Touch Revolution

MODEL: Fusion 10

P/N: F10A-0102

PRODUCT SPECIFICATION

Version 1.5

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

Touch Revolution is committed to continuous improvement of its product designs and performance. This specification is therefore subject to change without notice. Please contact a customer support representative to insure that you have the most current specification. Products are not intended for use in safety-critical or military/aerospace applications, and customer is responsible for all legal and regulatory requirements associated with use in such applications.

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	℃
Storage Temperature	-20 to +60	℃

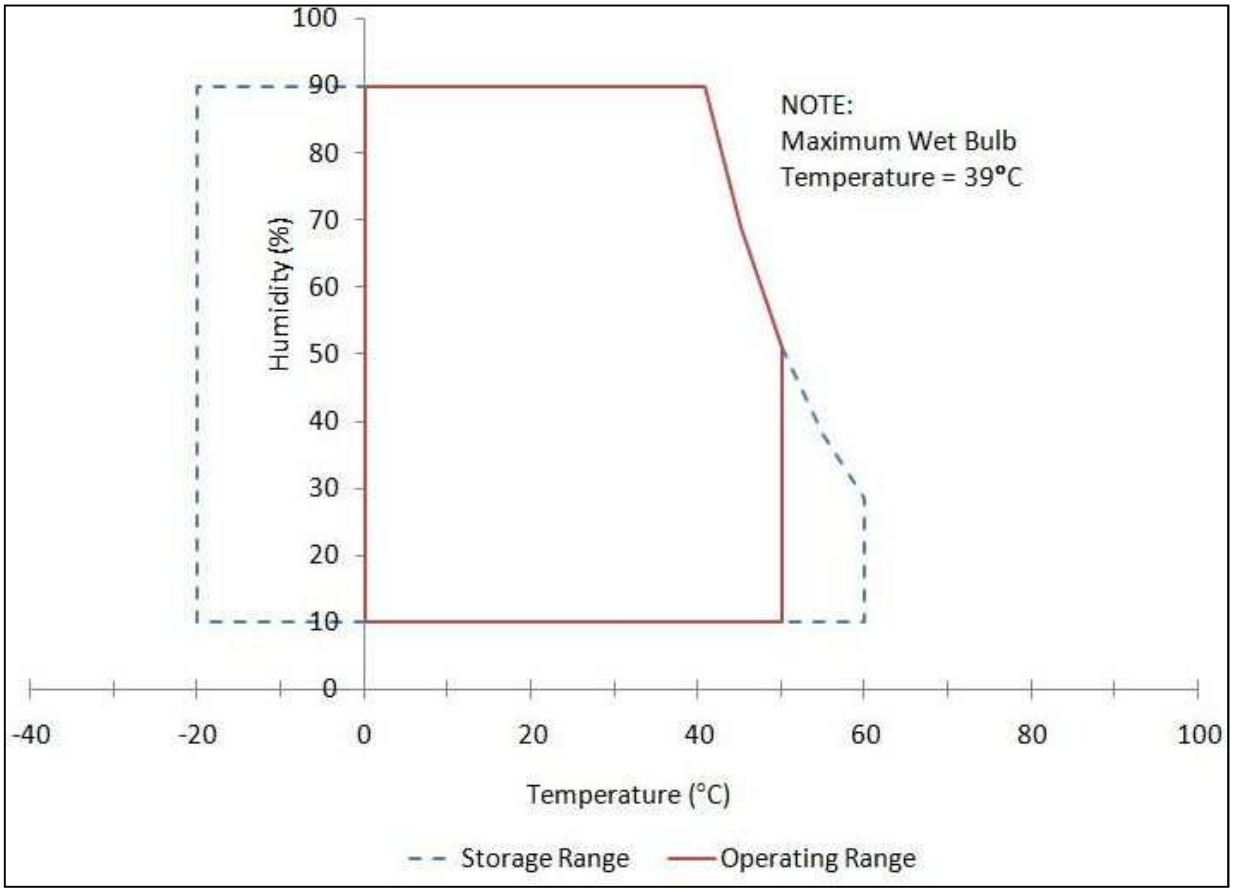


Figure 1 - Operating Temperature and Humidity Range

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.=45	Deg.	Note 6, Appendix A
		θ_L	Min.=40	Typ.=45		
	Vert.	Φ_T	Min.=10	Typ.=15	Deg.	
		Φ_D	Min.=30	Typ.=35		

2.5 MECHANICAL

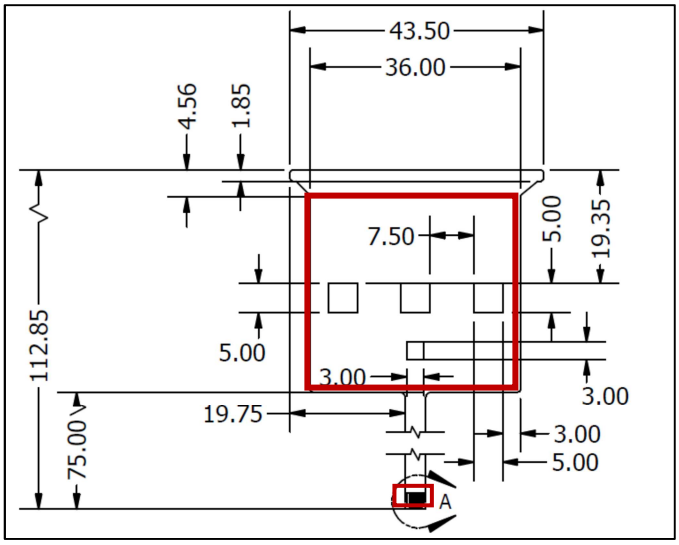
Table 5 - Mechanical Specification

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 Stiffener Areas



3 COMMUNICATIONS 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

o 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 INTERFACE

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 Features

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

4.1.3 General Specifications

Table 8 – LCD Specifications

Parameter	Specifications(LCD Only)	Unit
Screen Size	10.1" (Diagonal)	inch
Display Format	1024 RGB(H)X 600(V)	pixels
Pixel Configuration	RGB Vertical Stripe	
Active Area	222.72 (H) x 125.28 (V)	mm
Pixel Pitch	0.2175 (H) x 0.2088 (V)	mm
Outline Dimension	235(W) x 143(H) x 4.9(D) Typ.	mm
Backlight	White LED	
Power Consumption	0.65W(Logic) / 1.53W(Backlight)	Watt
Operating Temperature	0 ~ 50	℃
Storage Temperature	-20 ~ 60	℃

4.2 ABSOLUTE MAXIMUM RATINGS

Table 9 – LCD Maximum Ratings (GND = 0V)

Item	Symbol	Min.	Max.	Unit
Logic Supply Voltage	V_{DD}	-0.3	4.0	V
LED Power Supply Voltage	V_{LED}	-0.3	24	V
LED-EN and PWM pin Voltages	V_{EN}, V_{PWN}	-	5.5	V

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 Recommended Operating Conditions

Table 10 – LCD Recommended Operating Conditions (GND =0V, Ta=25℃)

Parameter	Symbol	Rating			Unit	Condition
		Min.	Typ.	Max.		
Power Supply Voltage	V_{DD}	3.0	3.3	3.6	V	Note 1
Power Supply Current	I_{DD}	-	0.192	-	A	V_{DD}=3.3v,L0 Pattern Ta=25℃, f_v=60Hz
Inrush	I_{RUSH}	-	-	1.50	A	

Note 1: V_{DD} – dip condition:

When V_{DD} is operating within $2.7V \leq V_{DD} < 3.0V$, $td \leq 10ms$, display operation may momentarily become abnormal.

If $V_{DD} < 2.7V$, V_{DD} dip condition should follow the Power On/Off conditions for the supply voltage.

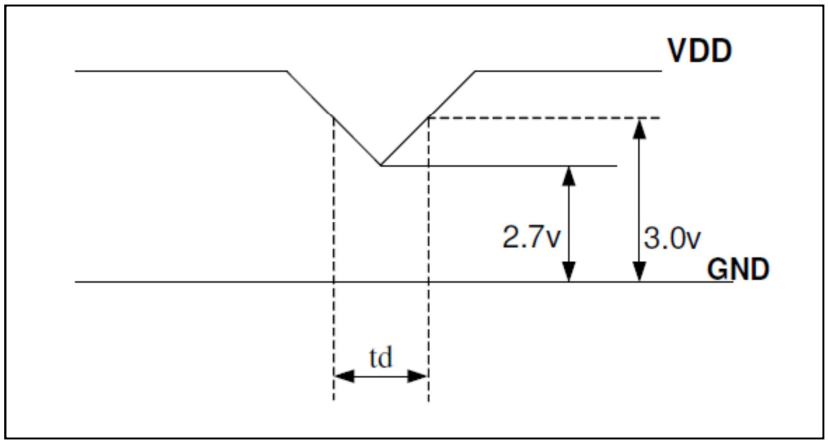


Figure 3 – Power Supply Voltage Dip Condition

4.3.2 LED Driving Conditions

Table 11 – LED Driving Conditions (Ta=25℃)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED Current	I_F	-	18.0	18.75	mA	
LED Voltage	V_F	3.0	3.2	3.4	V	
LED Power Consumption	P_{LED}	-	1.38	1.53		Note 1
LED Life	-	10,000	-	-	Hr.	I_F=18mA Note 2

Note 1: Calculated value for reference $P=I_F \times V_F \times N$(# of LEDs)

Note 2: LED life is defined as the time to 50% of the initial light output.

4.3.3 LED DC Electrical Characteristics

Table 12 – LED Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Remark
LED Power Supply Voltage	V_{LED}	5.0	-	21.0	V	
LED-EN High Threshold	V_{ENH}	2.0	-	-	V	
LED -N Low Threshold	V_{ENL}	-	-	0.3	V	
PWM High Threshold	V_{PWMH}	3.0	-	-	V	
PWM Low Threshold	V_{PWML}	-	-	0.2	V	
PWM Frequency	F_{PWM}	200	-	300	Hz	
PWM Duty Cycle	TD	10	-	-	%	Note 1

Note 1: PWM Duty Cycle. A longer duty pulse will increase light output.

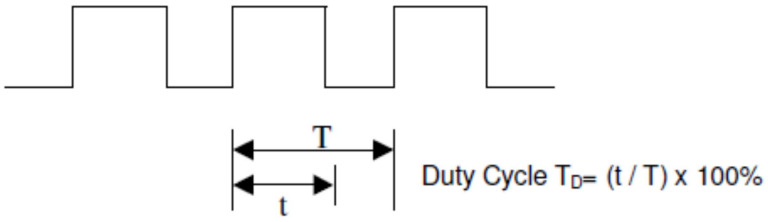


Figure 4 – LED Duty Cycle

4.3.4 LED Power On/Off Sequence

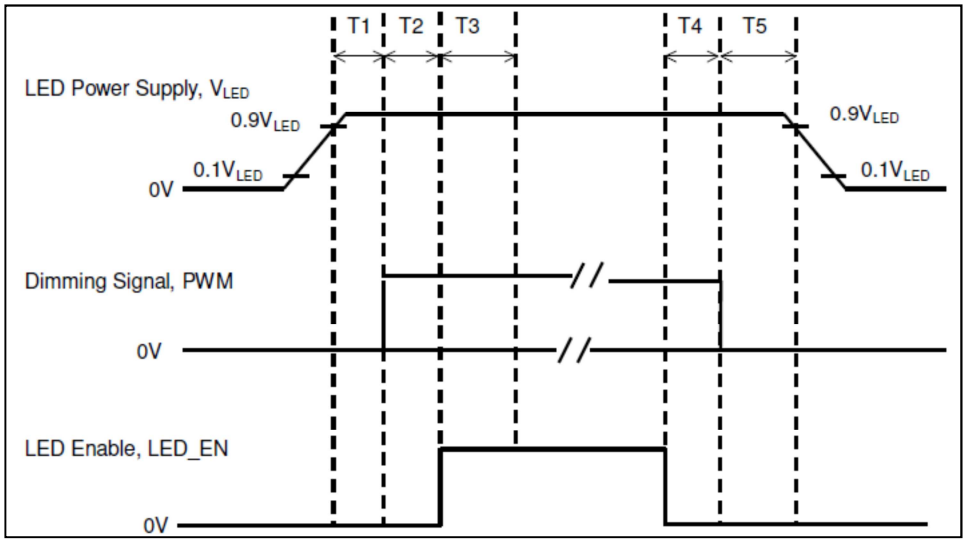


Figure 5 – LED Power On/Off Sequence

Table 13 – LED Power On/Off Values

Symbol	Value			Unit
	Min.	Typ.	Max.	
T1	10	-	-	ms
T2	10	-	-	
T3	50	-	-	
T4	0	-	-	
T5	10	-	-	

Note: The duty of the LED dimming signal should be more than 20%in T2 and T3.

4.4 INTERFACE

4.4.1 Switching Characteristics for LVDS Receiver

Table 14 – LVDS Input Values

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Differential Input High Threshold	Vth	-	-	100	mV	V_{CM}=1.2V
Differential Input Low Threshold	Vtl	-100	-	-	mV	
Input Current	IIN	-10	-	+10	uA	
Differential Input Voltage	I VID I	0.1	-	0.6	V	
Common Mode Voltage Offset	VCM	(I VID I /2)	1.25	1.8 - 0.4 - (I VID I /2)	V	

4.4.2 Bit Mapping and Interface Definition

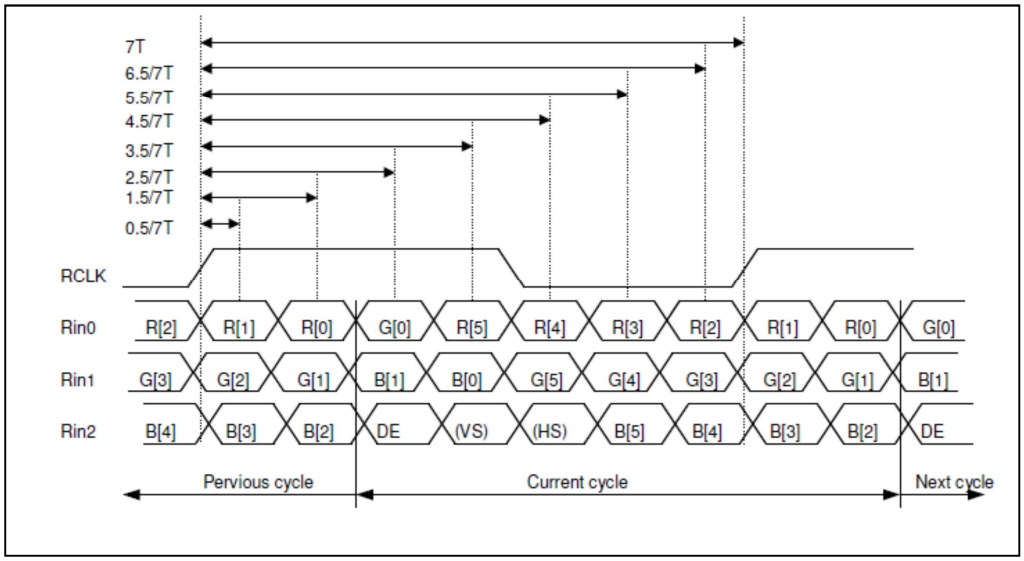


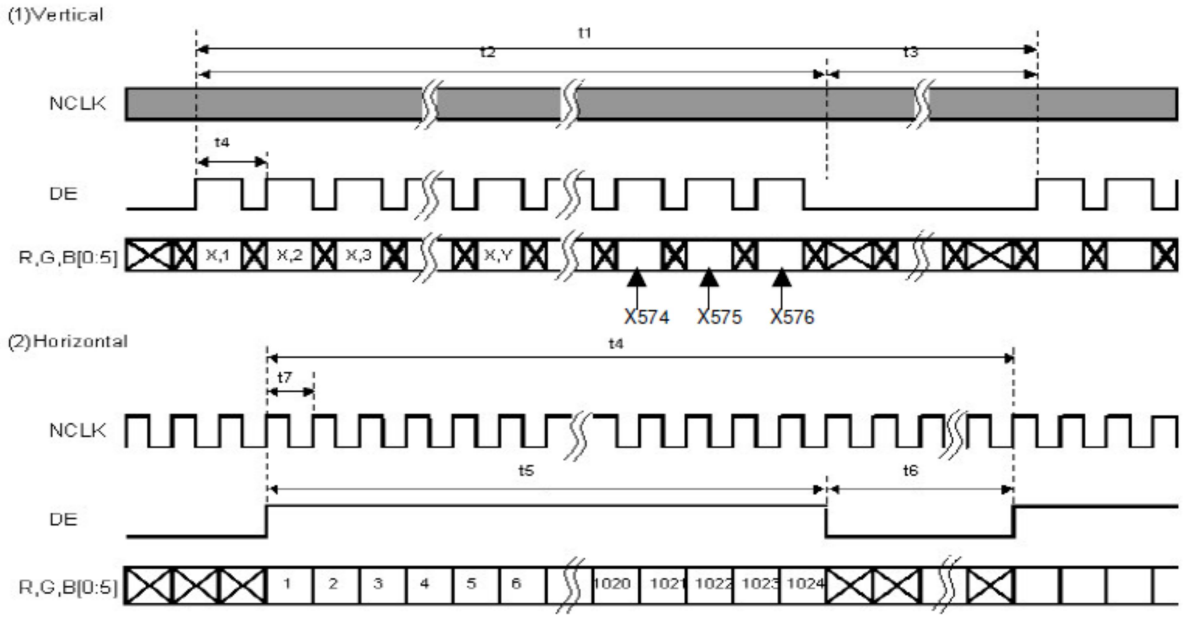
Figure 6 – LCD Input Waveform

4.4.3 Interface Timing (DE mode)

Table 15 – LCD Interface Timing

Item	Symbol	Min.	Typ.	Max.	Unit
Frame Rate	-	55	60	65	hz
Frame Period	t1	612	625	638	line
Vertical Display Time	t2	600	600	600	line
Vertical Blanking Time	t3	12	25	38	line
1 Line Scanning Time	t4	1160	1200	1240	clock
Horizontal Display Time	t5	1024	1024	1024	clock
Horizontal Blanking Time	t6	136	176	216	clock
Clock Rate	t7	39	45	51.42	MHz

4.4.4 Timing Diagram of Interface Signals (DE mode)



4.4.5 Power ON/OFF Sequence

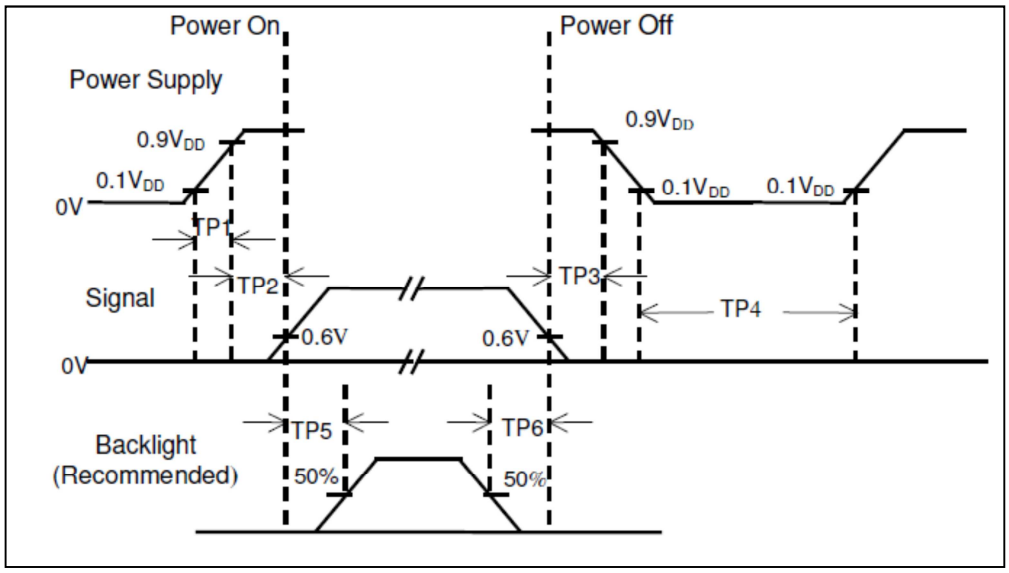


Figure 7 – Power On/Off Sequence

Table 16 – On/Off Sequence Values

Parameter	Specification			Unit
	Min.	Typ.	Max.	
TP1	0.5	-	10	ms
TP2	0	60	50	ms
TP3	0	-	50	ms
TP4	500	-	-	ms
TP5	200	-	-	ms
TP6	200	-	-	ms

Note:

1) The external supply voltage for the module input should have the same specification as V_{DD}.
2) Apply the lamp voltage after the LCD is operational. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become white.
3) If V_{DD}=off level, please keep the level of the input signal low or keep a high resistance.
4) TP4 should be measured after the module has been fully discharged after power off and before powering back on.
5) Interface signals shall not be kept at high impedance when the power is on.

4.4.6 LCD Signal Cable Definition

Table 17 – 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

4.4.6.1 LCD Signal Mating Connector

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

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

4.4.7 Block Diagram

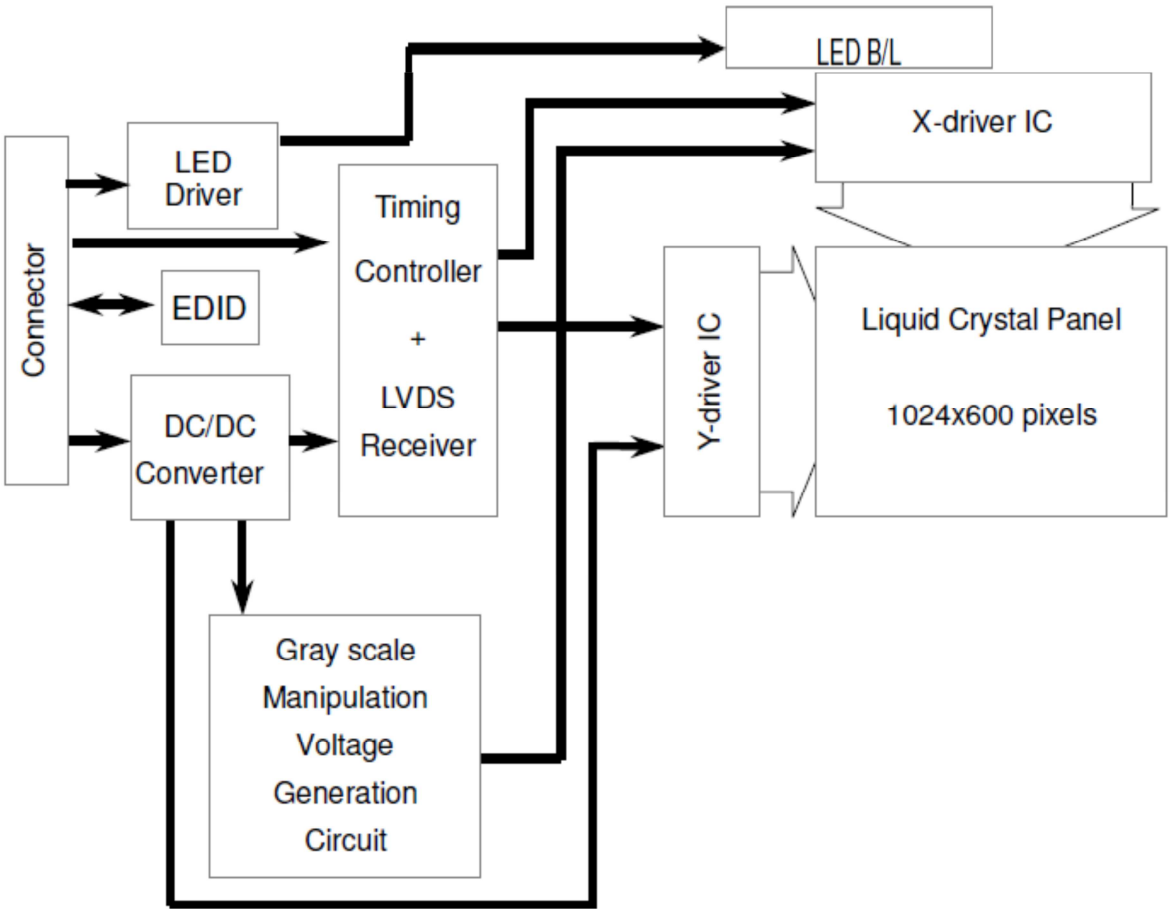
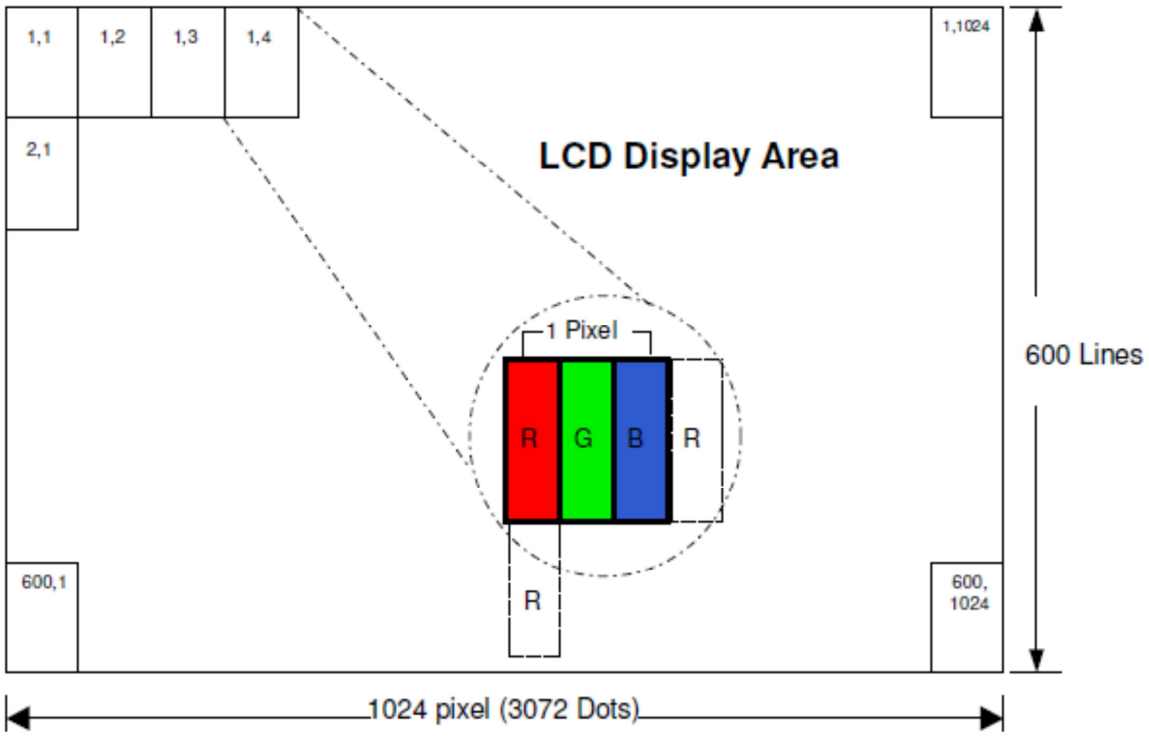


Figure 8 – LCD Block Diagram

4.5 PIXEL FORMAT



4.6 RELATIONSHIP BETWEEN DISPLAYED COLOR AND INPUT

	Display	MSB R5	R4	R3	R2	R1	LSB R0	MSB G5	G4	G3	G2	G1	LSB G0	MSB B5	B4	B3	B2	B1	LSB B0	Gray scale level
Basic color	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	-
	Blue	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	-
	Green	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L	-
	Light Blue	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	-
	Red	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	-
	Purple	H	H	H	H	H	H	L	L	L	L	L	L	H	H	H	H	H	H	-
	Yellow	H	H	H	H	H	H	H	H	H	H	H	H	L	L	L	L	L	L	-
	White	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	-
Gray scale of Red	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L0
	Dark ↑ ↓ Light	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L1
		L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L2
		⋮						⋮						⋮						L3...L60
		H	H	H	H	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L61
		H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L62
	Red	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	Red L63
Gray scale of Green	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L0
	Dark ↑ ↓ Light	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L1
		L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L2
		⋮						⋮						⋮						L3...L60
		L	L	L	L	L	L	H	H	H	H	L	H	L	L	L	L	L	L	L61
		L	L	L	L	L	L	H	H	H	H	H	L	L	L	L	L	L	L	L62
	Green	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L	Green L63
Gray scale of Blue	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L0
	Dark ↑ ↓ Light	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L1
		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L2
		⋮						⋮						⋮						L3...L60
		L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	L	H	L61
		L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L	L62
	Blue	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	Blue L63
Gray scale of White & Black	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L0
	Dark ↑ ↓ Light	L	L	L	L	L	H	L	L	L	L	L	H	L	L	L	L	L	H	L1
		L	L	L	L	H	L	L	L	L	L	H	L	L	L	L	L	H	L	L2
		⋮						⋮						⋮						L3...L60
		H	H	H	H	L	H	H	H	H	H	L	H	H	H	H	H	L	H	L61
		H	H	H	H	H	L	H	H	H	H	H	L	H	H	H	H	H	L	L62
	White	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	White L63

4.7 OPTICAL PERFORMANCE

Table 18 – LCD Optical Performance

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Brightness Uniformity		B_{UNI}	θ=0 (5 point)	80			%	
			θ=0 (13point)	70			%	
White Luminance (5 point)		Y_L	Viewing Normal Angle θ=0	160	200	-	cd/m²	I_L=18 ma
Response Time		Tr		-	4	8	ms	
		Tf		-	12	24	ms	
Contrast Ratio		CR		400	500		-	
Color Chromaticity	White	W_X		0.249	0.299	0.349		
		W_Y		0.278	0.328	0.378		
	Red	R_X		0.542	0.592	0.642		
		R_Y		0.305	0.355	0.405		
	Green	G_X		0.277	0.327	0.377		
		G_Y		0.505	0.555	0.605		
	Blue	B_X		0.104	0.154	0.204		
		B_Y		0.044	0.094	0.144		
Viewing Angle	Hor.	θR	CR≥10	40	45		Deg	
		θL		40	45			
	Ver.	ΦT		10	15			
		ΦD		30	35			

Note:

- Parameters in above table are for LCD only.
- Measured in a dark room at 25℃ ambient temperatur e after a 15 minute warm-up time.

5 RELIABILITY AND TESTING

5.1 RELIABILITY TEST SPECIFICATIONS

Table 19 – Reliability Test Specifications

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

5.2 PACKAGING SPECIFICATIONS

Table 20 – 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.

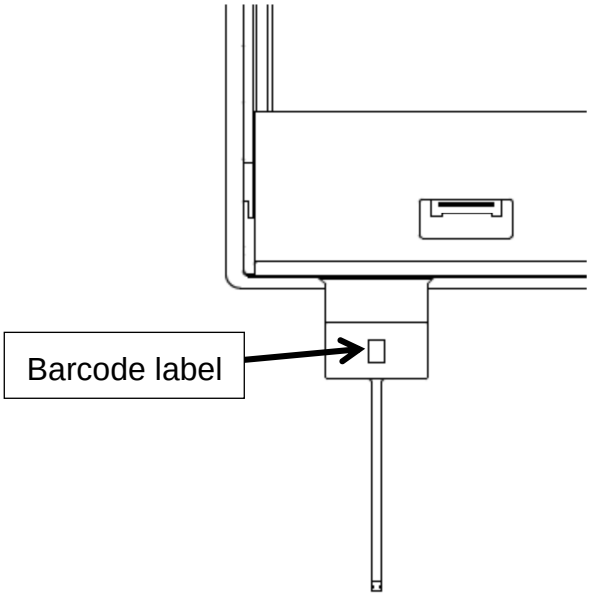


Figure 9 – Barcode Label Area (Rear View of Module Shown)

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.

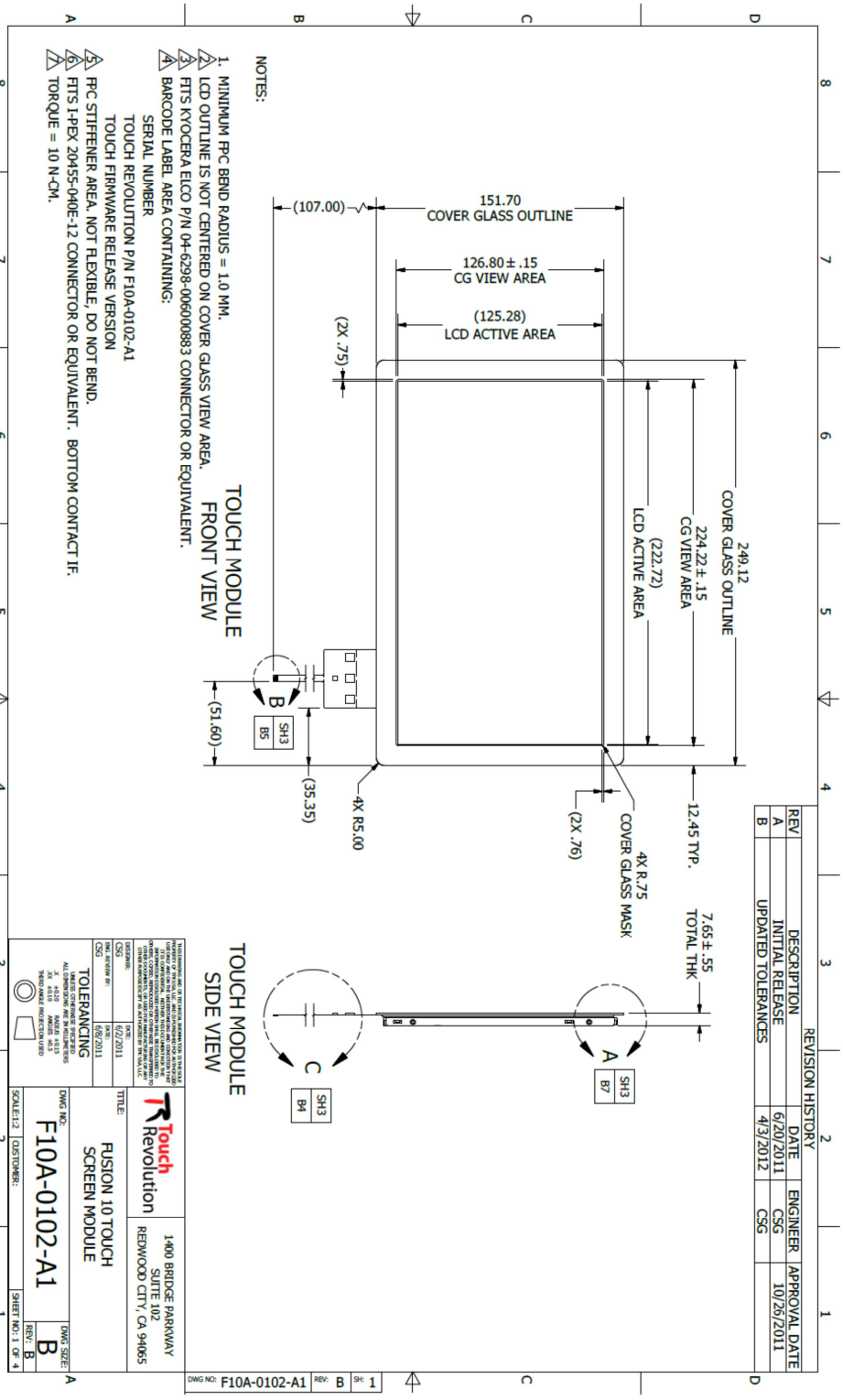
7.8 STATIC IMAGES

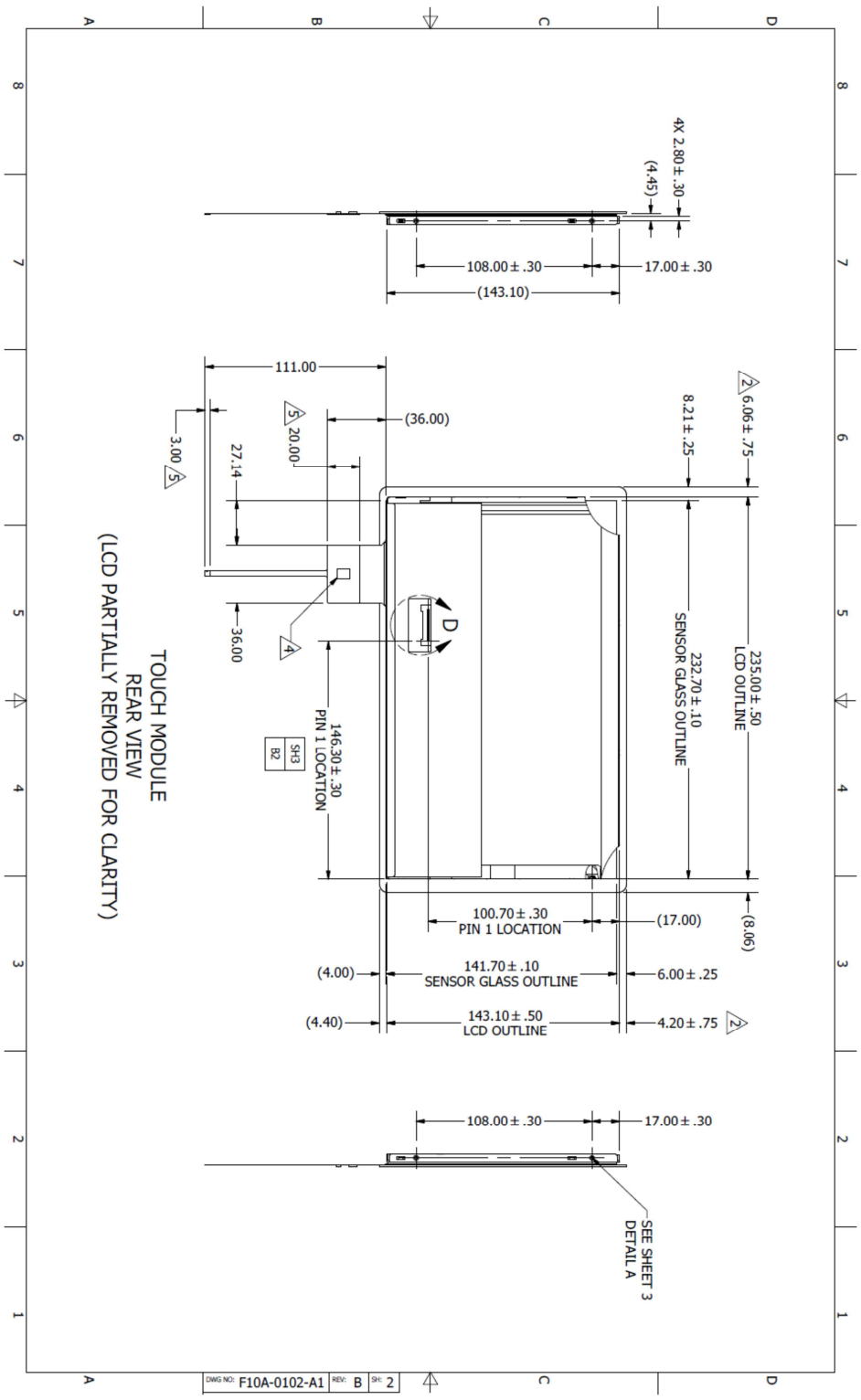
If fixed images are displayed for a long period of time, an afterimage is likely to occur.

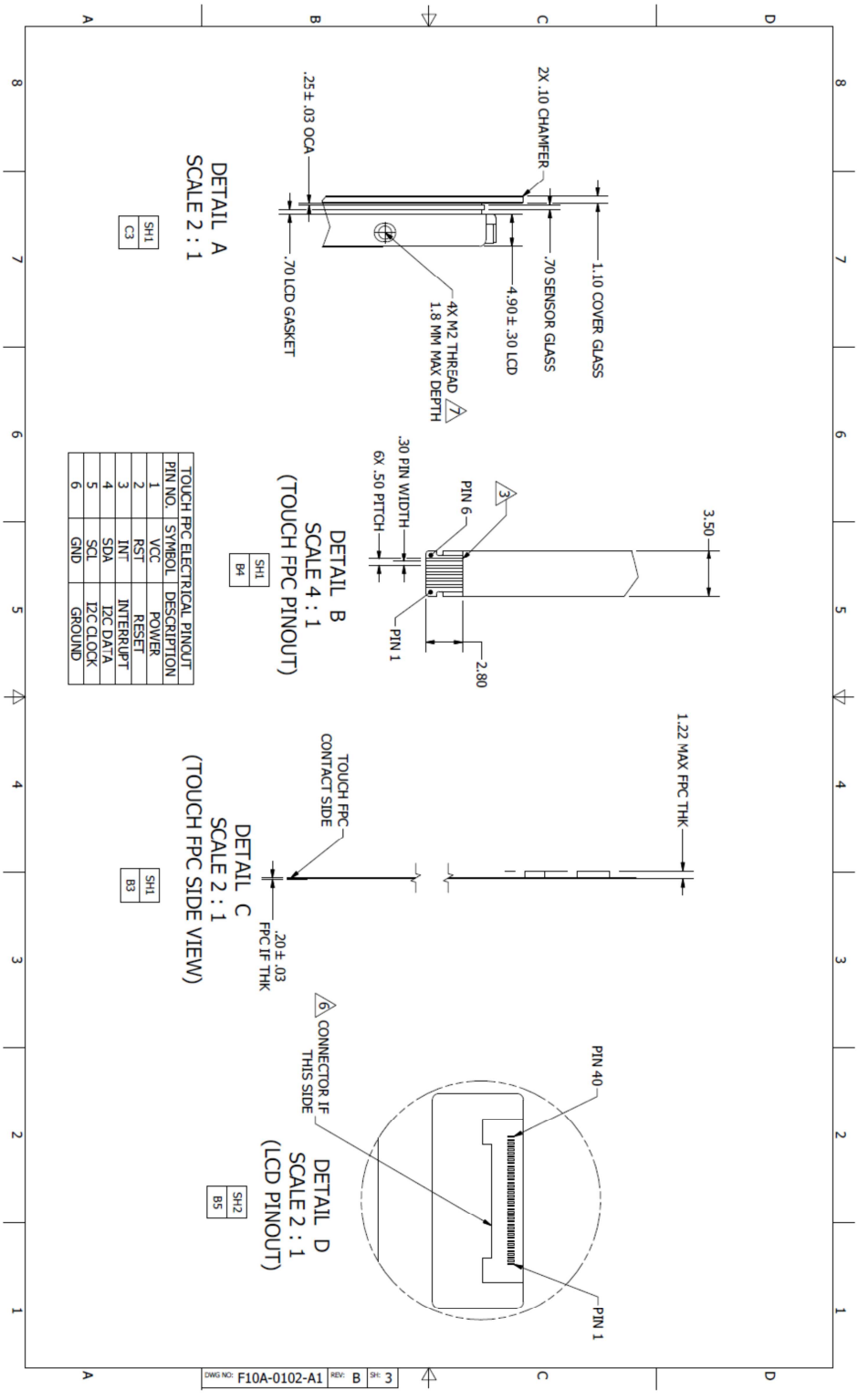
7.9 OUTGASSING

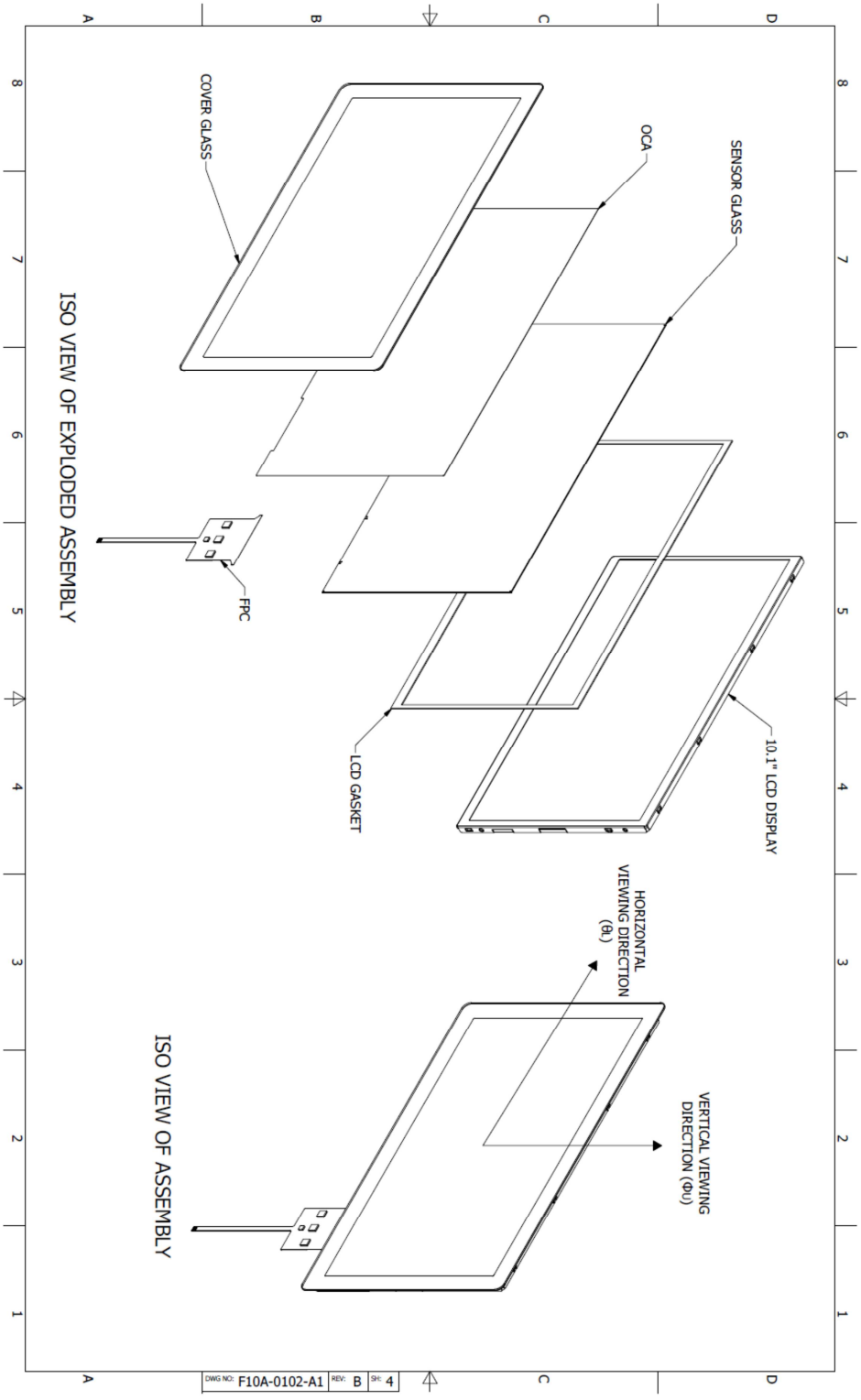
Do not store or use the touch module in an environment where caustic materials such as reagents, solvents, adhesives, and resins are present. Outgassing of these materials can damage the polarizer and ACF connections.

8 MECHANICAL DRAWINGS




TOUCH MODULE
REAR VIEW
(LCD PARTIALLY REMOVED FOR CLARITY)
4X 2.80 ± .30
(4.45)
108.00 ± .30
17.00 ± .30
(143.10)
111.00
(36.00)
20.00
3.00
27.14
36.00
6.06 ± .75
8.21 ± .25
146.30 ± .30
PIN 1 LOCATION
SH3
B2
SENSOR GLASS OUTLINE
232.70 ± .10
LCD OUTLINE
235.00 ± .50
100.70 ± .30
PIN 1 LOCATION
(17.00)
(8.06)
(4.00)
141.70 ± .10
SENSOR GLASS OUTLINE
6.00 ± .25
(4.40)
143.10 ± .50
LCD OUTLINE
4.20 ± .75
108.00 ± .30
17.00 ± .30
SEE SHEET 3
DETAIL A
DWG NO: F10A-0102-A1
REV: B
SH: 2


2X .10 CHAMFER
.25 ± .03 OCA
1.10 COVER GLASS
.70 SENSOR GLASS
4.90 ± .30 LCD
.70 LCD GASKET
4X M2 THREAD
1.8 MM MAX DEPTH
DETAIL A
SCALE 2 : 1
SH1
C3
.30 PIN WIDTH
6X .50 PITCH
PIN 6
PIN 1
3.50
2.80
DETAIL B
SCALE 4 : 1
(TOUCH FPC PINOUT)
SH1
B4
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
1.22 MAX FPC THK
TOUCH FPC
CONTACT SIDE
.20 ± .03
FPC IF THK
DETAIL C
SCALE 2 : 1
(TOUCH FPC SIDE VIEW)
SH1
B3
CONNECTOR IF
THIS SIDE
PIN 40
PIN 1
DETAIL D
SCALE 2 : 1
(LCD PINOUT)
SH2
B5
DWG NO: F10A-0102-A1
REV: B
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 (θU)
ISO VIEW OF ASSEMBLY
DWG NO: F10A-0102-A1
REV: B
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

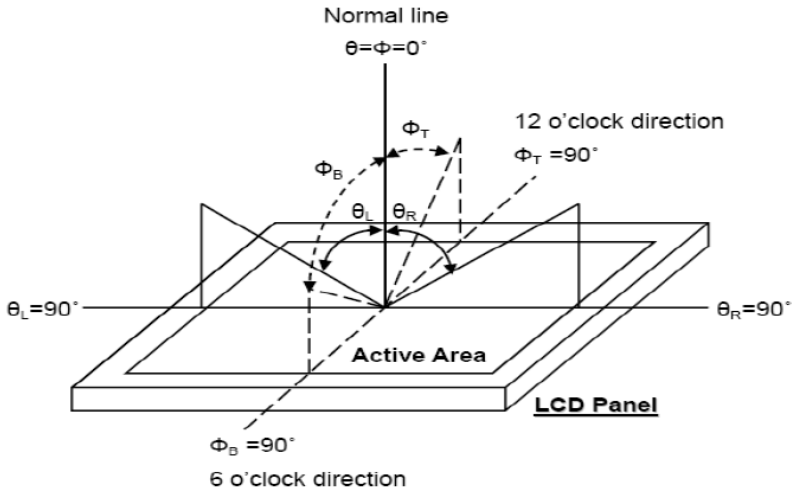
Note 4: **Minimum Touch Diameter**

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