MULTI-INNO TECHNOLOGY CO., LTD.

www.multi-inno.com

LCD MODULE SPECIFICATION

Model : MI0700J1T-5

This module uses ROHS material

For Customer's Acceptance:

Customer	
Approved	
Comment	

This specification may change without prior notice in order to improve performance or quality. Please contact Multi-Inno for updated specification and product status before design for this product or release of this order.	Revision	1.0
	Engineering	
	Date	2013-10-16
	Our Reference	

REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
1.0	2013-10-16	First Release	

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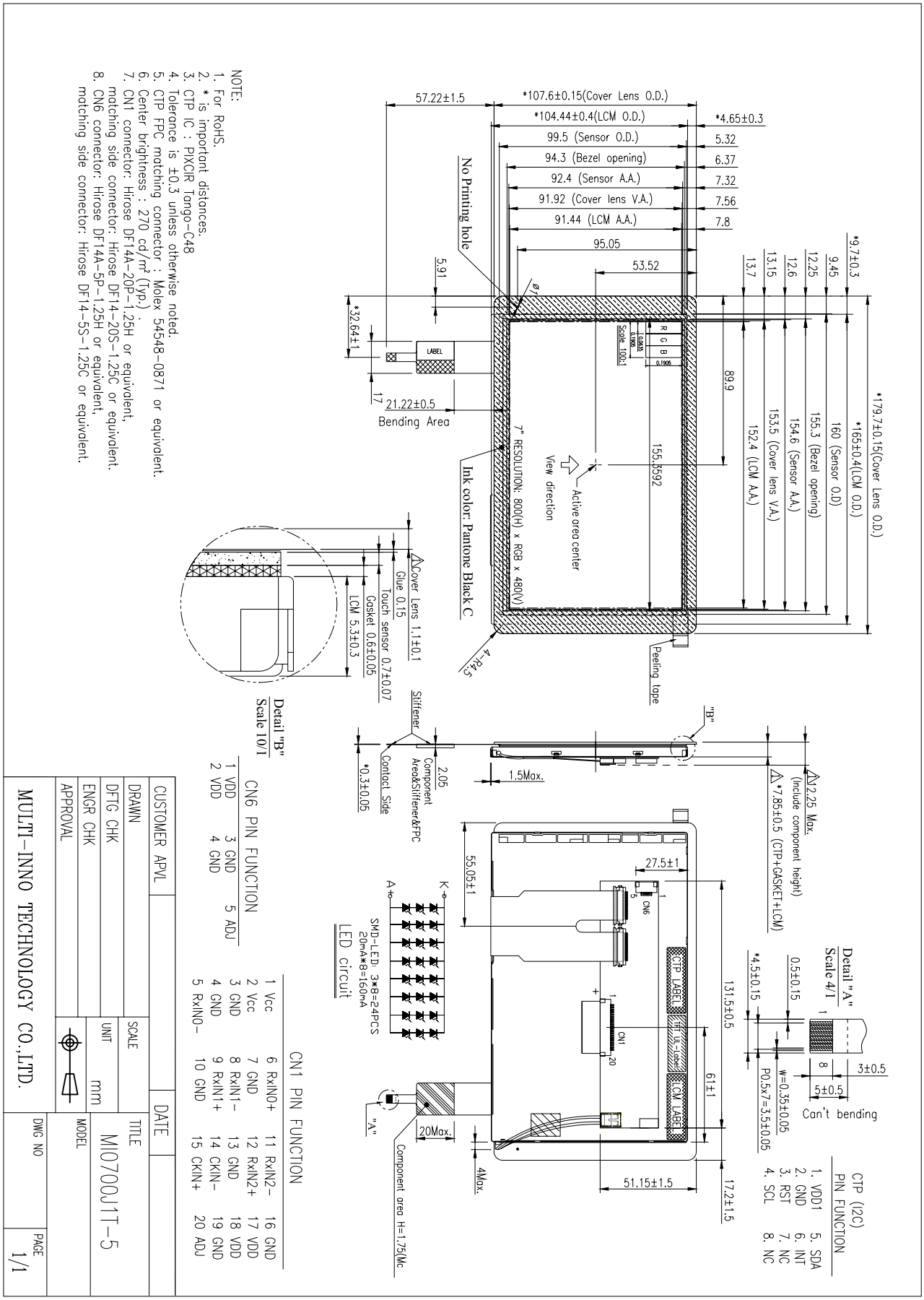
■ GENERAL INFORMATION

Item	Contents	Unit
LCD type	TFT	/
Size	7.0	Inch
Viewing direction	12:00(without image inversion and least brightness change)	O' Clock
Gray scale inversion direction	6:00 (contrast peak located at)	O' Clock
LCM (W × H × D)	179.70×107.60×12.25	mm^3
LCD active area (W×H)	152.40×91.44	mm^2
Sensor active area (W×H)	154.60×92.40	mm^2
Dot pitch (W×H)	0.0635×0.1905	mm^2
Number of dots	800 (RGB) × 480	/
CTP driver IC	C48	/
Backlight type	24 LEDs	/
Interface type	LVDS	/
Color depth	262K	/
Pixel configuration	Stripe	/
Surface treatment	Glare	/
Input voltage	3.3	V
With/Without TSP	With CTP	/
Weight	TBD	g

Note 1: RoHS compliant;
Note 2: LCM weight tolerance: ± 5% .

■ EXTERNAL DIMENSIONS



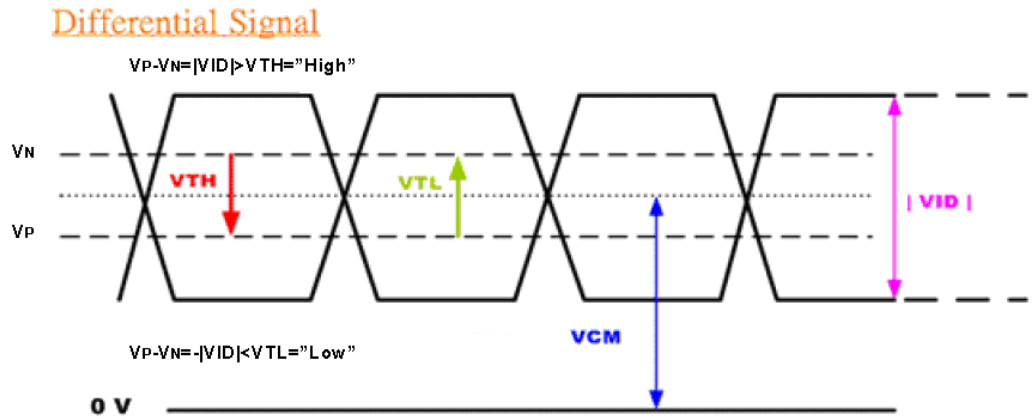
■ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Min	Max	Unit
Power supply voltage		VCC	-0.3	6.0	V
Logic input voltage		VI	-0.3	VCC+0.3	V
Operating temperature		TOP	-20	70	°C
Storage temperature		TST	-30	80	°C
Humidity	Operation	20%~90% relative humidity (Typ 38°C)			RH
	Non operation	5%~90% relative humidity (Typ 38°C)			

■ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit
Power supply voltage for LCD	VCC	3.0	3.3	3.6	V
Power supply current for LCD	ICC	-	150	200	mA
Power supply voltage for LED	VDD	3.0	3.3	5.5	V
Power supply current for LED	IDD	-	650	850	mA
		-	400	550	
Differential input high threshold	VTH	-	-	100	mV
Differential input low threshold	VTL	-100	-	-	mV
Ripple voltage	VRF	-	-	100	mVp-p
ADJ frequency		19K	20K	21K	Hz
ADJ input voltage	VIH	3.0	-	3.3	V
	VIL	0	-	0.3	
LED dice life time		-	20,000	-	Hr

Note 1: LVDS Signal Waveform.



Note 2: The "LED dice life time" is defined as the brightness decrease to 50% original brightness that the ambient temperature is 18℃~28℃ and LED dice current=20mA.

■ELECTRO-OPTICAL CHARACTERISTICS

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time		Tr+Tf	θ=0° ∅=0° Ta=25℃	-	16	26	ms	FIG 1.	4
Contrast ratio		Cr		250	400	-	---	FIG 2.	1
Luminance uniformity		δ WHITE		70	80	-	%	FIG 2.	3
Surface Luminance		Lv		210	270	-	cd/m^2	FIG 2.	2
Viewing angle range		θ	∅ = 90°	55	60	-	deg	FIG 3.	6
			∅ = 270°	55	60	-	deg	FIG 3.	
			∅ = 0°	65	70	-	deg	FIG 3.	
			∅ = 180°	65	70	-	deg	FIG 3.	
CIE (x, y) chromaticity	Red	x	θ=0° ∅=0° Ta=25℃	0.52	0.57	0.62		FIG 2.	5
		y		0.31	0.36	0.41			
	Green	x		0.30	0.35	0.40			
		y		0.53	0.58	0.63			
	Blue	x		0.10	0.15	0.20			
		y		0.09	0.14	0.19			
	White	x		0.26	0.31	0.36			
		y		0.28	0.33	0.38			
Image sticking	-	tis	2 hours	-	-	2	Sec	-	8

Note 1. Contrast Ratio(CR) is defined mathematically as For more information see FIG 2.

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P 3,P4, P5)}}$$

Note 2. Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see FIG 2.

Lv = Average Surface Luminance with all white pixels (P1, P2, P 3, P4, P5)

Note 3. The uniformity in surface luminance ， δ WHITE is determined by measuring luminance at each test position 1 through 5, and then dividing the maximum luminance of 5 points luminance by minimum luminance of 5 points luminance. For more information see FIG 2.

$$\delta \text{ WHITE} = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P 3, P4, P5)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P 3, P4, P5)}}$$

Note 4. Response time is the time required for the display to transition from White to black(Rise Time, Tr) and from black to white(Decay Time, Tf). For additional information see FIG 1. The test equipment is Autronic-Melchers's ConoScope. Series.

Note 5. CIE (x, y) chromaticity， The x, y value is determined by measuring luminance at each test position 1 through 5,and then make average value.

Note 6. Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module the conrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 3.

Note 7. For viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope. Series Instruments For contrast ratio, Surface Luminance, Luminance uniformity, CIE The test data is base on TOPCON's BM-5 photo detector.

Note 8.Definition of reflectance measurement system

Note 5) Reflectance is defined as follows:

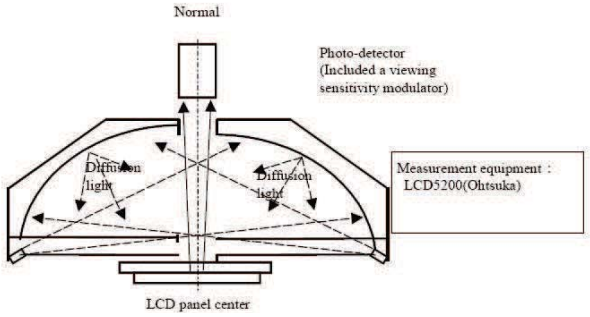


FIG. 1 The definition of Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".

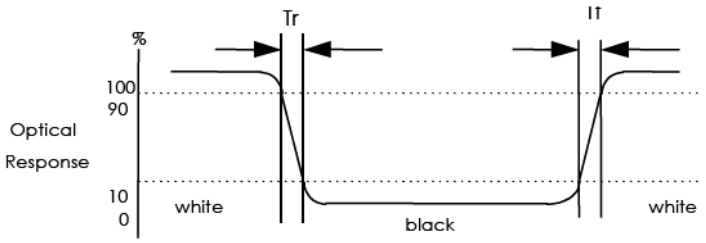
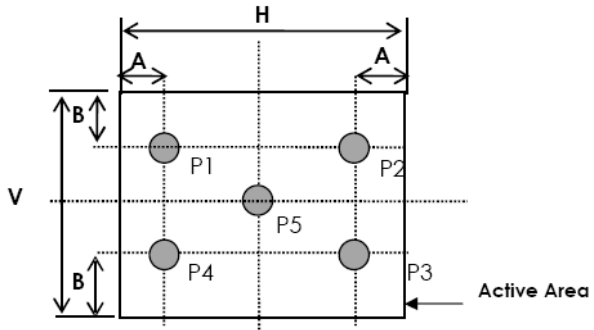
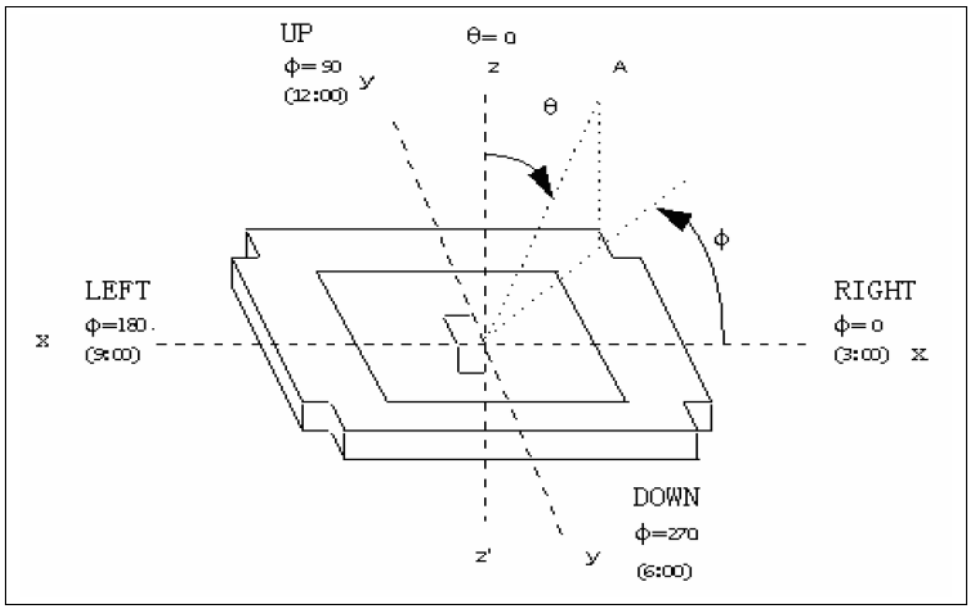


FIG. 2 Measuring method for Contrast ratio, surface luminance, Luminance uniformity , CIE (x, y) chromaticity



A : 5 mm
B : 5 mm
H,V : Active Area
Light spot size ∅=7mm, 500mm distance from the LCD surface to detector lens
measurement instrument is TOPCON's luminance meter BM-5

FIG. 3 The definition of viewing angle



■INTERFACE DESCRIPTION

Pin No	Symbol	Function	Remark
1	VCC	power supply for Digital Circuit	
2	VCC	power supply for Digital Circuit	
3	GND	Ground	
4	GND	Ground	
5	RxIN0-	Differential Data Input ,CH0(Negative)	
6	RxIN0+	Differential Data Input ,CH0(Positive)	
7	GND	Ground	
8	RxIN1-	Differential Data Input ,CH1(Negative)	
9	RxIN1+	Differential Data Input ,CH1(Positive)	
10	GND	Ground	
11	RxIN2-	Differential Data Input ,CH2(Negative)	
12	RxIN2+	Differential Data Input ,CH2(Positive)	
13	GND	Ground	
14	CKIN-	Differential Clock Input (Negative)	
15	CKIN+	Differential Clock Input (Positive)	
16	GND	Ground	
17	VDD	Power Supply for LED Driver Circuit	
18	VDD	Power Supply for LED Driver Circuit	
19	GND	Ground	
20	ADJ	Brightness control for LED B/L	

Remarks：

1) ADJ is brightness control Pin. The larger of the pulse duty is, the higher of the brightness.
2) ADJ signal is 0~3.3V.Operation frequency is 20KHz
3) GND PIN must be grounding, can not be floating.

Remarks:

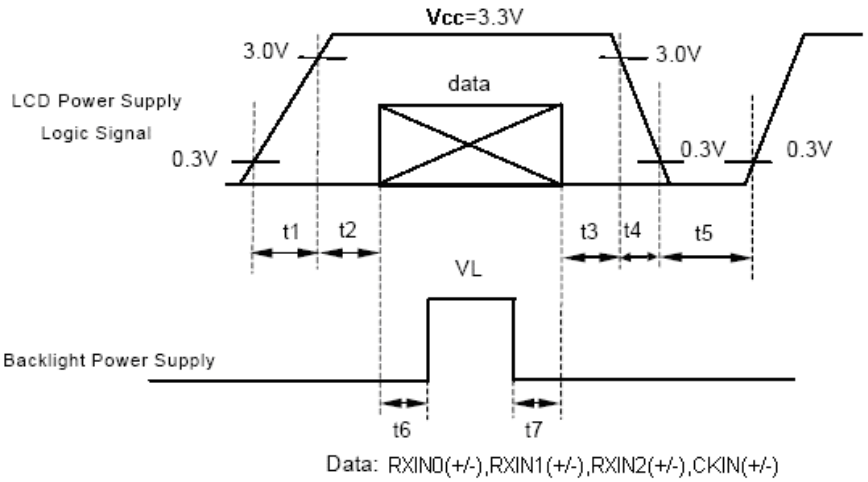
Power Signal sequence:

t1 ≤10ms ; 1 sec≤ t5

50ms≤ t2 ; 200ms ≤t6

0<t3 ≤50ms ; 200ms≤ t7

0<t4 ≤10ms

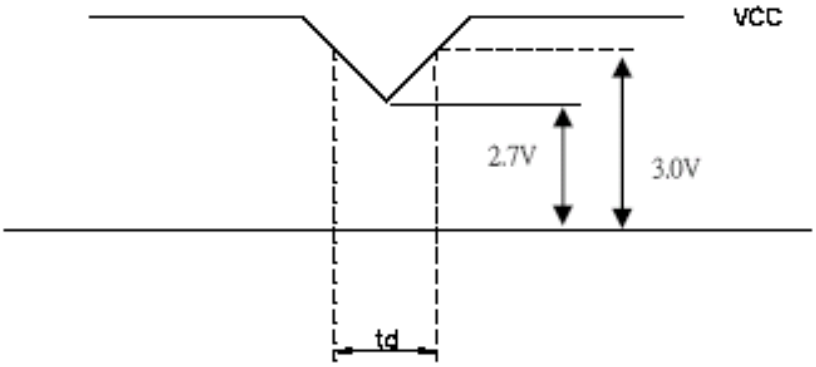


Data: RXIN0(+/-),RXIN1(+/-),RXIN2(+/-),CKIN(+/-)

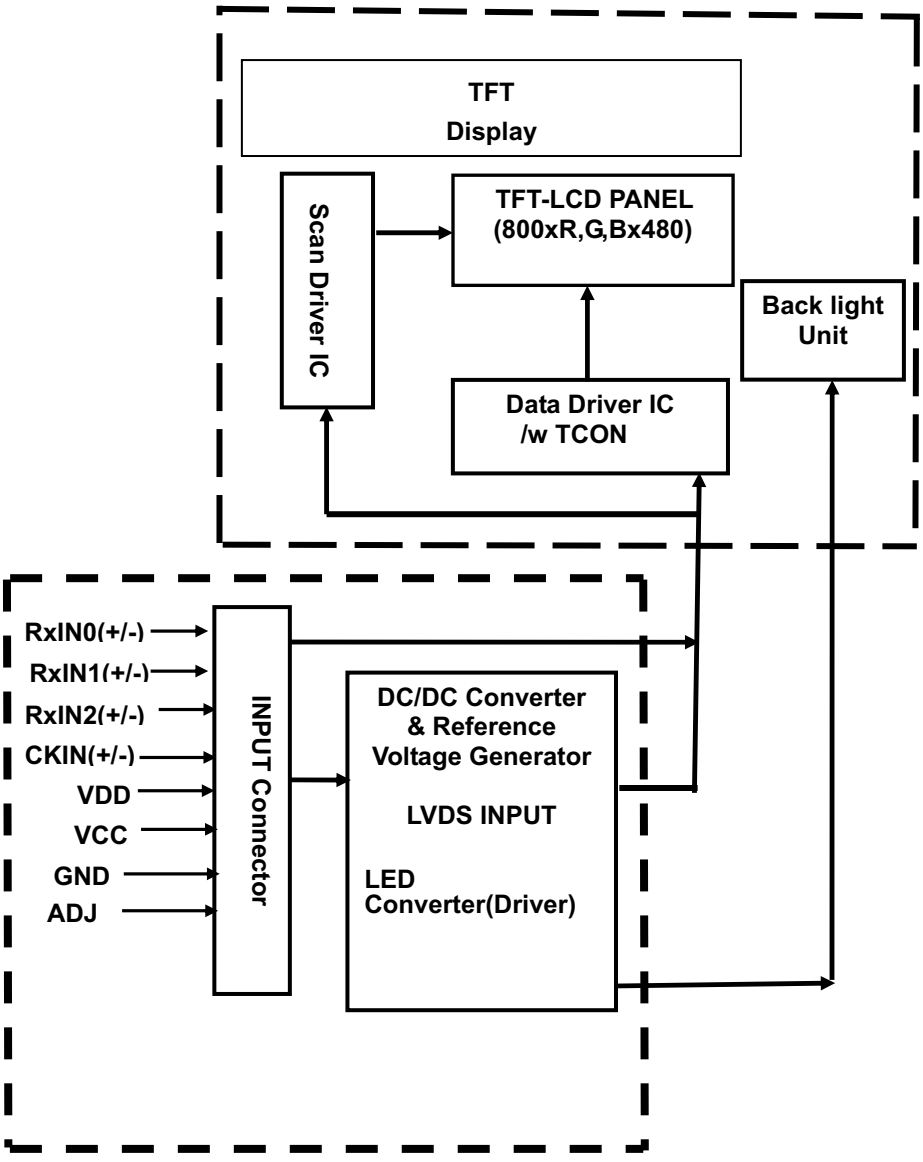
VCC-dip condition:

(1) 2.7 V ≤VCC <3.0V,td ≤ 10 ms

(2) VCC>3.0V,VCC-dip condition should be the same with VCC-turn-on condition。



■BLOCK DIAGRAM



■ APPLICATION NOTES

1. AC Characteristic

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Data setup time	T_{dsu}	6	-	-	ns
Data hold time	T_{dhd}	6	-	-	ns
DE setup time	T_{esu}	6	-	-	ns

2. Resolution：800x480

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
DCLK frequency	F_{CPH}	25	33.26	40	MHz
DCLK period	T_{CPH}	-	30.06	-	ns
DCLK pulse duty	T_{CWH}	40	50	60	%
DE period	$T_{DEH}+T_{DEL}$	1000	1056	1200	T_{CPH}
DE pulse width	T_{DEH}	-	800	-	T_{CPH}
DE frame blanking	T_{DEB}	10	45	110	$T_{DEH}+T_{DEL}$
DE frame width	T_{DE}	-	480	-	$T_{DEH}+T_{DEL}$

3. Timing Controller Timing Chart

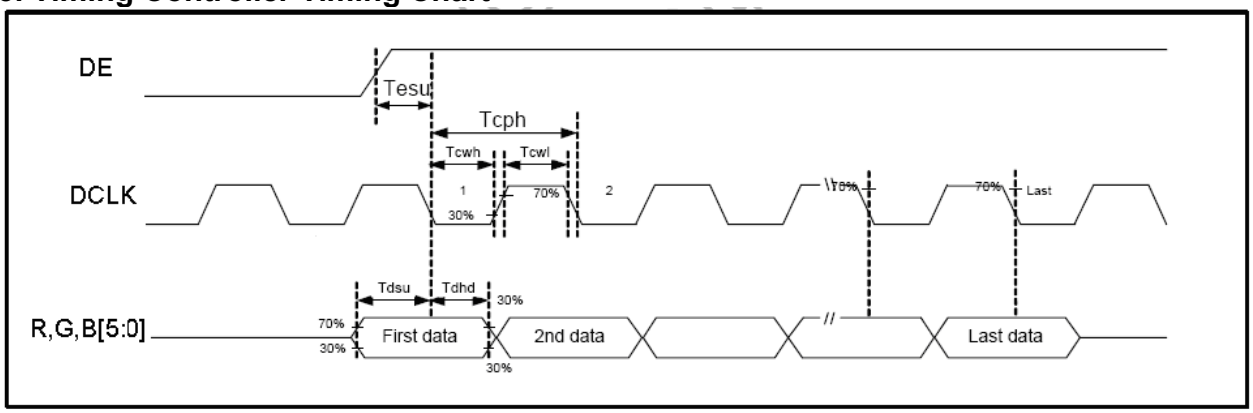
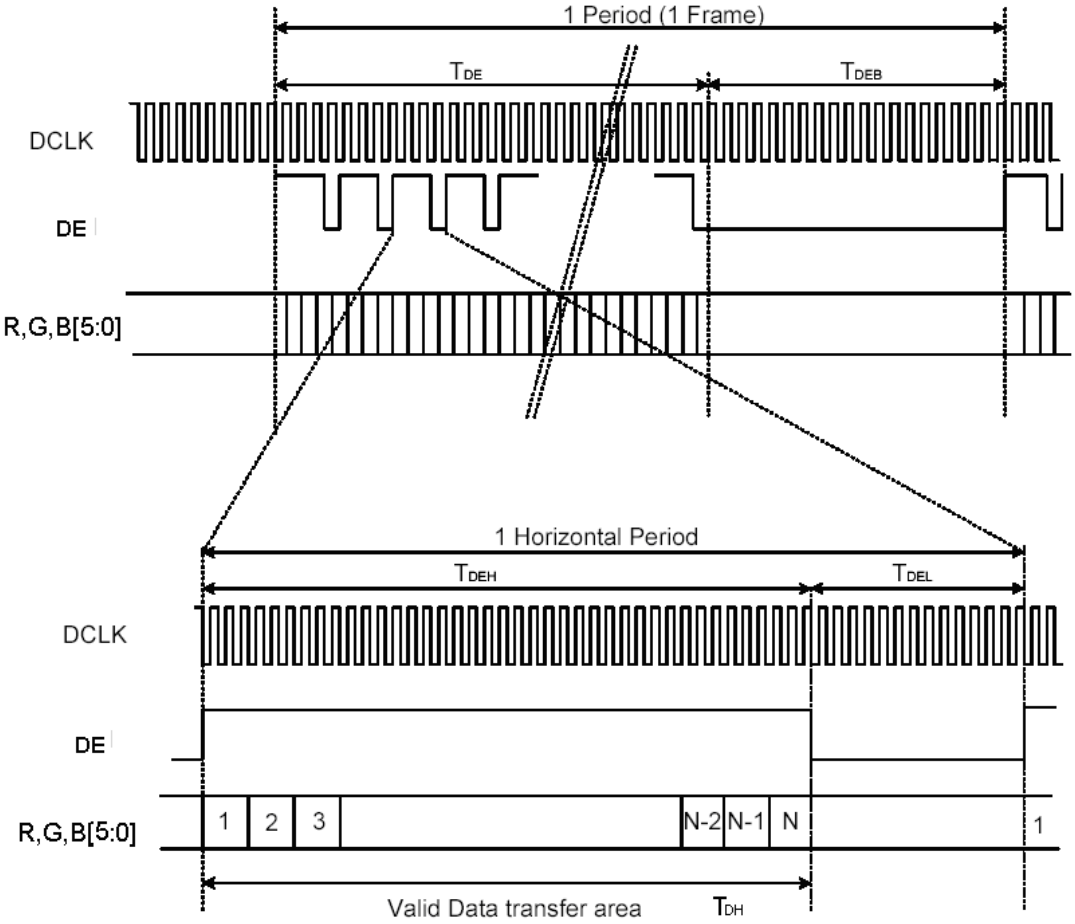
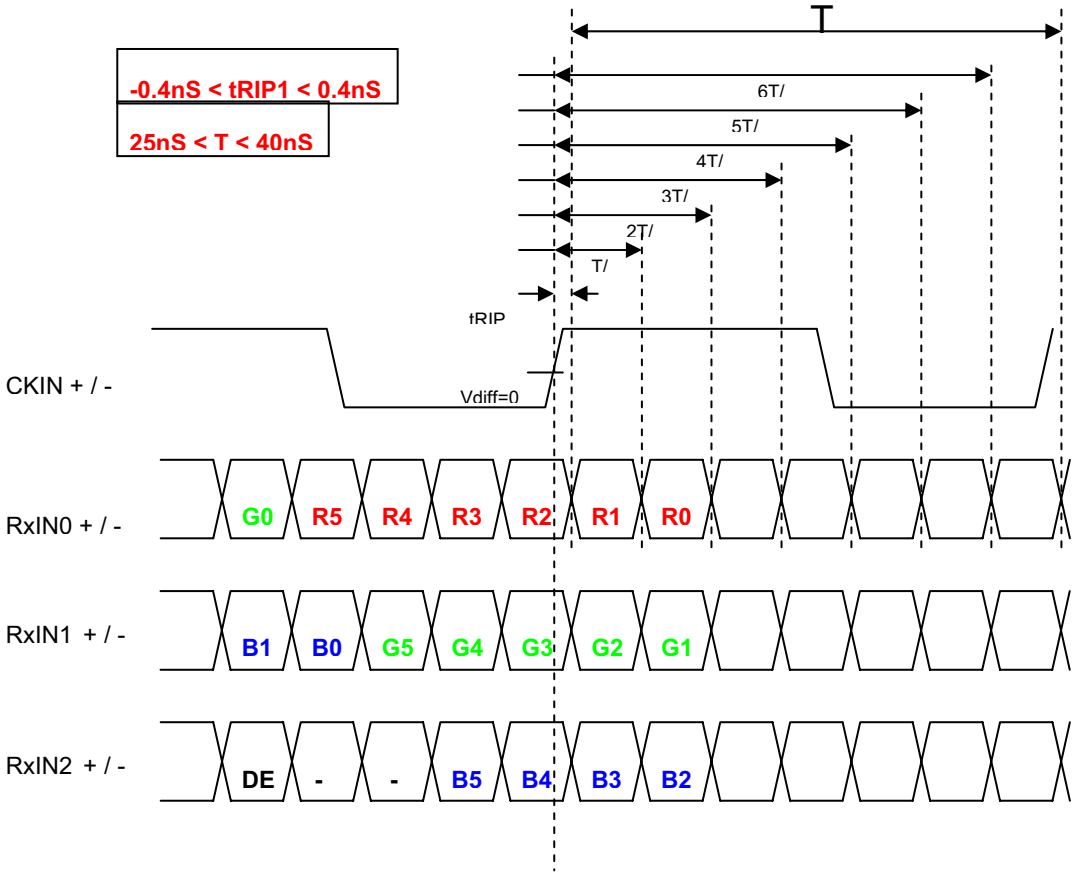


Figure 1 Clock and Data input waveforms.



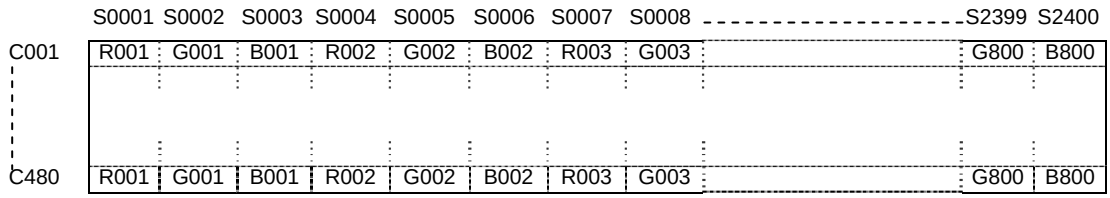
4. LVDS Timing Chart



5. Color Data Input Assignment

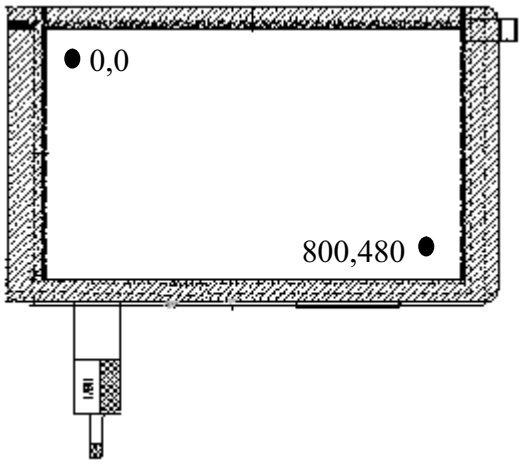
		Data Signal																	
		Red						Green						Blue					
Color		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	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
Gray Scale of Red	Red(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	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(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	Green(0)/ Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	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(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Gray Scale of Blue	Blue(0)/ Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	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 (61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue (62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue (63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Correspondence between Data and Display Position



■ CTP SPECIFICATIONS

1. GENERAL SPECIFICATIONS

Item	Specification	Unit
Type	Transparent type projected capacitive touch panel	
Input mode	Human's finger	
Multi touch	5	Point
(X,Y) Position		

2. ABSOLUTE MAXIMUM RATINGS

Symbol	Description	Min	Typ	Max	Unit
VDD1	Supply voltage	-0.3	-	3.6	V
V_I	Logic input voltage	-0.3	-	VDD1+0.3	V

3. ELECTRICAL CHARACTERISTICS

Symbol	Description	Min	Typ	Max	Unit
VDD1	Supply voltage	2.5	3.3	3.6	V
GND	Supply voltage	-	0	-	V
V_{IH}	Input H voltage	0.8VDD1	-	VDD1	V
V_{IL}	Input L voltage	0	-	0.2VDD1	V

4. POWER CONSUMPTION

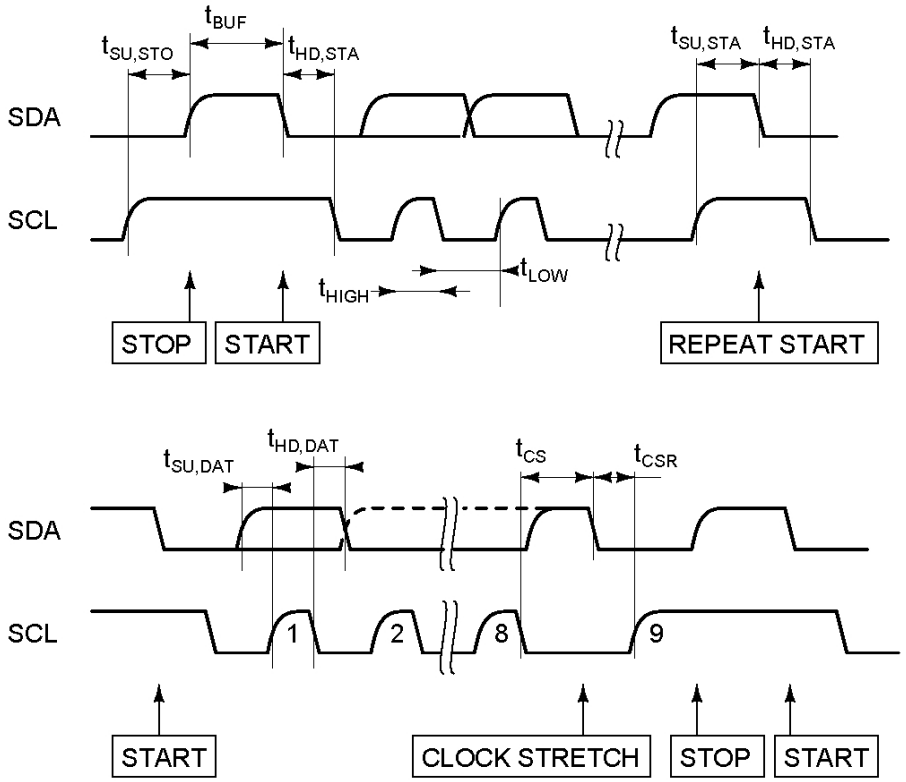
Symbol	Description	Fingers	F_{scan}(Hz)	Min	Typ	Max	Unit
IVDD1	Active mode	1	280		-	4	mA
		2	160		-	5	mA
		3	90		-	5.2	mA
		4	80		-	5.4	mA
		5	75		-	5.6	mA
I_{sleep}	Sleep mode	0	10		-	0.11	mA
	Deep sleep mode	-			-	50	uA
I_{freeze}	Freeze mode	-			-	2	uA
	Boot load	-			-	6.2	mA
	Calibration	-			-	6.2	mA

5. I²C Protocol Specifications

1. Supports 100 KHz clock frequency and up to 400 kHz (Fast Mode).
2. Only support single master solution.
3. Only support 7 bit addressing.
4. If I²C master can't finish 1byte data in 100ms, I²C slave will restart. The CTP controller operates only as a slave device. The I²C interface is functional in active and sleep modes. In sleep mode, asynchronous address match detector hardware allows a sleeping controller to recognize its address and wake up. And the firmware can implements different I²C touch protocols. The timings for example that as table 10.1 and figure 10.1.
5. I²C slave can hold off the master in the middle of a transaction using what's called clock stretching (the slave keeps SCL pulled low until it's ready to continue). Refer to figure 10.2 for an example.
6. Slave device address = 0x5C.

Table 5.1: I²C timing

Symbol	Parameter	Min	Typ	Max	Unit
TLOW	I²C clock low time	2 • TCPU			
THIGH	I²C clock high time	2 • TCPU			
THD,STA	I²C clock hold time	2 • TCPU			
TSU,STA	I²C start setup time				
TSU,STO	I²C stop setup time				
THD,DAT	I²C data hold time, when driven by master side				
TSU,DAT	I²C data setup time, when driven by master side				
TBUF	I²C bus free time	4.7			us
TCSR	I²C clock stretching release time	9 • TCPU			
TVD,DAT	I²C data valid after clock change, when data is driven by slave side	9 • TCPU			
TTCPU	CPU master clock period			55	ns



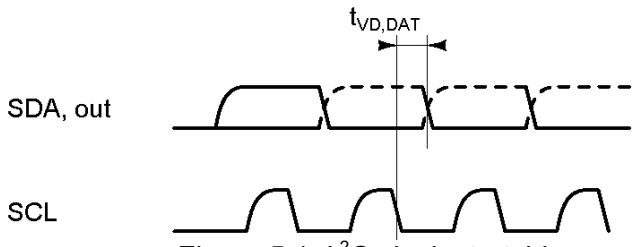


Figure 5.1: I²C clock stretching example

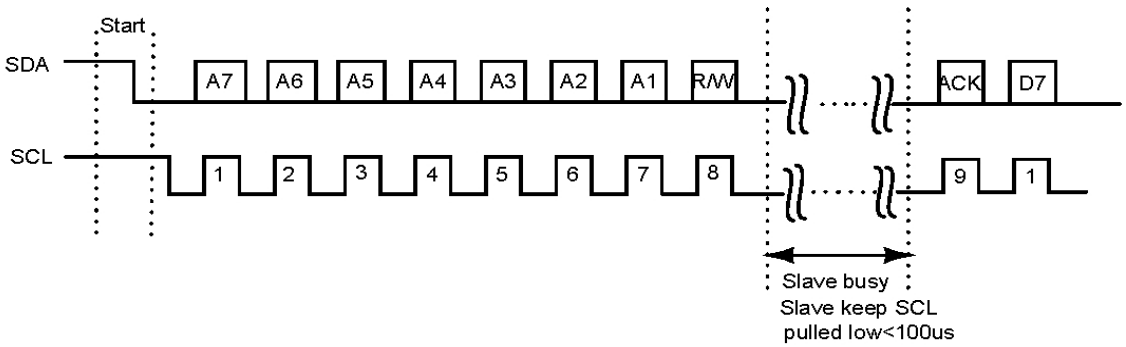


Figure 5.2: I²C clock stretching example

6. Data Protocol

The communication follows I²C convention. Refer to figure 10.3 for a definition of the symbols used.

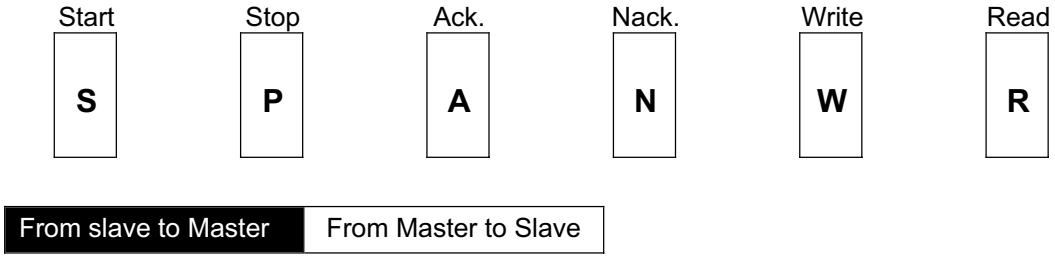


Figure 10.3: I²C symbols

6. Introduction

The protocol for data exchange has been designed with the following considerations

- Most of the data traffic is read operation to get the finger or fingers position.
- Read operation do need an initial write operation.
- Write operations are most of the time power management and interrupt setting instructions.
- Interrupt pulse width setting adjustments need a write operation.

7. Read operation

Read packets have variable content length, decided by the host. It is available to do a single read operation or a sequential read operation. Therefore, the beginning register address is needed to set before a read operation. And the data sent exactly follow the register table 10.2, table 10.5. And, the firmware in the slave will use a memory copy of the register for I²C slave read operation, so that firmware can continue updates, and I²C slave is still using a consistent (but old) coordinates for read operation.

- In a sequential read operation, the first data sent by the controller is therefore the touching register, and then the X and Y coordinates of the first finger, then 2nd finger, 3rd finger, 4th finger and then coordinates of the 5th finger, and so on. Referred in figure 10.5.
- If the host do not finish the read operation when the INT line is set again, the slave firmware will delay to update coordinates registers for I²C read operation until the host finish the read operation. referred to first part of figure 10.6.
- I²C stop condition will release data protection and allow the slave firmware update the coordinates registers for I²C read operation. So, the host has the chance to get incorrect data when it get the coordinates data with single read operation. Because the host send many times of I²C stop condition in each multi-fingers coordinates position reading, it will give the slave firmware chance to update the coordinates registers for I²C read operation, the host will give a combines unrelated data (combines new and old coordinates together), referred to the second part of figure 10.6.

Figure 7.4: Read operation

Figure 7.5: Coordinates read operation

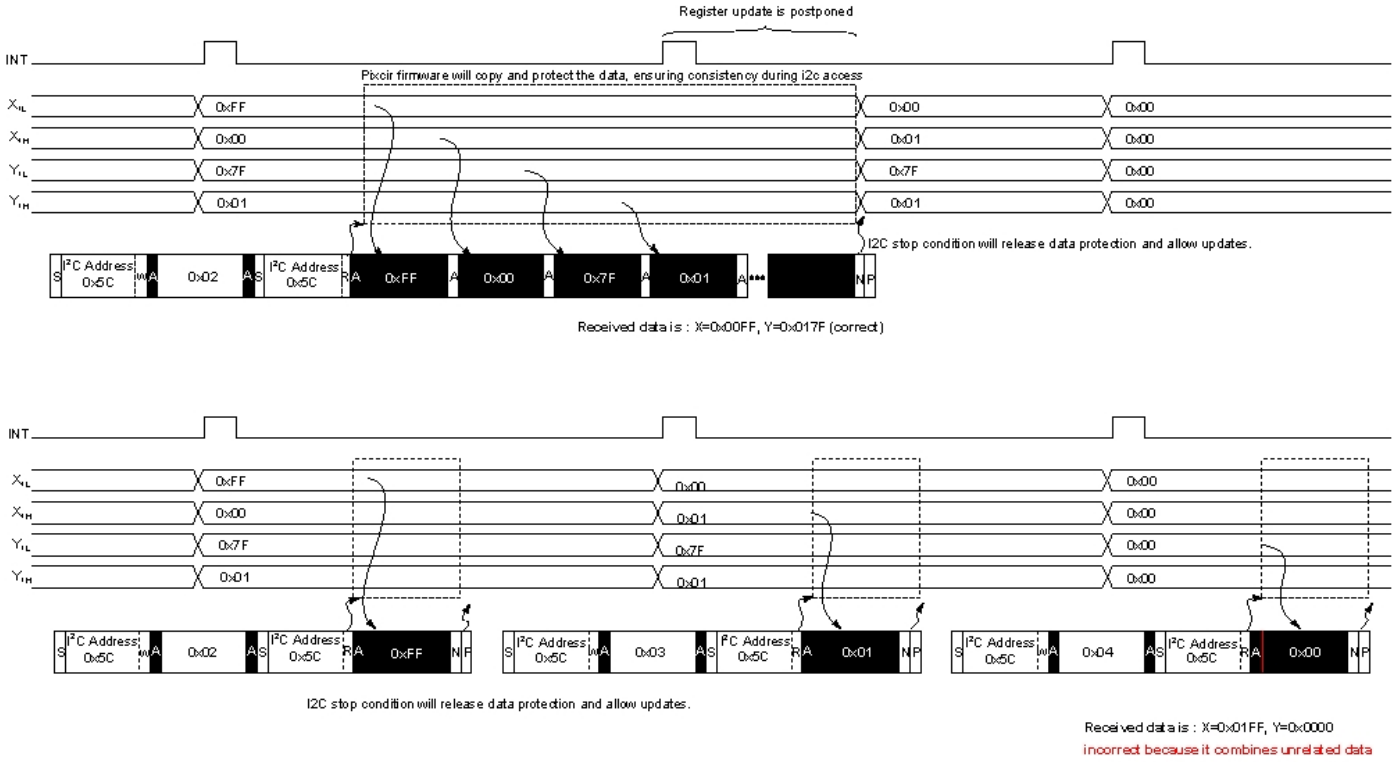


Figure 7.6: Coordinates read operation explanation

7.1 Write operation

Write packets have variable content length, decided by the host. Write operation stops when host issues an I²C STOP symbol. The write packet is illustrated in figure 10.7 and figure 10.8. Following the I²C device address, the first byte of the write packet is always the destination register address, referred in table 10.2, table 10.5. Subsequent data value are written at the register pointed by the address, immediately upon reception of the byte. The address counter is automatically incremented. Subsequent data bytes are treated in continuation of the writing operation.

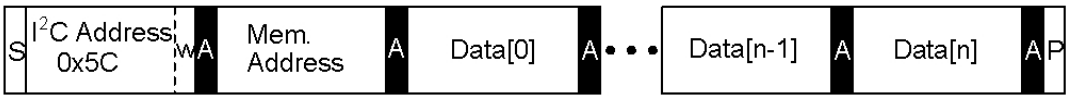


Figure 10.7: Write operation.

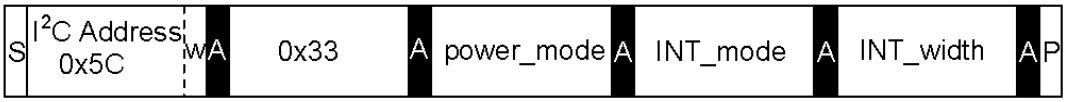


Figure 10.8: Write mode setting operation.

7.2 Registers

7.2.1 Endianness

Data are little endian, which means LSB byte appears before MSB byte.

7.2.2 Registers organization

The accessible registers are shown in the table 10.2, table 10.5. These registers are technically accessible both for reading or writing direction. However, most registers have only one meaningful direction: finger position registers, for example, are typically used in read direction, and writing to them will have no effect; their content will be overridden after a new sensor scan.

Table 7.2: registers table

Address	Type	Name	Description	Category
0	Char	Touching	Bit field, see table 11.3	Touch
1	Char	Buttons	Reserved	
2 (LSB) 3 (MSB)	Int	PosX1	Finger #1 X position	
4 (LSB) 5 (MSB)	Int	PosY1	Finger #1 Y position	
6	Char	ID1	Finger #1 identificator	
7 (LSB) 8 (MSB)	Int	PosX2	Finger #2 X position	
9 (LSB) 10 (MSB)	Int	PosY2	Finger #2 Y position	
11	Char	ID2	Finger #2 identificator	
12 (LSB) 13 (MSB)	Int	PosX3	Finger #3 X position	
14 (LSB) 15 (MSB)	Int	PosY3	Finger #3 Y position	
16	Char	ID3	Finger #3 identificator	
17 (LSB) 18 (MSB)	Int	PosX4	Finger #4 X position	
19 (LSB) 20 (MSB)	Int	PosY4	Finger #4 Y position	
21	Char	ID4	Finger #4 identificator	
22 (LSB) 23 (MSB)	Int	PosX5	Finger #5 X position	
24 (LSB) 25 (MSB)	Int	PosY5	Finger #5 Y position	
26	Char	ID5	Finger #5 identificator	
27	Char	Strength1	Finger #1 strength	
28	Char	Strength2	Finger #2 strength	
29	Char	Strength3	Finger #3 strength	
30	Char	Strength4	Finger #4 strength	
31	Char	Strength5	Finger #5 strength	
32 (LSB) 33 (MSB)	int	Initial_ distance	Distance separating fingers on the first time multi touch is detected	Gesture
34 (LSB) 35 (MSB)	int	Distance	Distance separating fingers	
36 (LSB) 37 (MSB)	int	Ratio	100*distance / initial_ distance	
38	Char	Water_ level		Monitor
39	Char	Noise_ level		
40	Char	Palm_ level		
41	Char	Signal_ x		
42	Char	Signal_ y		
43 50	Char	Button1button8	Reserved	Buttons
51	Char	Power_ mode	Power management register. See subsection §11.7.4 and table 11.6	power management
52	Char	INT_ mode	Control of the INT pin, see table 11.7	
53	Char	INT_ width	INT pulse width	
54	Char	Sleep_ freq	Scanning frequency in Sleep mode	
55	Char	Auto_ sleep_ delay	The delay time, the start is the last touch released in Active mode and the end is switch into Sleep mode	

			successful	
56-57	Char		Reserved	Special operations
58	Char	SPECOP	Reserved	
59 (LSB) 60 (MSB)	Int	EEPROM_ read_ addr	Reserved	
61	Char	Engineering_ cmd	Allows, with I^2C, to send "hyper terminal like commands" for engineering modes	
62 (LSB) 63 (MSB)	Int	CRC	Reserved	version
64-95	Char	Version[0..31]	Customer version control (32bytes)	
96-135	Char	Message[0..39]	Null terminated ASCII message string for engineering and debug purpose	
136 (LSB) 137 (MSB)	Int	RAW_CTRL	Controls RAW data mode (internal, raw, etc. . .) see table 11.3	
138	Char	Cross_ X	X coordinate for method 1 crossing node measurement request	Method 1
139	Char	Cross_ Y	Y coordinate for method 1 crossing node measurement request	
140 (LSB) 141 (MSB)	Int	Cross_ node	Measurement result for method 1	
142 (LSB) 143 (MSB)	Int	RAW[0..69] Shared with History_ buffer	Raw data, content controlled by RAW_CTRL register, or alternatively, history buffer (see Below)	RAW data
144 (LSB) 145 (MSB)	Int			
Etc.	Int			

Table 7.3: touching register (R0)

Bit 0,1,2	Nb of fingers touching (NBF)
Bit 3	Noise flag (indicates the report is unreliable) (NOI)
Bit 4	Message flag (indicates a message string is sent by slave) (MSG)
Bit 5	Buffer indicates the master has missed more than 2 reports, which are stored in buffer array (BUF)
Bit 6	Palm flag (indicates the algorithm has a palm or similar blocking issue) (PAL)
Bit 7	Water flag, indicates the algorithm has a rejected inputs due to water (WAT)

7.3 RAW_CTRL write & read

It is advised to use INT mode=0x08 when debug information are consulted (RAW_CTRL register not zero). Also, the slave can not instantly refresh the RAW tables following a modification by the master to the RAW_CTRL register, since in some conditions a relatively lengthy collection of measurements has to be performed. The master however can have the guaranty that the data reported in the RAW table reflects the request placed in RAW_CTRL if 2 INT pulses have elapsed. If the request in RAW_CTRL is unchanged, to every new INT pulse corresponds a refresh of the RAW table.

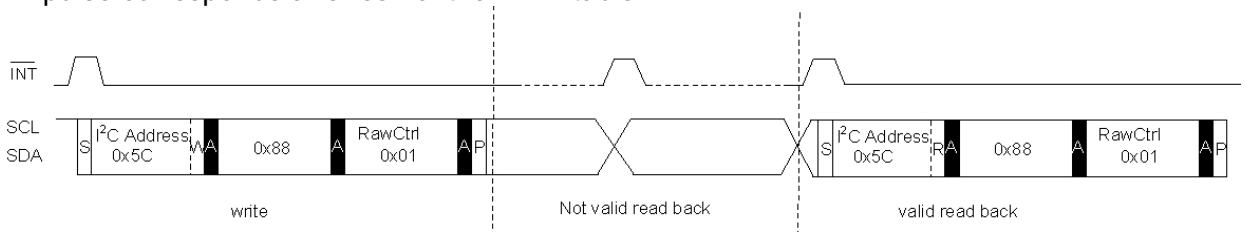


Figure 11.9: RAW_CTRL write & read

Table 7.4: RAW_CTRL (R136, 137)

Bit 0 Bit 1	Choose function (0: history buffer, 1: RAW data, 2: system info) See table 12.5
Bit 2	Method (0 or 1)
Bit 3	Show offset correction (and low-pass filtering for M0)
Bit 4	Show m0 sensitivity adjustment (bit3 must also be set)
Bit 5	M1 pattern small (0) or pattern large (1)
Bit 6	M1 sense direction (0:Y,1:X)
Bit 7	M1 band scan. if 0, only report a single cross node. If 1,report a full X axis scan at RAW position
Bit 8	Disable Algorithm
Bit 9	Enable single shot RAW refresh, must be set to 1 and bit9 to 0. Auto back to 0 and bit9 to 1 after single shot is done
Bit 10	Refresh frozen after single shot is done when 1. Set to 0 to release the freeze and go back to normal refreshing
Bit 11	
Bit 12	
Bit 13	
Bit 14	
Bit 15	

Table 7.5: History buffer registers

Address	Type	Name	Description	Category
142	Char	Interval	Sub sampling rate when filling the history buffer. Disable: 0. Keep all points. 1. Keep one out of two. 2. Etc.	History buffer
143	Char	Buffer_ level	Number of fingers report in the buffer	
144 (LSB) 145 (MSB)	Int	Pos X	Coordinate X of the reported point, at time=0	
146 (LSB) 147 (MSB)	Int	Pos Y	Coordinate Y of the reported point, at time=0	
148 (LSB) 149 (MSB)	Int	Pos X	Coordinate X of the reported point at time=1	
150 (LSB) 151 (MSB)	Int	Pos Y	Coordinate Y of the reported point at time=1	

298 (LSB) 299 (MSB)	Int	Pos X	Coordinate X of the reported point, at time=19	
300 (LSB) 301 (MSB)	Int	Pos Y	Coordinate Y of the reported point, at time=19	

7.4 Power_ mode register

The POWER_MODE register controls the power management and operation of the controller. However, modification becomes effective at any time. There are shown in the table 10.6.

Table 7.6: Power_ mode register (R51)

Bit	Name	Description
7-3	--	Not used
2	ALLOW_SLEEP	Allow self demotion from active to sleep mode, provide that this flag is set. If the controller is in active mode and no finger is detected for more than IDLE_PERIOD time, then it allow automatically jumps to sleep mode. If this flag is not set, the host must explicitly switch the device from active to sleep mode.
1-0	POWER_MODE[1-0]	Power mode setting: 00: Active Mode 01: Sleep Mode 11: Freeze Mode

7.5 INT_ mode register

The slave can set the INT line, and host can read and write controller device, so the controller behaves like an I^2C slave device and fully complies with I^2C addressing and usual I^2C hand shake protocol. As such, controller is suitable in a bus shared with other I^2C slaves.

Table 7.7: INT_ mode register (R52)

Bit	Name	Description
7-4	-	Not used
3	EN_INT	0:disable interrupt mode 1:enable interrupt mode
2	INT_POL	0:the interrupt is low active(default) 1:the interrupt is high-active
1-0	INT_MODE[1-0]	00:INT assert periodically 01:INT assert only when finger moving(default) 10:INT assert only when finger touch 11: INT pulse assert only when finger touch

When INT_MODE=00 in the INT mode register, the slave will set the INT line with INT_ width pulse width after each scan in order to request the attention from the host, as shown in figure 7.10 and figure 7.11.

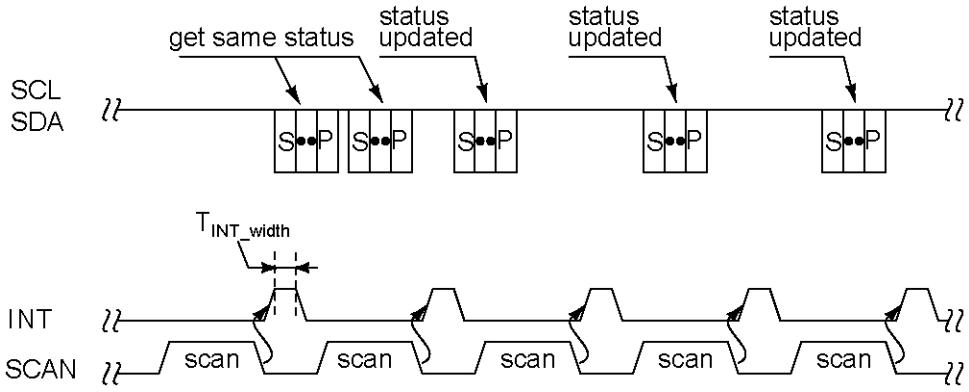


Figure 7.10: INT line pull up by slave (INT_P OL=1,INT_MODE=00 in the INT mode register)

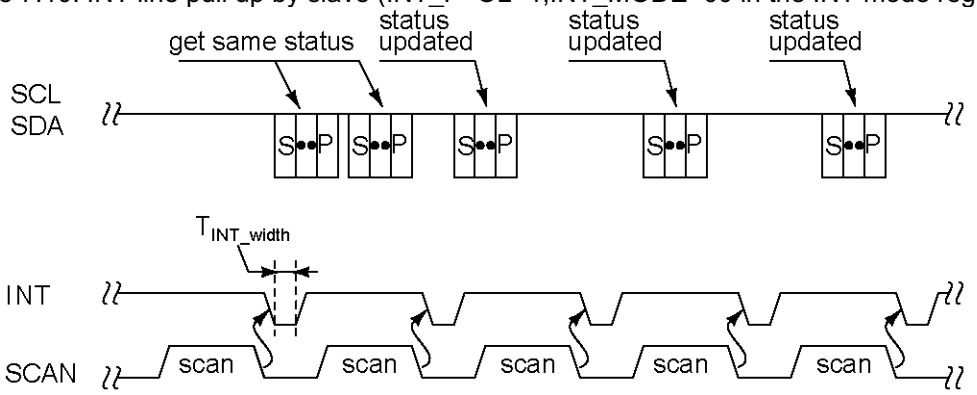


Figure 7.11: INT line pull down by slave (INT_P OL=0, INT_MODE=00 in the INT mode register)

When INT_Mode=01 in the INT mode register and finger moving on the panel, the slave will set the INT line after each scan, as shown in figure 7.12. W hen finger leaves the panel, the slave will continue to pulse INT line for each scan; but once the master has serviced this request and become now aware that there is no more finger touching, the slave will stop pulse the INT line, and will also gradually reduce the scan speed, as shown in figure 7.12.

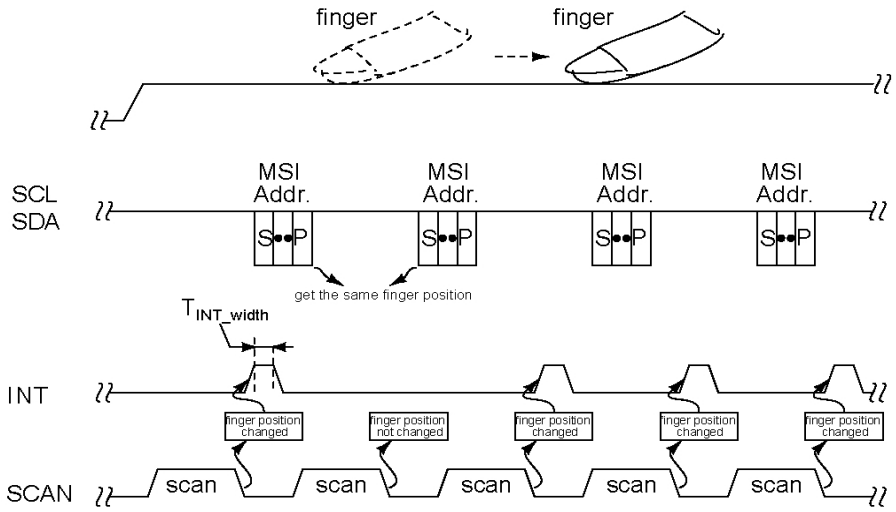


Figure 7..12: INT line pull up when finger moving (INT _POL=1, INT_MODE=01 in the INT mode register)

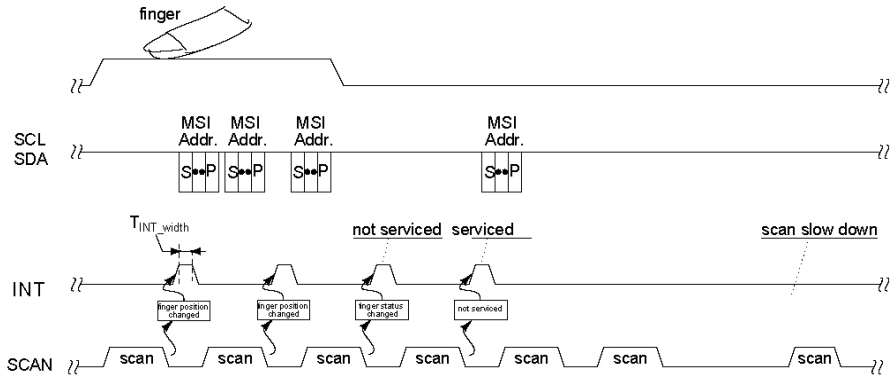


Figure 7.13: INT line will stop pulse when finger leaves and master has acknowledged the situation (INT_POL=1 in the INT mode register)

When INT_Mode=10 in the INT mode register and finger touch the panel, the slave will set the INT line after each scan, as shown in figure 7.14. When finger leaves the panel, the slave will continue keep INT line status for each scan; but once the master has serviced this request and become now aware that there is no more finger touching, the slave will release the INT line, and will also gradually reduce the scan speed, as shown in figure 7.15 .

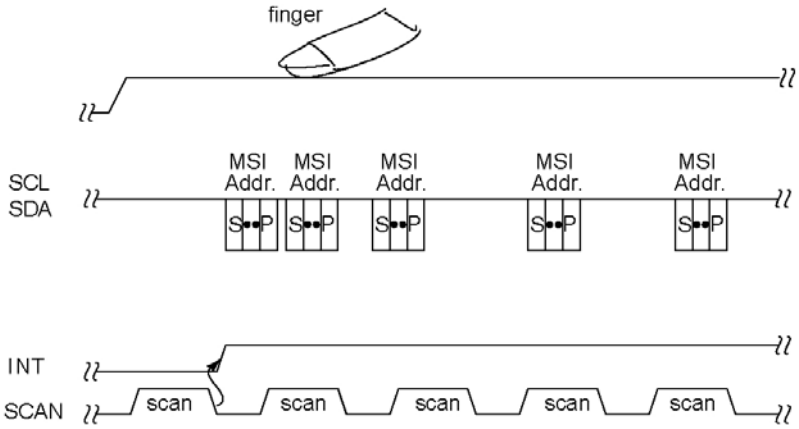


Figure 7.14: INT line pull up when finger touch (INT _POL=1, INT_MODE=10 in the INT mode register)

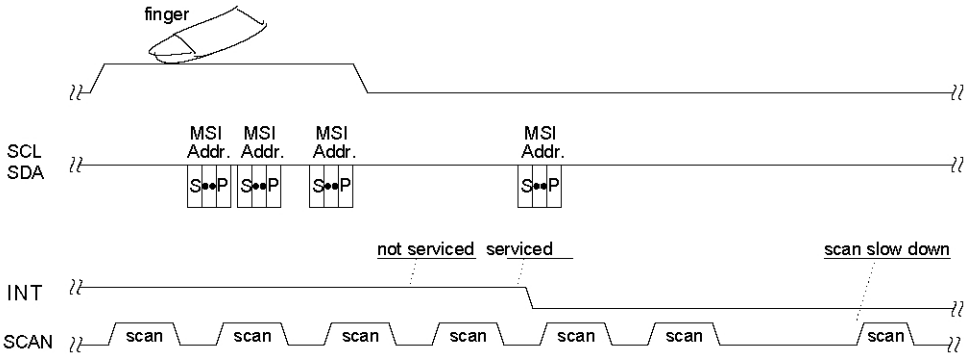


Figure 7.15: INT line will reset level when finger leaves and master has acknowledged the situation (INT_POL=1 in the INT mode register)

The only difference is send INT pulse instead of level between INT_ Mode=10 to INT_ Mode =11.

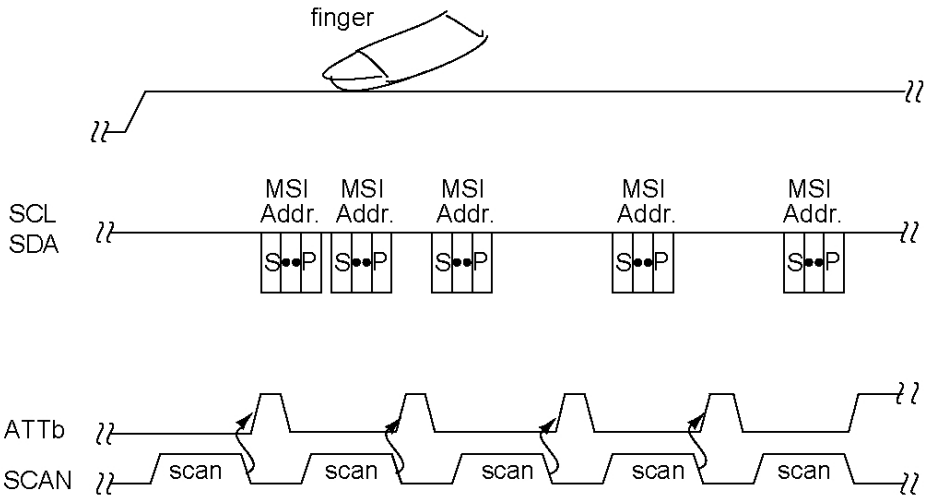


Figure 7.16: INT line pull up when finger touch (INT_POL=1, INT_MODE=11 in the INT mode register)

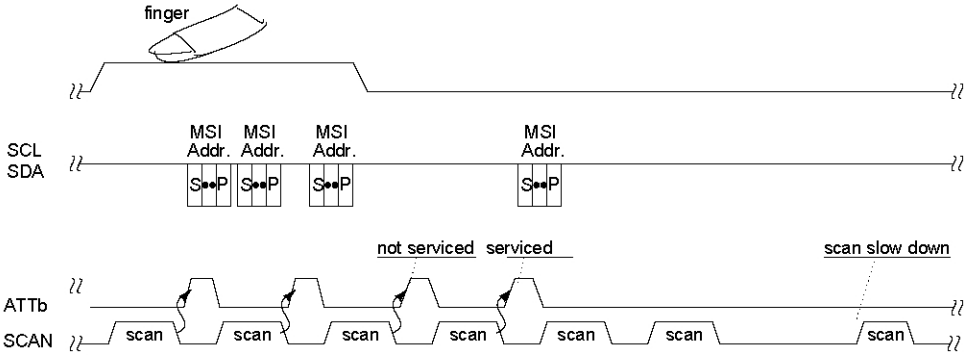
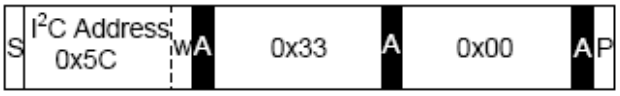


Figure 7.17: INT line will stop pulse when finger leav es and master has acknowledged the situation (INT_POL=1 in the INT mode register)

8 Power management

Active mode

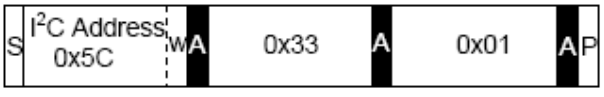
In this mode, the slave resumes with a new scan directly after each I²C transfer (after INT rising edge). This is used to reach the highest refresh rate (reach to 400Hz), but also has the highest current consumption. Below is shows how to force the slave into Active mode.



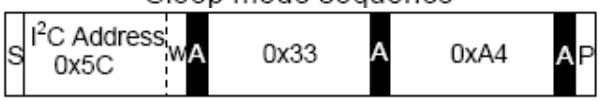
Active mode sequence

Sleep mode

This mode is selected to decrease the current consumption during low activity phases on the sensor, which need a lower refresh rate (10Hz or can be controlled by **Sleep_ freq** in table 10.2). The controller does automatically switch to Active mode when finger is detected or by setting the POWER_MODE register to Active mode. Also, the controller can automatically switch from Active to Sleep mode when no finger is detected for more than IDLE_PERIOD time, provided that ALLOW_SLEEP bit is set in the POWER_MODE register. Below are shows how to force the slave into Sleep mode and force the slave to switch automatically into Sleep mode (set ALLOW_SLEEP bit in POWER_MODE register).



Sleep mode sequence

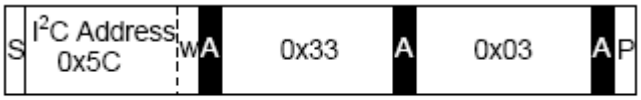


Sleep mode automatically switch sequence

Freeze mode

In this mode, the slave MCU internal clock source is stopped, and consumption is only MOS leakage. Below shows how to force the slave into Freeze mode. There are two ways to wake up from freeze mode.

- RST pin pull down (connect to the Ground) (default)
- INT pin change (“1 to 0” or “0 to 1”)

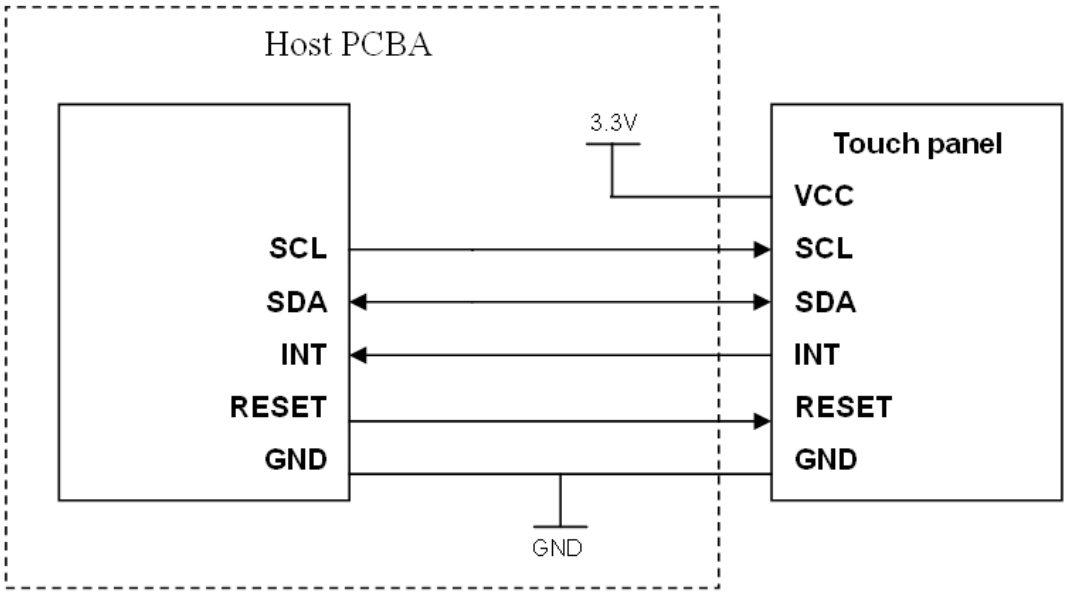


Freeze mode sequence

9. PIN CONNECTIONS

No.	Name	I/O	Description
1	VDD1	P	Power
2	GND	P	Ground
3	RST	I	Reset,active high
4	SCL	I	I²C clock input
5	SDA	I/O	I²C data signal
6	INT	O	Interrupt output
7	NC	--	No connect
8	NC	--	No connect

10. BLOCK DIAGRAM



Note : 1. To reduce the noise from the power, we suggest you use the independent power for the touch panel (VDD1)

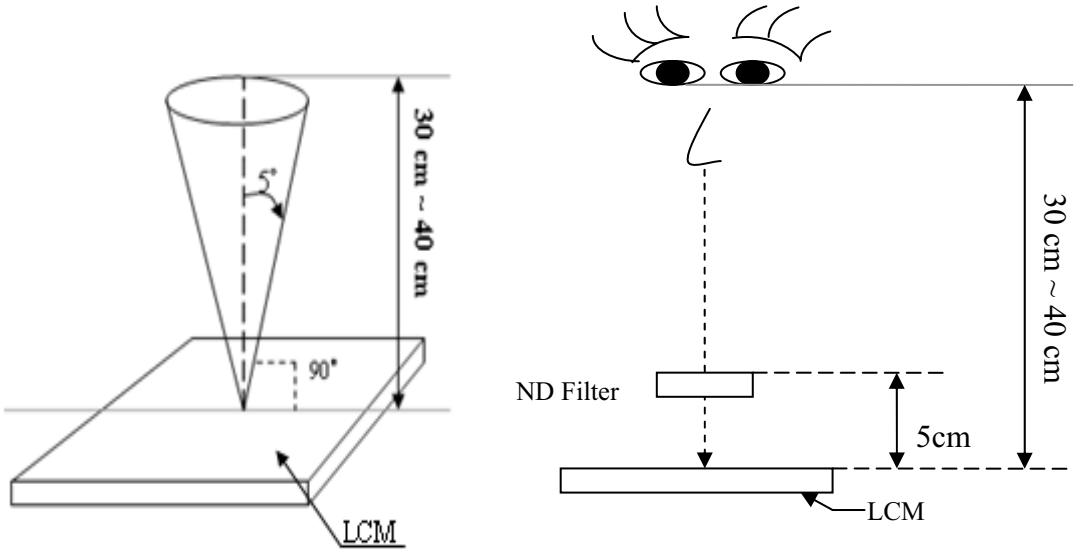
■ RELIABILITY TEST

No.	Reliability Test Item & Level	Test Level	Remark
1	High Temperature Storage Test	T=80°C,240hrs	IEC68-2-2
2	Low Temperature Storage Test	T=-30°C,240hrs	IEC68-2-1
3	High Temperature Operation Test	T=70°C,240hrs	IEC68-2-2
4	Low Temperature Operation Test	T=-20°C,240hrs	IEC68-2-1
5	High Temperature and High Humidity Operation Test	T=60°C,90% RH,240hrs	IEC68-2-3
6	Temperature Cycle Test (No operation)	-30°C → +25°C → +80°C,50 Cycles 30 min 5min 30 min	IEC68-2-14
7	Vibration Test (No operation)	Frequency:10 ~ 55 Hz Amplitude:1.0 mm Sweep Time:11min Test Period:6 Cycles for each Direction of X,Y,Z	IEC68-2-6
8	Shock Test (No operation)	100G, 6ms Direction：± X,± Y,± Z Cycle：3 times	IEC68-2-27

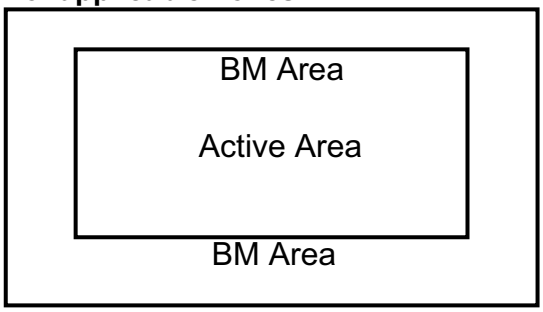
■ INSPECTION CRITERION

OUTGOING QUALITY STANDARD	PAGE 1 OF 4
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	

1.1 Temperature: 25± 5 ℃
1.2 Humidity: 55 ± 10% RH
1.3 Light source: Fluorescent Light
1.4 Inspection: Viewing distance: 35±5cm
1.5 Ambient Illumination:
(1) Cosmetic Inspection: 500 ~ 800 lux
(2) Functional Inspection: 400 ~ 600 lux
1.6 Inspection View angle:
(1) Inspection under operating condition : ±5°
(2) Inspection under non-operating condition : ± 45°



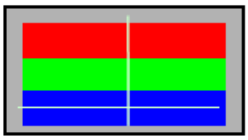
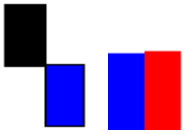
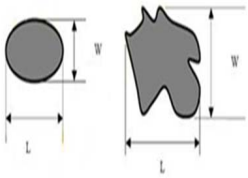
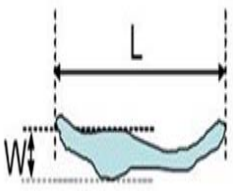
2. Definition of applicable Zones

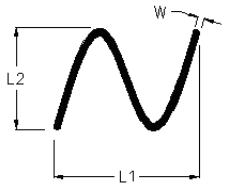
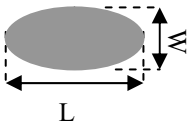


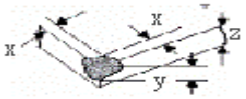
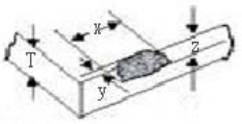
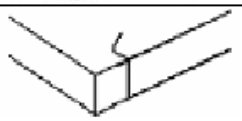
3 Judgment standard

The Judgment of the above test should be made after exposure in room temperature for two hours as follow:
Pass: Normal display image with no obvious non-uniformity and no line defect.
Partial transformation of the module parts should be ignored.
Fail: No display image, obvious non-uniformity, or line defect.

4. Cosmetic Specification and Inspection Items

<table>
<tr><th>Inspection Item</th><th>Inspection Criteria</th><th>Illustration</th></tr>
<tr><td>Display function</td><td>No Display malfunction</td><td>  </td></tr>
<tr><td>Contrast ratio</td><td>Does not meet specified range in the spec.</td><td>(Major) (Note:2)</td></tr>
<tr><td>Line Defect</td><td>No obvious Vertical and Horizontal line defect in black and White.</td><td>  </td></tr>
<tr><td>Point Defect</td><td>
<table>
<tr><td rowspan="2">Item</td><td>Acceptable number</td><td rowspan="2">Total</td></tr>
<tr><td>Active Area</td></tr>
<tr><td>Bright</td><td>2</td><td rowspan="2">5</td></tr>
<tr><td>Dark</td><td>4</td></tr>
<tr><td>Two adjacent dot</td><td>2</td><td>2</td></tr>
</table>
</td><td>One Dot
 
Two adjacent dot
  </td></tr>
<tr><td>Foreign material (Black or White spots shape)</td><td>
<table>
<tr><td>Zone
Dimension</td><td>Acceptable number</td><td>Class of Defects</td></tr>
<tr><td>D> 0.8 mm</td><td>0</td><td rowspan="3">Minor</td></tr>
<tr><td>0.3mm ≦D≦ 0.8 mm</td><td>5</td></tr>
<tr><td>D< 0.3mm</td><td>*</td></tr>
</table>
</td><td> 
D= (L + W) / 2</td></tr>
<tr><td>Foreign Material (Line shape)</td><td>
<table>
<tr><td>Zone
Dimension</td><td>Acceptable number</td><td>Class of Defects</td></tr>
<tr><td>W> 0.1mm or L >10mm</td><td>0</td><td rowspan="3">Minor</td></tr>
<tr><td>0.05 mm≦W≦0.1 mm
L ≦10mm</td><td>5</td></tr>
<tr><td>W< 0.05mm</td><td>*</td></tr>
</table>
</td><td> 
L : Long W : Width</td></tr>
<tr><td>Non-uniformity</td><td>Visible through 2 %ND filter White, R, G, B and gray 50% pattern.</td><td>(Minor)</td></tr>
<tr><td>Dimension</td><td>Outline</td><td>(Major)</td></tr>
<tr><td>Bezel appearance</td><td>uneven</td><td>(Minor)</td></tr>
</table>

<table>
<tr>
<td>Scratch on the Touch panel</td>
<td>
<table>
<tr><th>Zone / Dimension</th><th>Acceptable number</th><th>Class of Defects</th></tr>
<tr><td>W> 0.1mm or L >10mm</td><td>0</td><td rowspan="2">Minor</td></tr>
<tr><td>W≦0.1 mm
L≦10mm</td><td>5</td></tr>
</table>
</td>
<td> 
</td>
</tr>
<tr>
<td>Dent on the Touch panel</td>
<td>
<table>
<tr><th>Zone / Dimension</th><th>Acceptable number</th><th>Class of Defects</th></tr>
<tr><td>D> 0.8 mm</td><td>0</td><td rowspan="2">Minor</td></tr>
<tr><td>0.3mm ≦D≦ 0.8 mm</td><td>5</td></tr>
</table>
</td>
<td> 

D= (L + W) / 2</td>
</tr>
<tr><td>Polarizer flaw or leak out resin</td><td>Defect is defined as the active area.</td><td></td></tr>
<tr><td>Corner Chipping</td><td>X<3 mm, Y<3 mm, Z< Glass thickness</td><td> 
</td></tr>
<tr><td>Edge Chipping</td><td>X<3 mm, Y<3 mm, Z< Glass thickness</td><td> 
</td></tr>
<tr><td>Crack</td><td>reject</td><td>  </td></tr>
</table>

5. Sampling Condition

Unless otherwise agree in written, the sampling inspection shall be applied to the incoming inspection of customer.
Lot size: Quantity of shipment lot per model.
Sampling type: normal inspection, single sampling
Sampling table: MIL-STD-105E
Inspection level: Level II

Class of defects	Definition		
	Major	AQL 0.65%	It is a defect that is likely to result in failure or to reduce materially the usability of the product for the intended function.
	Minor	AQL 1.5%	It is a defect that will not result in functioning problem with deviation classified.

Note:1.(a)Bright point defect is defined as point defect of R,G,B with area >1/2 dot respectively
(b)Dark point defect is defined as visible in full white pattern.
(c)Definition of distribution of point defect is as follows:
-minumum separation between dark point defects should be larger than 5mm.
-minumum separation between bright point defects should be larger than 5mm.
(d)Definition of joined bright point defect and joined dark point defect are as follows:
- Three or more joined bright point defects must be nil.
- Three joined dark point defects must be nil.
- Two Joined dark point is counted as two dark points with 2 pair maximum.
(e) Line defect is defined as visible by using 2 % ND filter.

Note:2 Luminance measurement for contrast ratio is at the distance 50± 5cm between the detective head and the panel with ambient illuminance less than 1 lux. Contrast ratio is obtained at optimum view angle.

■ PRECAUTIONS FOR USING LCD MODULES

Handing Precautions

(1) The display panel is made of glass and polarizer. As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring. Do not subject it to a mechanical shock by dropping it or impact.

(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.

(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary. Do not touch the display with bare hands. This will stain the display area and degraded insulation between terminals (some cosmetics are determined to the polarizer).

(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully. Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.). Do not put or attach anything on the display area to avoid leaving marks on. Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizer. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.

(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents

- Isopropyl alcohol
- Ethyl alcohol

Do not scrub hard to avoid damaging the display surface.

(6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.

- Water
- Ketone
- Aromatic solvents

Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading. Avoid contacting oil and fats.

(7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

(8) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.

(9) Do not attempt to disassemble or process the LCD module.

(10) NC terminal should be open. Do not connect anything.

(11) If the logic circuit power is off, do not apply the input signals.

(12) Electro-Static Discharge Control, Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential. Be sure to ground the body when handling the LCD modules.
- Tools required for assembling, such as soldering irons, must be properly grounded. make certain the AC power source for the soldering iron does not leak. When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions. To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended. As far as possible make the electric potential of your work clothes and that of the work bench the ground potential
- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated

（13）Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

- Do not alter, modify or change the shape of the tab on the metal frame.
- Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
- Do not damage or modify the pattern writing on the printed circuit board.
- Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
- Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
- Do not drop, bend or twist LCM.

Storage Precautions

When storing the LCD modules, the following precaution is necessary.

(1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for the dessicant.

(2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C.

(3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped).

Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

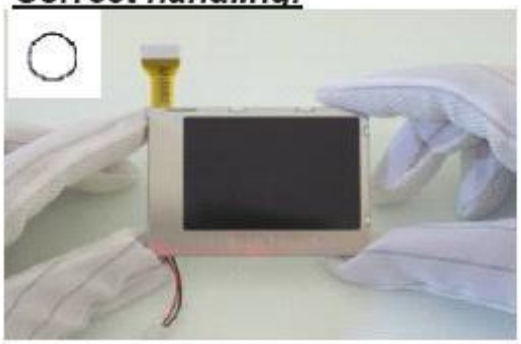
To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

- Exposed area of the printed circuit board.
-Terminal electrode sections.

Handling precaution for LCM

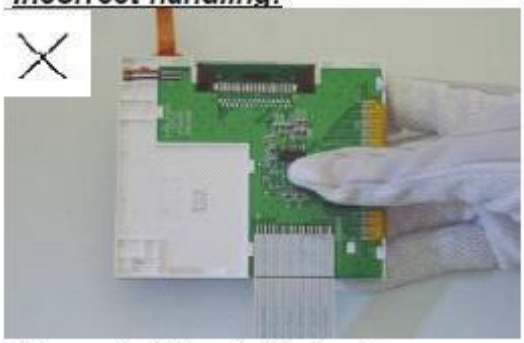
LCM is easy to be damaged.
Please note below and be careful for handling!

Correct handling:

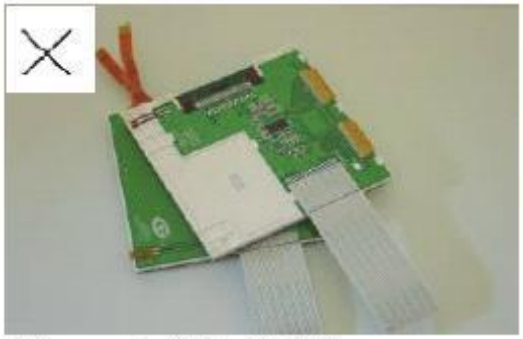


As above picture, please handle with anti-static gloves around LCM edges.

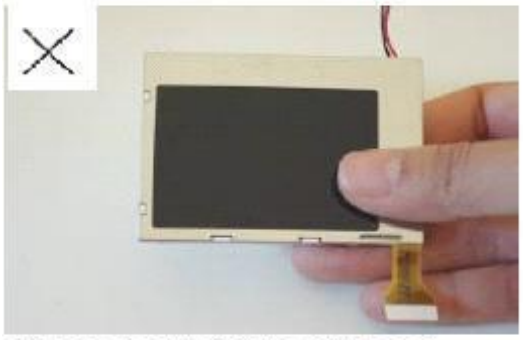
Incorrect handling:



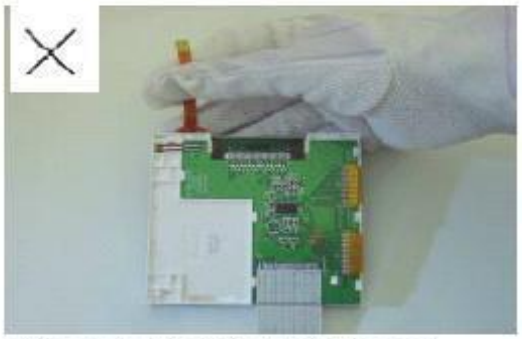
Please don't touch IC directly.



Please don't stack LCM.



Please don't hold the surface of panel.

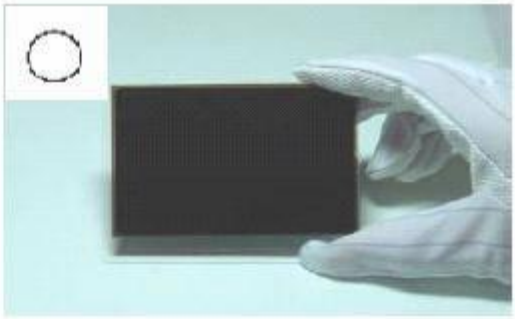


Please don't stretch interface of output, such as FPC cable.

Handling precaution for LCD

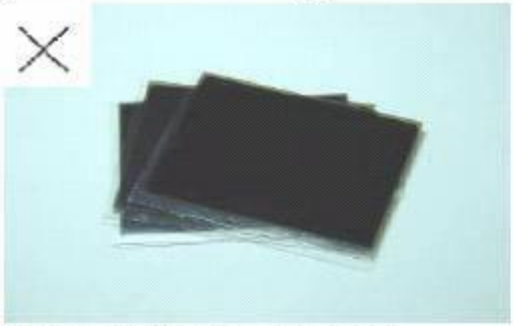
LCD is easy to be damaged.
Please note below and be careful for handling!

Correct handling:



As above photo, please handle with anti-static gloves around LCD edges.

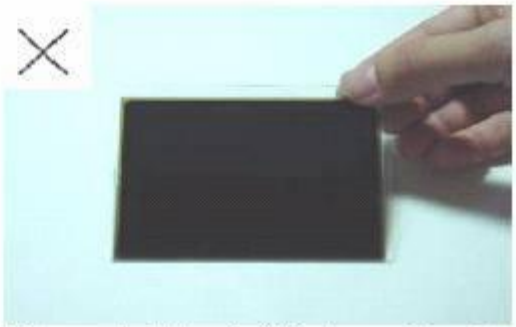
Incorrect handling:



Please don't stack the LCDS.

Please don't hold the surface of LCD.

Please don't operate with sharp stick such as pens.



Please don't touch ITO glass without anti-static gloves.

Storage Precautions

When storing the LCD modules, the following precaution is necessary.

(1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for the dessicant.

(2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C, and keep the relative humidity between 40%RH and 60%RH.

(3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the anti-static electricity container in which they were shipped.

Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

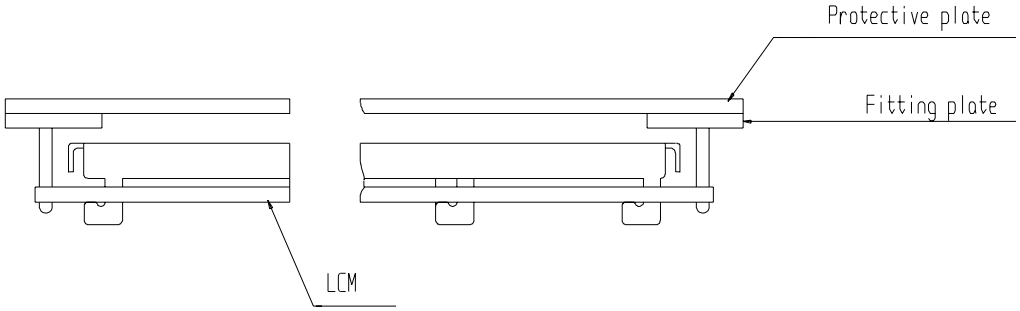
- Exposed area of the printed circuit board.
-Terminal electrode sections.

USING LCD MODULES

Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

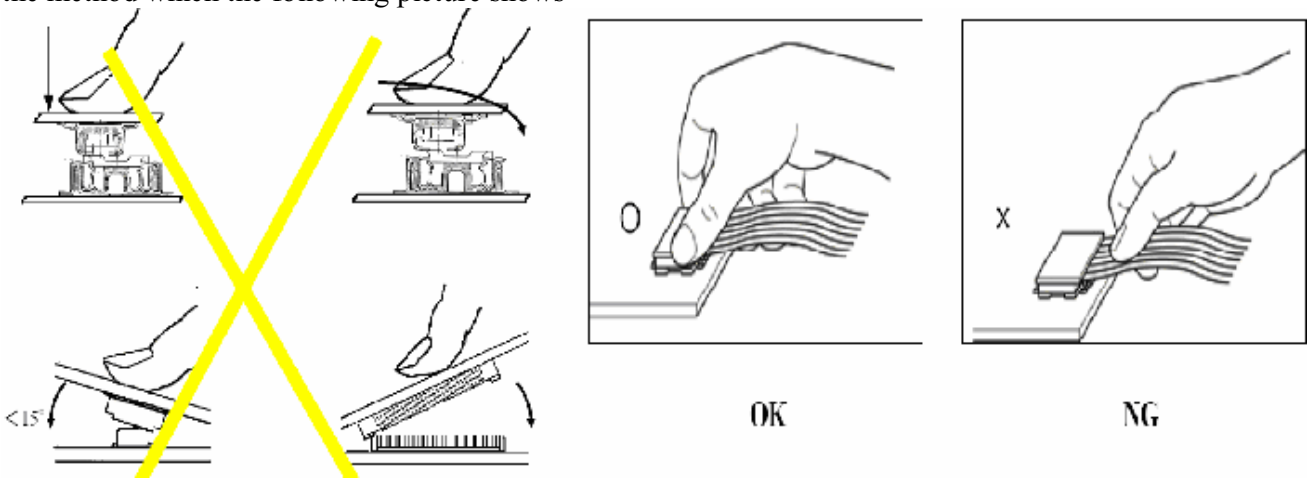
(1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



(2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be ±0.1mm.

Precaution for assemble the module with BTB connector:

Please note the position of the male and female connector position,don't assemble or assemble like the method which the following picture shows



Precaution for soldering to the LCM

	Hand soldering	Machine drag soldering	Machine press soldering
No ROHS product	290°C ~350°C. Time : 3-5S.	330°C ~350°C. Speed : 4-8 mm/s.	300°C ~330°C. Time : 3-6S. Press: 0.8~1.2Mpa
ROHS product	340°C ~370°C. Time : 3-5S.	350°C ~370°C. Time : 4-8 mm/s.	330°C ~360°C. Time : 3-6S. Press: 0.8~1.2Mpa

(1) If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

(2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.

(3) When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

Precautions for Operation

(1) Viewing angle varies with the change of liquid crystal driving voltage (VLCD). Adjust VLCD to show the best contrast.

(2) It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit cause the shorter LCD life. An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.

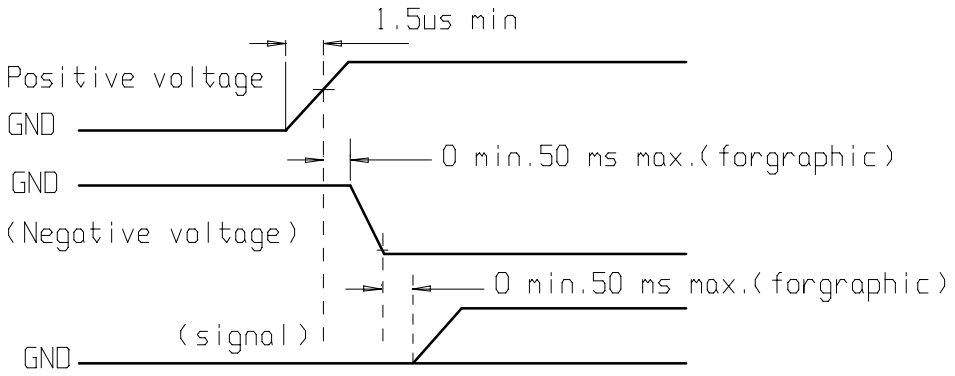
(3) Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, Which will come back in the specified operating temperature.

(4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.

(5) A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Usage under the maximum operating temperature,50%RH or less is required.

(6) Input each signal after the positive/negative voltage becomes stable.

(7) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.



Safety

(1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

(2) If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

Limited Warranty

Unless agreed betweenMulti-Inno and customer,Multi-Inno will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with Multi-Inno LCD acceptance standards (copies available upon request) for a period of one year from date of production. Cosmetic/visual defects must be returned to Multi-Inno within 90 days of shipment. Confirmation of such date shall be based on data code on product. The warranty liability of Multi-Inno limited to repair and/or replacement on the terms set forth above. Multi-Inno will not be responsible for any subsequent or consequential events.

Return LCM under warranty

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

- Broken LCD glass.
- PCB eyelet is damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- Soldering to or modifying the bezel in any manner.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet, conductors and terminals.

■ PRIOR CONSULT MATTER

1.①For Multi-Inno standard products, we keep the right to change material, process ... for improving the product property without notice on our customer.

②For OEM products, if any change needed which may affect the product property, we will consult with our customer in advance.

2. If you have special requirement about reliability condition, please let us know before you start the test on our samples.