interface Timing

Item		Symbol	Min.	Typ.	Max.	Unit
Frame Rate		-	60	60	60	Hz
DCLK		f_{clk}	40.8	51.2	67.2	MHz
DENA	Horizontal Total Time	t_H	1114	1344	1400	t_{CLK}
DENA	Horizontal Active Time	t_{HA}	1024	1024	1024	t_{CLK}
DENA	Horizontal Blank Time	t_{HB}	90	320	376	t_{CLK}
DENA	Vertical Total Time	t_V	610	635	800	t_{CLK}
DENA	Vertical Active Time	t_{VA}	600	600	600	t_{CLK}
DENA	Vertical Blank Time	t_{VB}	10	35	200	t_{CLK}

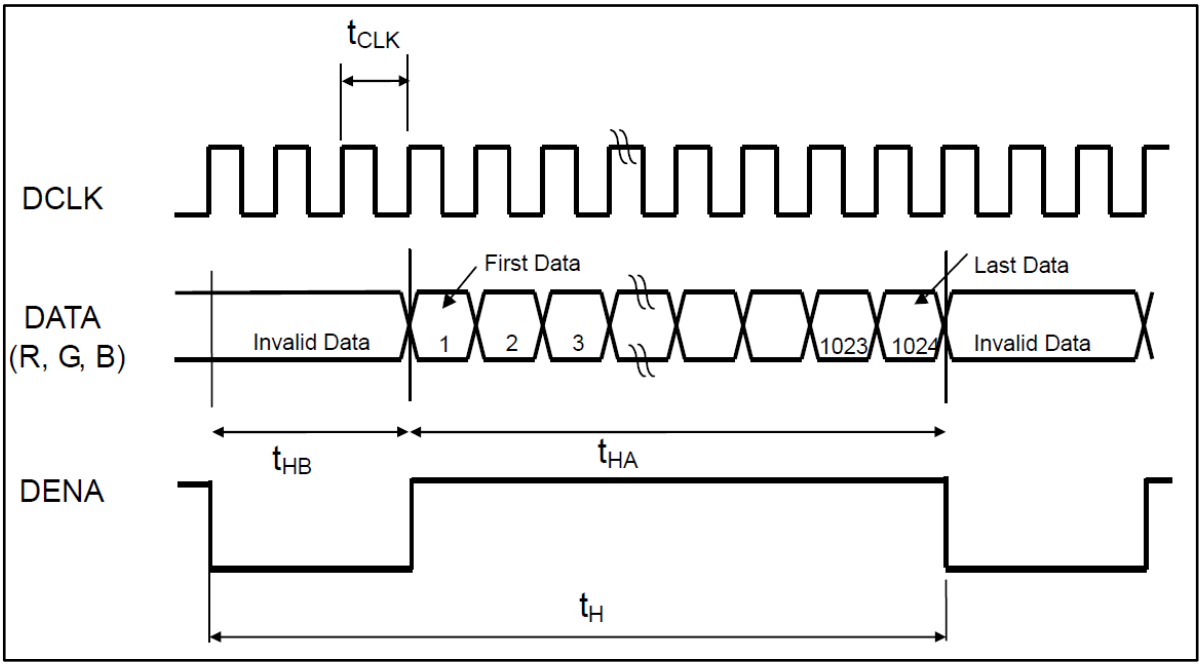
Note:

1. DENA (Data Enable) usually is positive
2. During the whole blank period, DCLK should keep input

4.5.2 Timing example

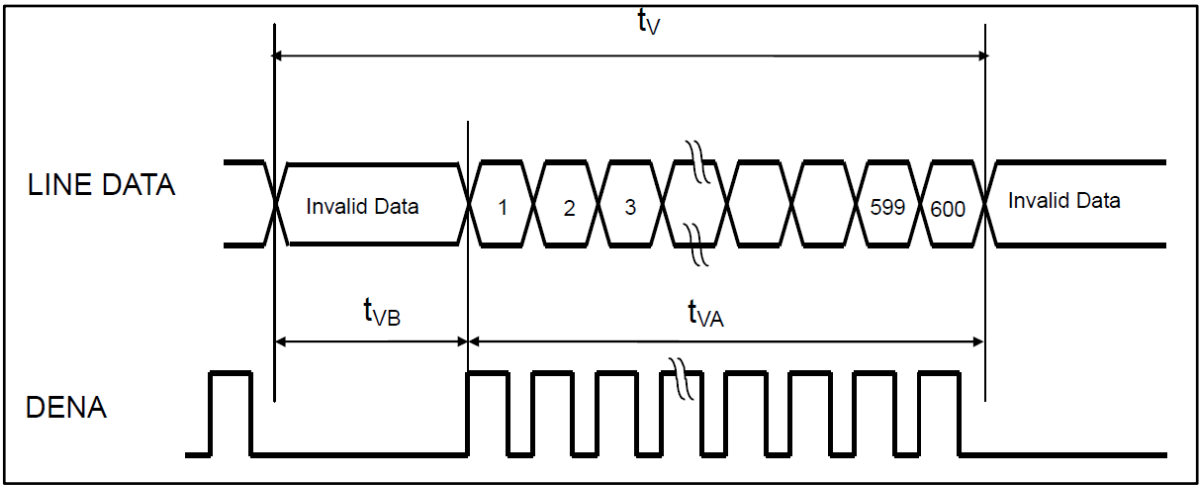
4.5.2.1 Horizontal Sequence

Figure 16 - Horizontal Sequence Timing Diagram



4.5.2.2 Vertical Sequence

Figure 17 - Vertical Sequence Timing Diagram



4.6 LCD COLOR DEFINITION

4.6.1 Relationship between Displayed Color and Input

Figure 18 - LCD Color definition

COLOR	INPUT DATA	R DATA						G DATA						B DATA					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
		MSB					LSB	MSB					LSB	MSB					LSB
BASIC COLOR	BLACK	0	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	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	BLUE(255)	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
RED	RED(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	1	0	0	0	0	0	0	0	0	0	0	0	0
	RED(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(254)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(255)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN(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	1	0	0	0	0	0	0
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	GREEN(254)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
BLUE	BLUE(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	1
	BLUE(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	BLUE(254)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Note:

1. Gray level：Color(n)：n is level order; higher n means brighter level.

2. DATA：1: high，0: low

5 RELIABILITY AND TESTING

5.1 RELIABILITY TEST SPECIFICATIONS

Table 16 – Reliability Test Specifications

Item	Condition
High Temperature Storage	T_A= +60°C, 240 hrs
Low Temperature Storage	T_A= -20°C, 240 hrs
High Temperature Operation	T_A= +50°C, 240 hrs
Low Temperature Operation	T_A= 0°C, 240 hrs
Thermal cycling	-20°C (30 min) ⇨ +60°C (30 Min), 100 cycles (DRY)
Electrostatic discharge	±8kV (Contact) / ±10kV (air)

5.2 PACKAGING SPECIFICATIONS

Table 17 – Packaging Specifications

Item	Condition
Drop Test	1) Drop Sequence: 1 corner, 3 edges, and 6 surfaces. 2) Drop height according to the weight of the package. 3) Inspection: sampling check, check each layer of upper and lower, 2 layers in center, total 4 layers.
Non-Operating Random Vibration	1) Truck Spectrum: (0.52G rms) and Air Spectrum: (PSD=1.46G rms), 3 axis (X/Y/Z), 20 min per axis per test. 2) Inspection: sampling check, check each layer of upper and lower, 2 layers in center, total 4 layers.

Note: All packaging tests are performed on 1 complete box of Fusion Touch Modules.

6 BARCODE

6.1 DESCRIPTION

Every Fusion touch panel contains a unique 2 dimensional barcode. This barcode is used for serial number identification and part specification.

6.2 LOCATION

The barcode is located on the flex tail as pictured below.

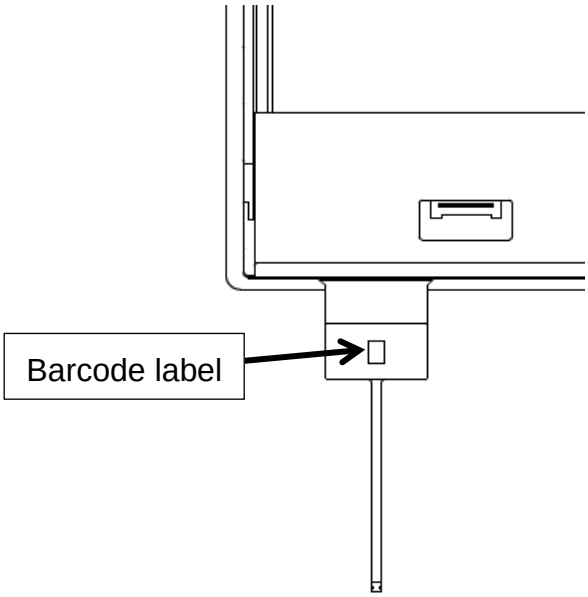


Figure 19 – Barcode Label Area (Rear View of Module Shown)

6.3 CONTENTS

The barcode contains the serial number, Touch Revolution part number, project name (if applicable), and touch firmware release version.

7 HANDLING AND PRECAUTIONS

7.1 DISASSEMBLY OR MODIFICATION

Do not disassemble or modify the touch display. This may cause damage to sensitive components and may cause dust or scratches between the touch sensor and LCD. Touch Revolution's warranty will be void if the unit has been disassembled or modified.

7.2 UV EXPOSURE

Long term exposure to sunlight can affect the optical performance of the LCD.

7.3 CLEANING

The cover glass should be cleaned using a soft, lint free cloth. It is recommended that either an ammonia based glass cleaner (e.g. Windex) or a 50:50 solution of isopropyl alcohol and water be used for cleaning the sensor. Apply the cleaning solution to the cloth and gently wipe the surface of the sensor. To help minimize streaking, wipe in a circular motion starting in the center and working outwards.

7.4 STATIC ELECTRICITY

Since the LCD and Touch panel use CMOS ICs, the device is susceptible to electrostatic discharge. Please use appropriate grounding when handling these modules.

7.5 ABSOLUTE MAXIMUM RATINGS

Do not exceed the absolute maximum rating values for the supply voltages and environmental conditions to prevent damage to the touch display.

7.6 BREAKAGE

If the LCD panel breaks be careful not to touch any liquid crystal material that may spill. Immediately rinse with water if liquid crystal material comes in contact with skin.

7.7 INPUT VOLTAGES

Turn off the power supply before handling and/or inserting signal or power cables to the touch module.

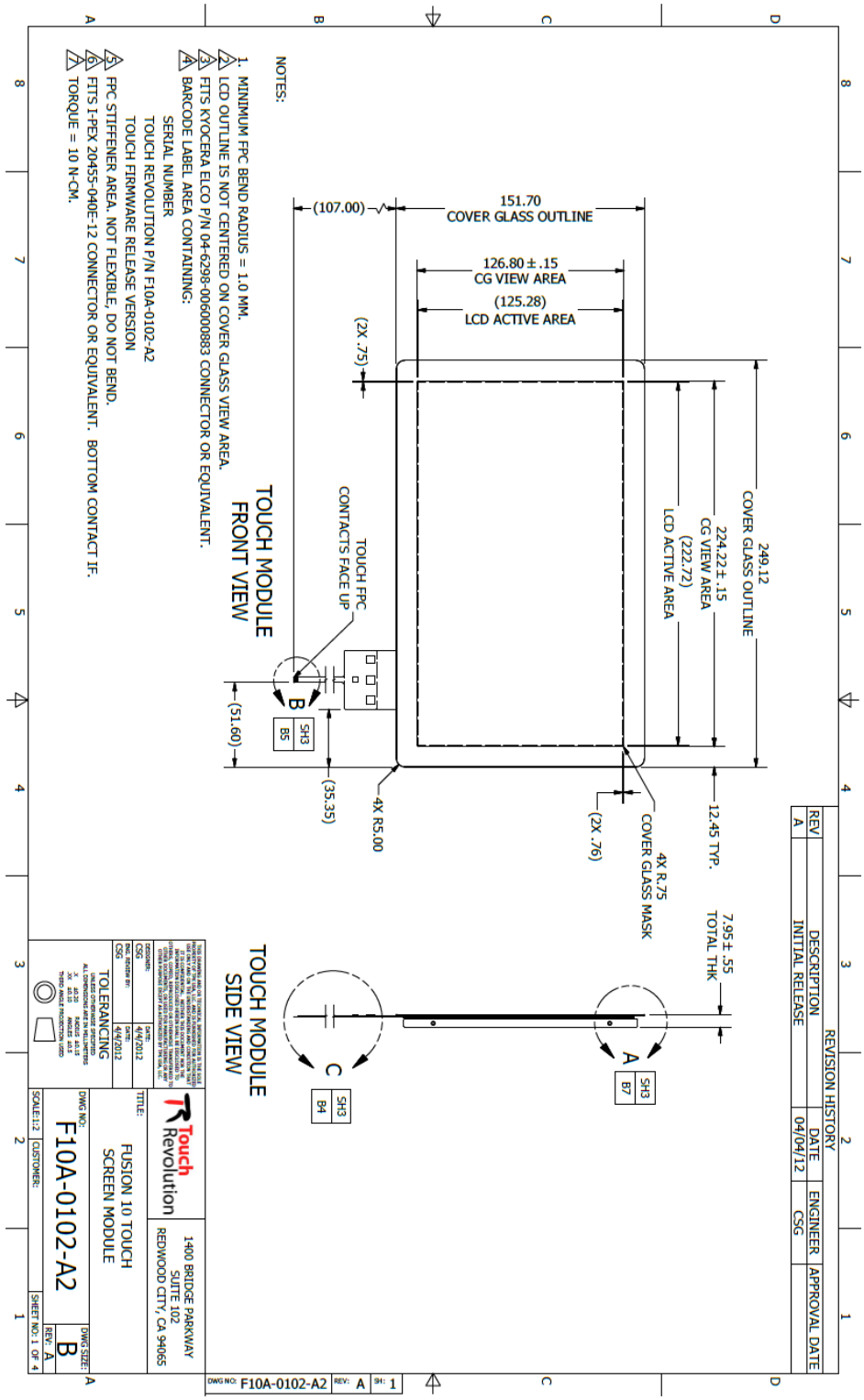
7.8 STATIC IMAGES

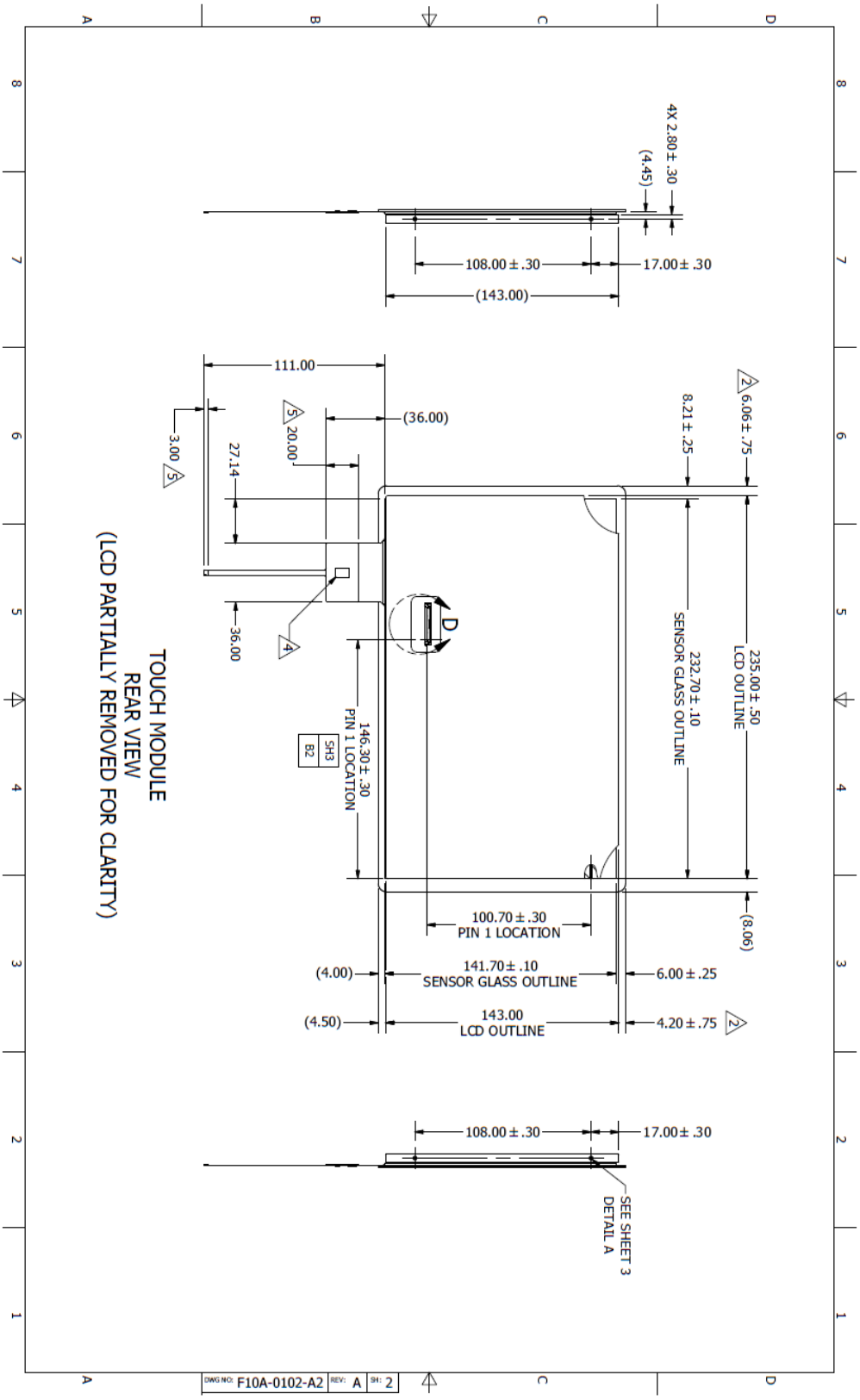
If fixed images are displayed for a long period of time, an afterimage is likely to occur.

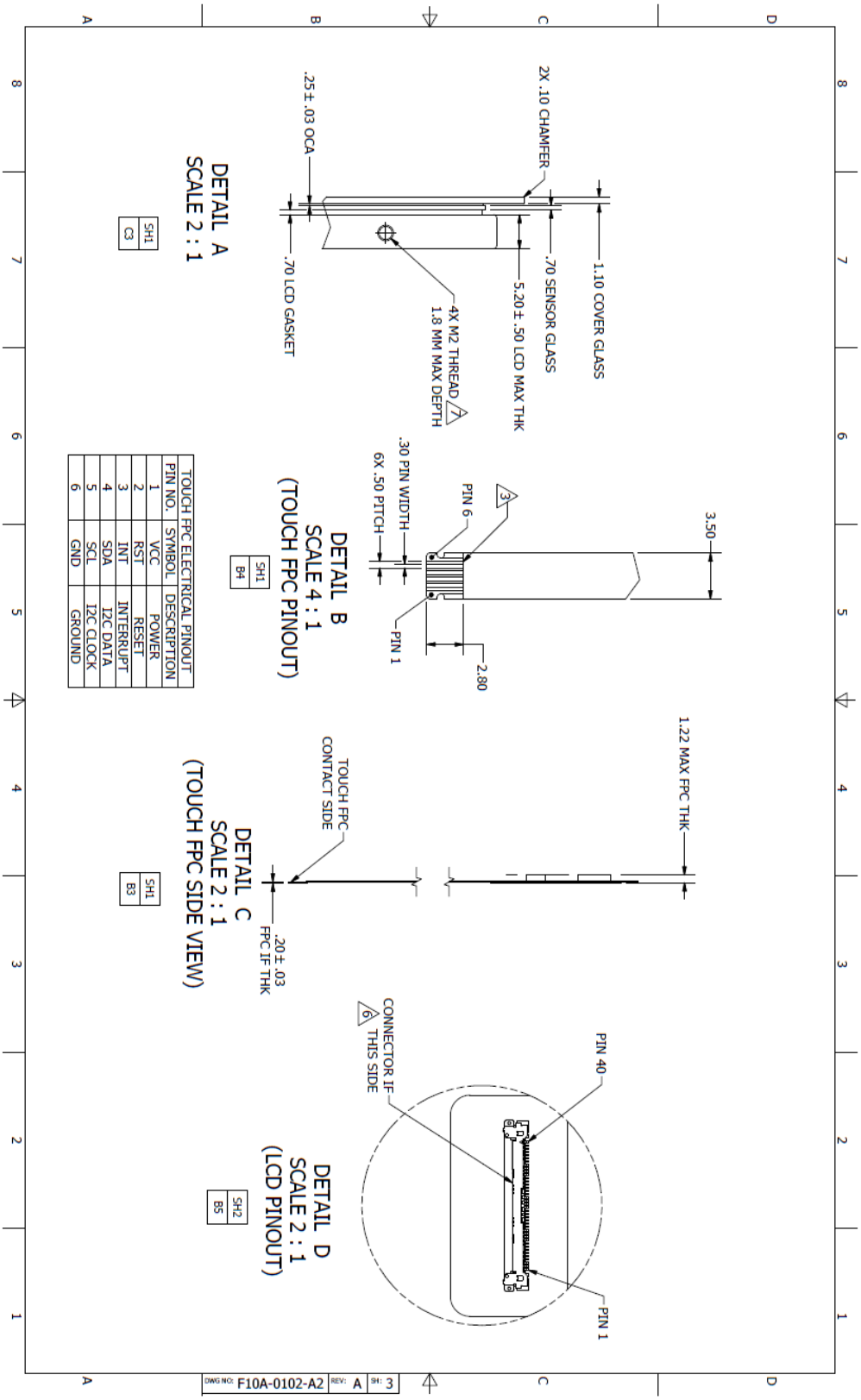
7.9 OUTGASSING

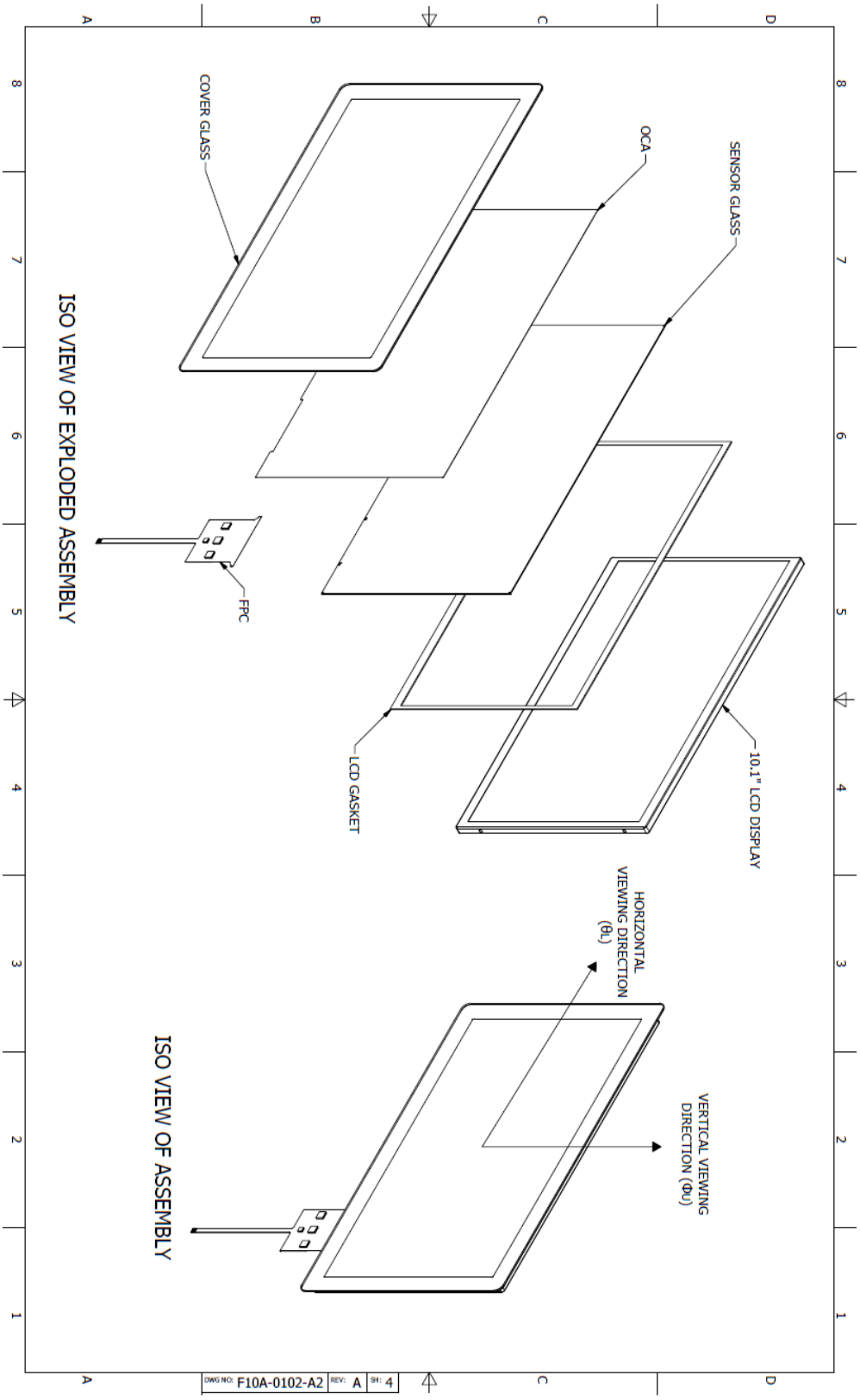
Do not store or use the touch module in an environment where caustic materials such as reagents, solvents, adhesives, and resins are present. Outgassing of these materials can damage the polarizer and ACF connections.

8 MECHANICAL DRAWINGS




TOUCH MODULE
REAR VIEW
(LCD PARTIALLY REMOVED FOR CLARITY)
4X 2.80 ± .30
(4.45)
108.00 ± .30
17.00 ± .30
(143.00)
111.00
(36.00)
20.00
3.00
27.14
36.00
6.06 ± .75
8.21 ± .25
SENSOR GLASS OUTLINE
232.70 ± .10
LCD OUTLINE
235.00 ± .50
146.30 ± .30
PIN 1 LOCATION
SH3
R2
100.70 ± .30
PIN 1 LOCATION
(8.06)
(4.00)
141.70 ± .10
SENSOR GLASS OUTLINE
6.00 ± .25
(4.50)
143.00
LCD OUTLINE
4.20 ± .75
108.00 ± .30
17.00 ± .30
SEE SHEET 3
DETAIL A
DWG NO: F10A-0102-A2
REV: A
SH: 2


DETAIL A
SCALE 2 : 1
.25 ± .03 OCA
.70 LCD GASKET
2X .10 CHAMFER
4X M2 THREAD
1.8 MM MAX DEPTH
.70 SENSOR GLASS
5.20 ± .50 LCD MAX THK
1.10 COVER GLASS
DETAIL B
SCALE 4 : 1
(TOUCH FPC PINOUT)
.30 PIN WIDTH
6X .50 PITCH
PIN 6
PIN 1
2.80
3.50
TOUCH FPC ELECTRICAL PINOUT
PIN NO. SYMBOL DESCRIPTION
1 VCC POWER
2 RST RESET
3 INT INTERRUPT
4 SDA I2C DATA
5 SCL I2C CLOCK
6 GND GROUND
DETAIL C
SCALE 2 : 1
(TOUCH FPC SIDE VIEW)
TOUCH FPC CONTACT SIDE
.20 ± .03 FPC IF THK
1.22 MAX FPC THK
DETAIL D
SCALE 2 : 1
(LCD PINOUT)
CONNECTOR IF THIS SIDE
PIN 40
PIN 1
DWG NO: F10A-0102-A2
REV: A
SH: 3


COVER GLASS
OCA
SENSOR GLASS
FPC
LCD GASKET
10.1" LCD DISPLAY
ISO VIEW OF EXPLODED ASSEMBLY
HORIZONTAL VIEWING DIRECTION (θL)
VERTICAL VIEWING DIRECTION (ΦU)
ISO VIEW OF ASSEMBLY
DWG NO: F10A-0102-A2
REV: A
SH: 4

APPENDIX A

Note 1: **Linearity Test Definition**

The linearity of the sensor is tested by dragging a 6mm copper slug in a line across the first surface of the touch sensor. The distance between the actual location of the center of the slug and the reported location shall be less than or equal to the maximum specified error.

Note 2: **Report Rate**

Report rate is the maximum rate at which touch data is returned to the host PC. The report rate may drop to 30 Interrupts/second for some unique two finger touch combinations.

Note 3: **Response Time**

Response time is the time elapsed between the first touch and interrupt assuming touch is in active mode

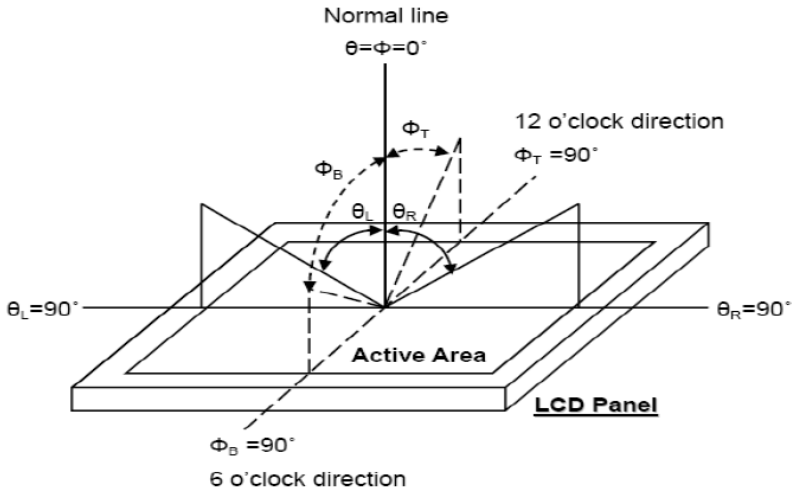
Note 4: **Minimum Touch Diameter**

The minimum touch diameter is the minimum diameter of a copper slug that is needed to record a touch.

Note 5: **Optical Transmittance**

Measured Per ASTM D1003

Note 6: **Viewing Angle**



Note 7: **First Surface Hardness**

Measured Per ASTM D3363