



**MULTI-INNO TECHNOLOGY CO., LTD.**

**www.multi-inno.com**

## **LCD MODULE SPECIFICATION**

**Model : MI0700XT-8**

**For Customer's Acceptance:**

Customer	
Approved	
Comment	

Revision	1.2
Engineering	
Date	2013-02-22
Our Reference	

## REVISION RECORD

[illegible]

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## ■ GENERAL INFORMATION

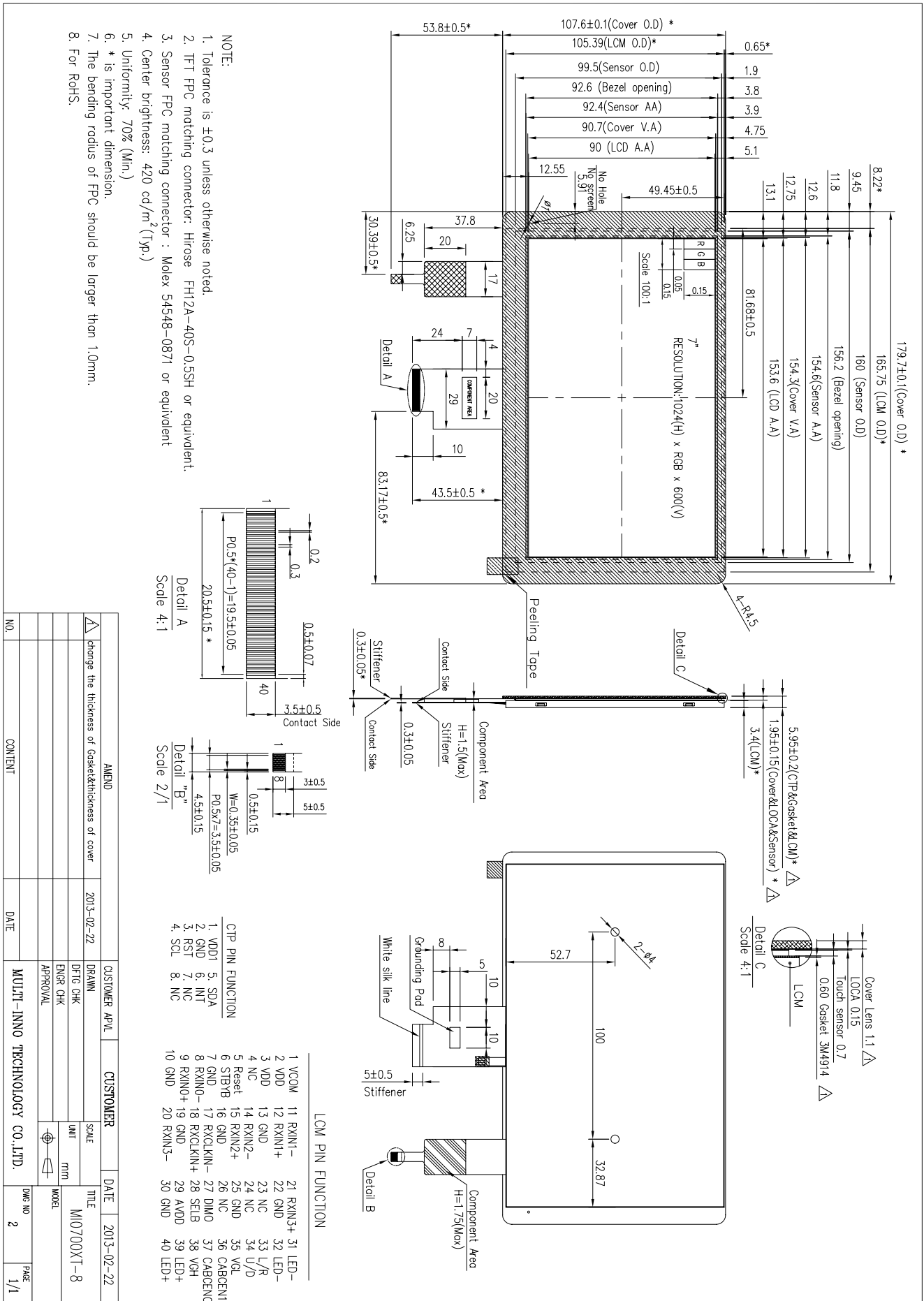
Item	Contents	Unit
LCD type	TFT/Normally white	/
Size	7.0	Inch
Viewing direction	12:00	O' Clock
Gray scale inversion direction	6:00	O' Clock
LCM (W × H × D )	179.0×107.6×5.5	mm <sup>3</sup>
LCD active area (W×H)	153.6×90.0	mm <sup>2</sup>
CTP active area (W×H)	154.6×92.4	mm <sup>2</sup>
Number of dots	1024(RGB) × 600	/
Backlight type	27 LEDs	/
Interface type	LVDS	/
Color depth	16.7M	/
Pixel configuration	Stripe	/
Surface treatment	Glare	/
Finger	5	/
Input voltage	3.3	V
With/Without TSP	With CTP	/
Weight	TBD	g

Note 1: Viewing direction for best image quality is different from TFT definition, there is a 180 degree shift.

Note 2: RoHS compliant;

Note 3: LCM weight tolerance: ± 5%.

## EXTERNAL DIMENSIONS



## ■ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Power supply voltage	VDD	-0.3	5.0	V
	AVDD	6.5	13.5	V
	VGH	-0.3	42	V
	VGL	-20	0.3	V
	VGH-VGL	-	40	V
Operating temperature	T <sub>OP</sub>	-20	60	°C
Storage temperature	T <sub>ST</sub>	-30	70	°C
Humidity	Operation	20%-90% relative humidity (Ta<=38°C)		
	Non operation	5%-90% relative humidity (Ta<=38°C)		

## ■ELECTRICAL CHARACTERISTICS

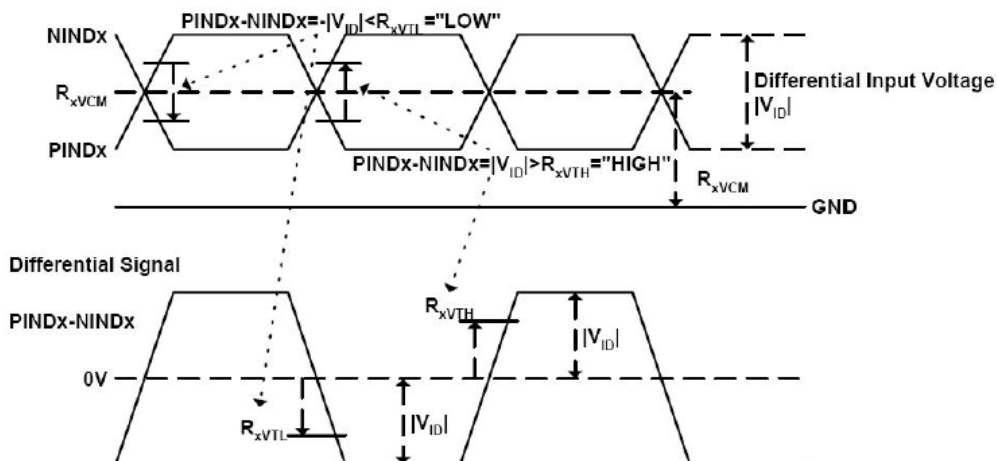
### DC CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit
Power supply voltage	VDD	3.0	3.3	3.6	V
	AVDD	10.8	11	11.2	V
	VGH	19.7	20	20.3	V
	VGL	-6.5	-6.8	-7.1	V
Input signal voltage	VCOM	2.7	3.7	4.7	V
Differential input high threshold	R <sub>x</sub> V <sub>TH</sub>	-	-	100	mV
Differential input low threshold	R <sub>x</sub> V <sub>TL</sub>	-100	-	-	mV
Input voltage range(singled-end)	R <sub>x</sub> V <sub>IN</sub>	0	-	2.4	V
Differential input common mode voltage	R <sub>x</sub> V <sub>CM</sub>	V <sub>ID</sub>  /2	-	2.4- V <sub>ID</sub>  /2	V
Differential voltage	V <sub>ID</sub>	0.2	-	0.6	V
Differential input leakage current	R <sub>V</sub> x <sub>l</sub> iz	-10	-	+10	uA
"H"level logical input voltage	V <sub>IH</sub>	0.7VDD	-	VDD	V
"L"level logical input voltage	V <sub>IL</sub>	0	-	0.3VDD	V

Note 1: LVDS, Reset.

Note 2: LVDS Signal Waveform.

#### Single-end Signals



Note 3: Typical VCOM is only a reference value, it must be optimized according to each LCM. Be sure to use VR;

## ■ CURRENT CONSUMPTION

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Remark
Current for Driver	IGH	-	0.25	1.0	mA	VGH=20V
	IGL	-	0.25	1.0	mA	VGL=-6.8V
	IVDD	-	38	60	mA	VDD=3.3V
	IAVDD	-	20	30	mA	AVDD=11V

## ■ BACKLIGHT CHARACTERISTICS

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED voltage	$V_L$	-	9.3	10.2	V	Note 1
LED current	$I_L$	-	180	190	mA	
LED life time	-	-	30000	--	hr	Note 2

Note 1: The LED Supply Voltage is defined by the number of LED at Ta=25°C and  $I_L = 180\text{mA}$ .

Note 2: The "LED life time" is defined as the module brightness decrease to 50% original brightness at Ta=25°C and  $I_L = 180\text{mA}$ . The LED lifetime could be decreased if operating  $I_L$  is larger than 160mA.

## ■ ELECTRO-OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time	Tr+ Tf	$\theta=0^{\circ}$ $\varnothing=0^{\circ}$ Ta=25℃	---	25	50	ms	Fig.1	4
Contrast ratio	Cr		500	700	---	---	FIG 2.	1
Luminance uniformity			70	---	---	%	FIG 2.	3
Surface Luminance	Lv		---	420	---	cd/m <sup>2</sup>	FIG 2.	2
Viewing angle range	$\theta$	$\varnothing=90^{\circ}$	---	70	---	deg	FIG 3.	6
		$\varnothing=270^{\circ}$	---	75	---	deg	FIG 3.	
		$\varnothing=0^{\circ}$	---	75	---	deg	FIG 3.	
		$\varnothing=180^{\circ}$	---	75	---	deg	FIG 3.	
NTSC ratio	---	---	---	---	---	%	---	---
CIE (x, y) chromaticity	Red	x	$\theta=0^{\circ}$ $\varnothing=0^{\circ}$ Ta=25℃	---	---	---	FIG 2.	5
		y		---	---	---		
	Green	x		---	---	---		
		y		---	---	---		
	Blue	x		---	---	---		
		y		---	---	---		
	White	x		0.260	0.310	0.360		
		y		0.280	0.330	0.380		

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

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels } (P_1, P_2, P_3, P_4, P_5)}{\text{Average Surface Luminance with all black pixels } (P_1, P_2, P_3, P_4, P_5)}$$

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

$$L_v = \text{Average Surface Luminance with all white pixels } (P_1, P_2, P_3, P_4, P_5)$$

Note 3. The uniformity in surface luminance,  $\delta$  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.

$$\delta \text{ WHITE} = \frac{\text{Minimum Surface Luminance with all white pixels } (P_1, P_2, P_3, P_4, P_5)}{\text{Maximum Surface Luminance with all white pixels } (P_1, P_2, P_3, P_4, P_5)}$$

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

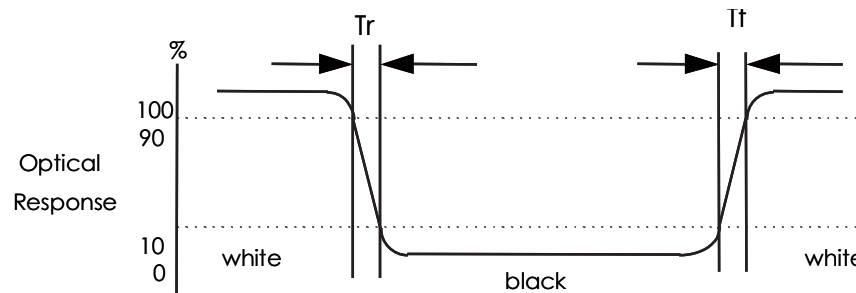
Note 5. CIE (x, y) chromaticity, The x,y value is determined by measuring luminance at each test position 1 through 5, and then make average value

Note 6. Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module the contrast 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.

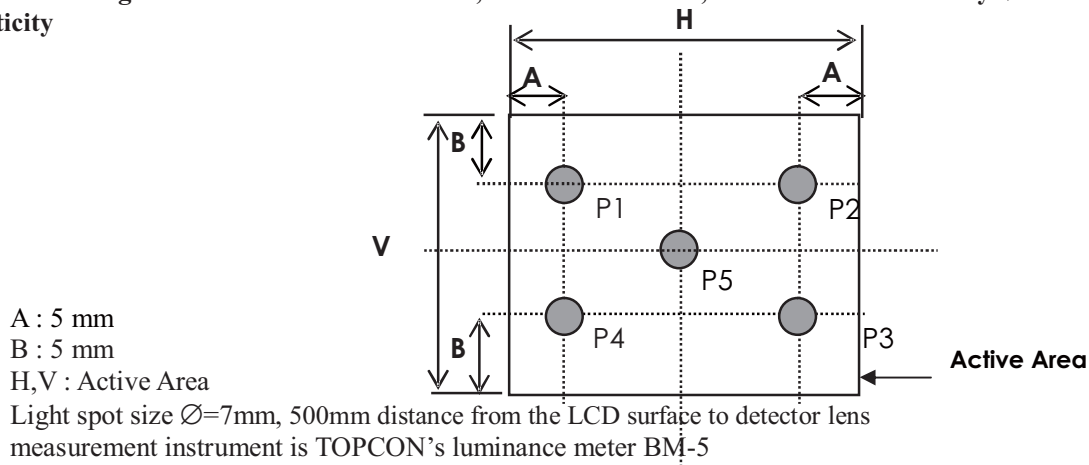
Note 7. For Viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope. Series Instruments. For contrast ratio, Surface Luminance, Luminance uniformity, CIE The test data is base on TOPCON's BM-5 photo detector.

**FIG. 1 The definition of Response Time**

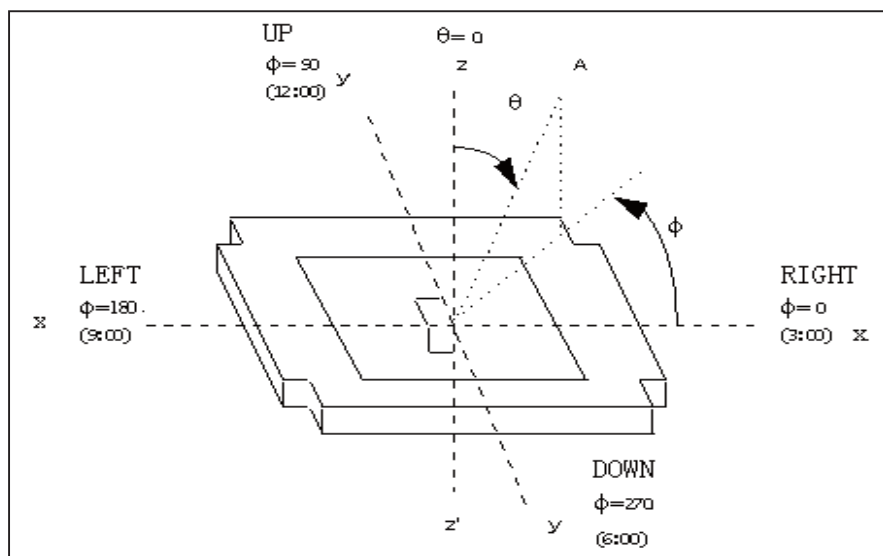
The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



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



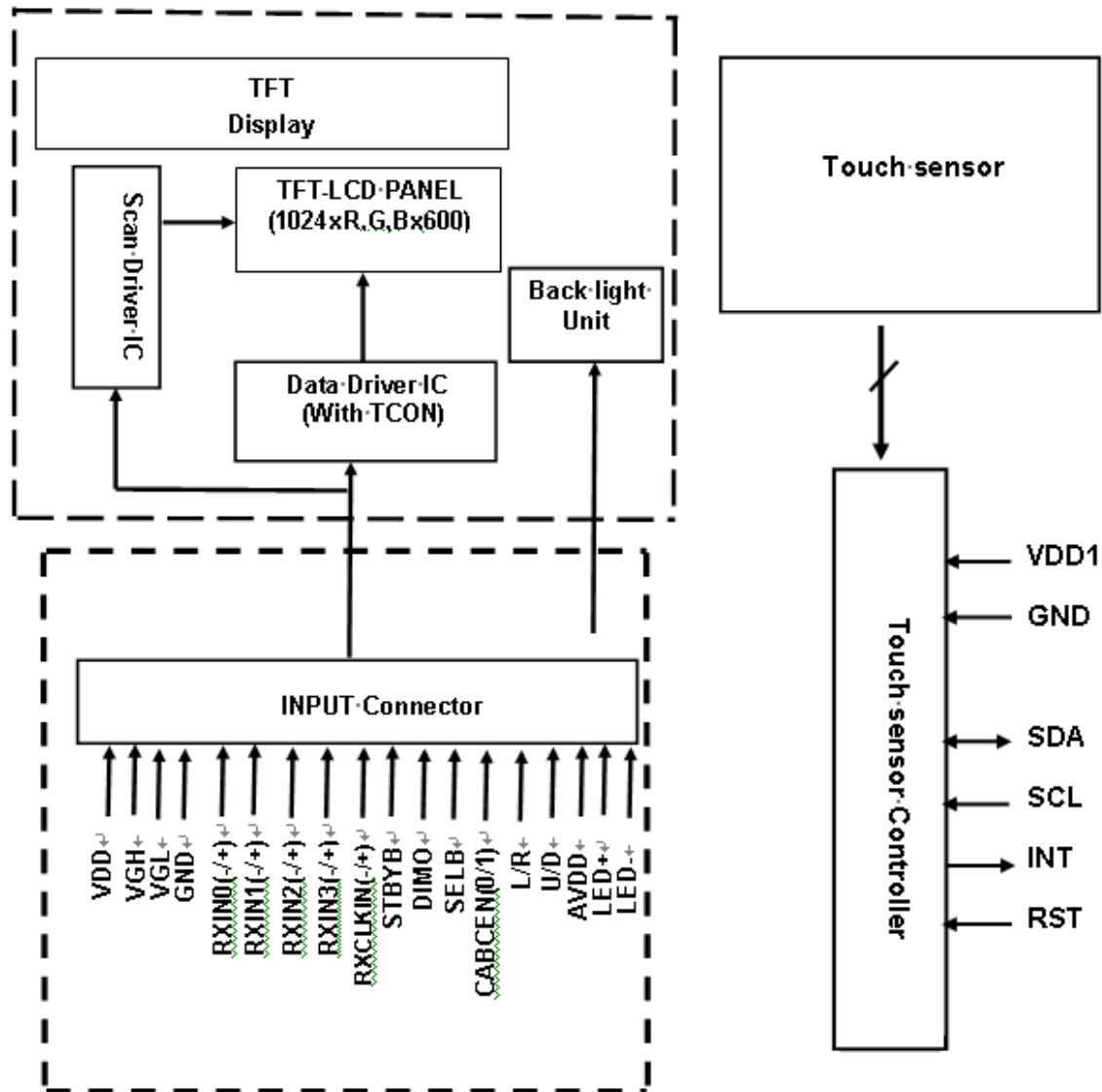
**FIG. 3 The definition of viewing angle**





## ■ INTERFACE DESCRIPTION

### 1. BLOCK DIAGRAM



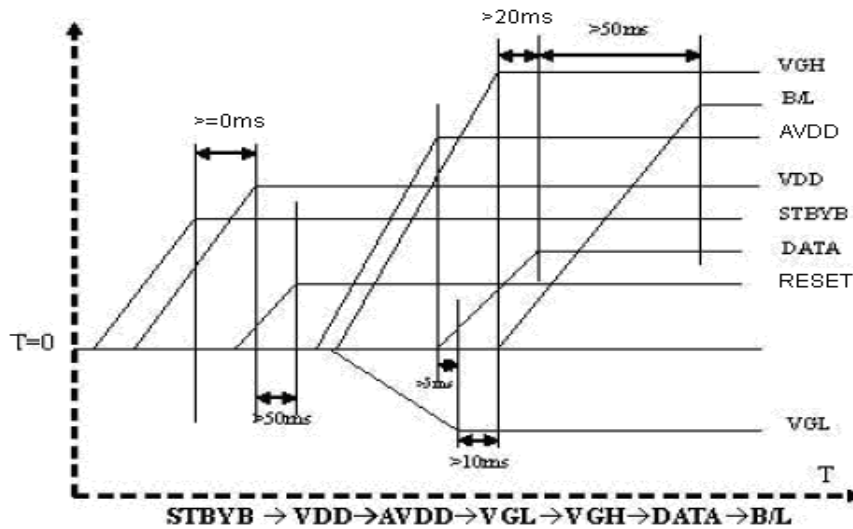
## 2. PIN CONNECTIONS

Pin No	Symbol	Description	Remark
1	VCOM	Common Voltage	
2	VDD	Power Voltage for digital circuit	
3	VDD	Power Voltage for digital circuit	
4	NC	No connection	
5	Reset	Global reset pin	
6	STBYB	Standby mode, Normally pulled high STBYB = "1", normal operation STBYB = "0", timing controller, source driver will turn off, all output are High-Z	
7	GND	Ground	
8	RXIN0-	- LVDS differential data input	
9	RXIN0+	+ LVDS differential data input	
10	GND	Ground	
11	RXIN1-	- LVDS differential data input	
12	RXIN1+	+LVDS differential data input	
13	GND	Ground	
14	RXIN2-	- LVDS differential data input	
15	RXIN2+	+LVDS differential data input	
16	GND	Ground	
17	RXCLKIN-	- LVDS differential data input	
18	RXCLKIN+	+ LVDS differential data input	
19	GND	Ground	
20	RXIN3-	- LVDS differential data input	
21	RXIN3+	+ LVDS differential data input	
22	GND	Ground	
23	NC	No connection	
24	NC	No connection	
25	GND	Ground	
26	NC	No connection	
27	DIMO	Backlight CABC controller signal output	
28	SELB	6bit/8bit mode select	Note 1
29	AVDD	Power for Analog Circuit	
30	GND	Ground	
31	LED-	LED Cathode	
32	LED-	LED Cathode	
33	L/R	Horizontal inversion	Note 3
34	U/D	Vertical inversion	Note 3
35	VGL	Gate OFF Voltage	
36	CABCEN1	CABC H/W enable	Note 2
37	CABCEN0	CABC H/W enable	Note 2
38	VGH	Gate ON Voltage	
39	LED+	LED Anode	
40	LED+	LED Anode	

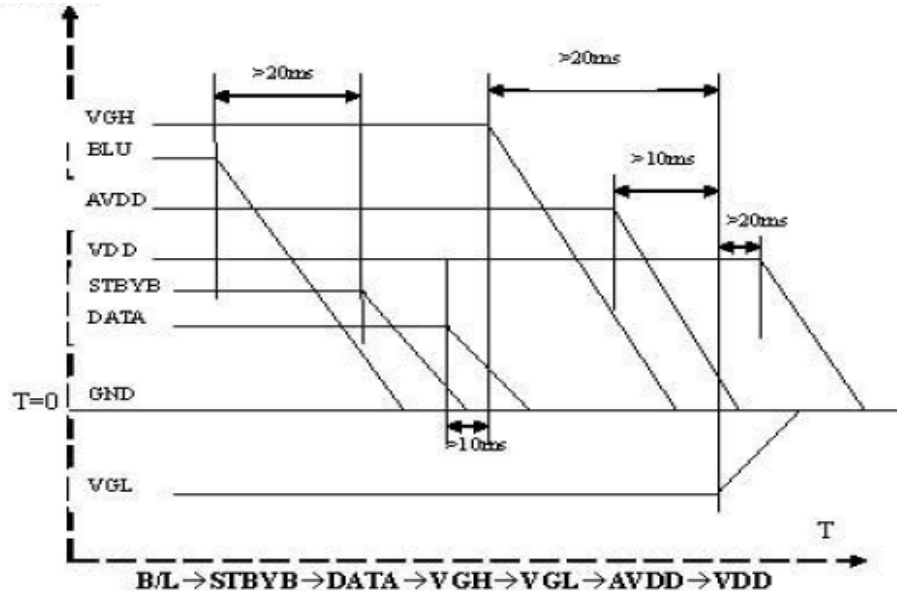
- Note 1: If LVDS input data is 6 bits ,SELB must be set to High;  
If LVDS input data is 8 bits ,SELB must be set to Low.
- Note 2: When CABC\_EN="00", CABC OFF.  
When CABC\_EN="01", user interface image.  
When CABC\_EN="10", still picture.  
When CABC\_EN="11", moving image.  
When CABC off, don't connect DIMO, else connect it to backlight.
- Note 3: When L/R="0", set right to left scan direction.  
When L/R="1", set left to right scan direction.  
When U/D="0", set top to bottom scan direction.  
When U/D="1", set bottom to top scan direction.

## 2.1 power ON/OFF sequence:

Power on:



Power off:



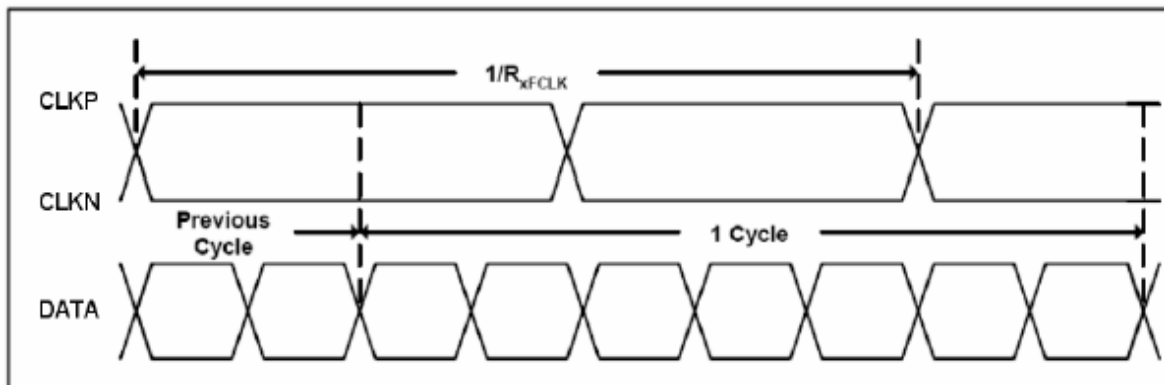
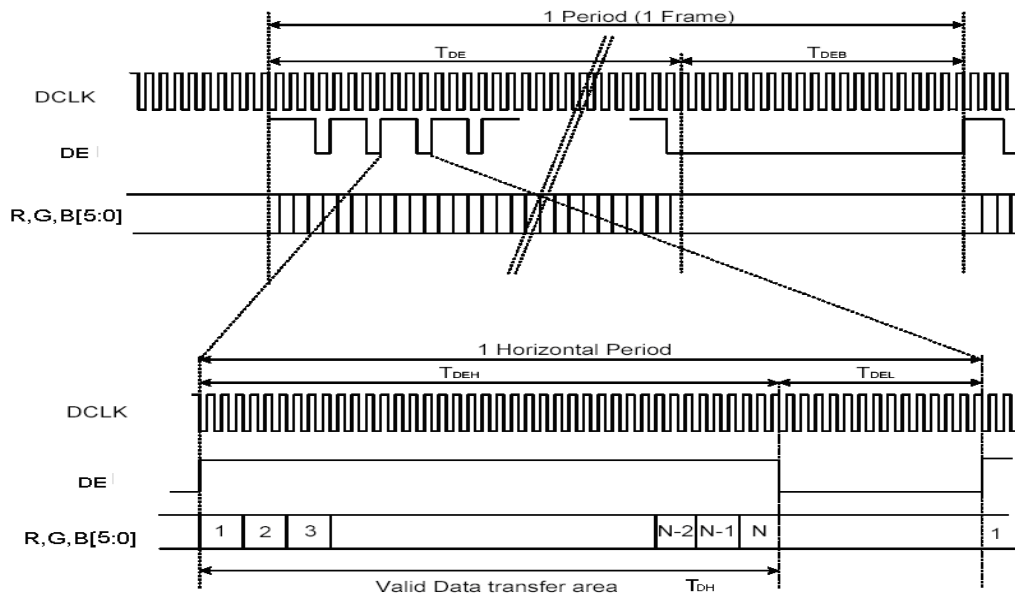
## APPLICATION NOTES

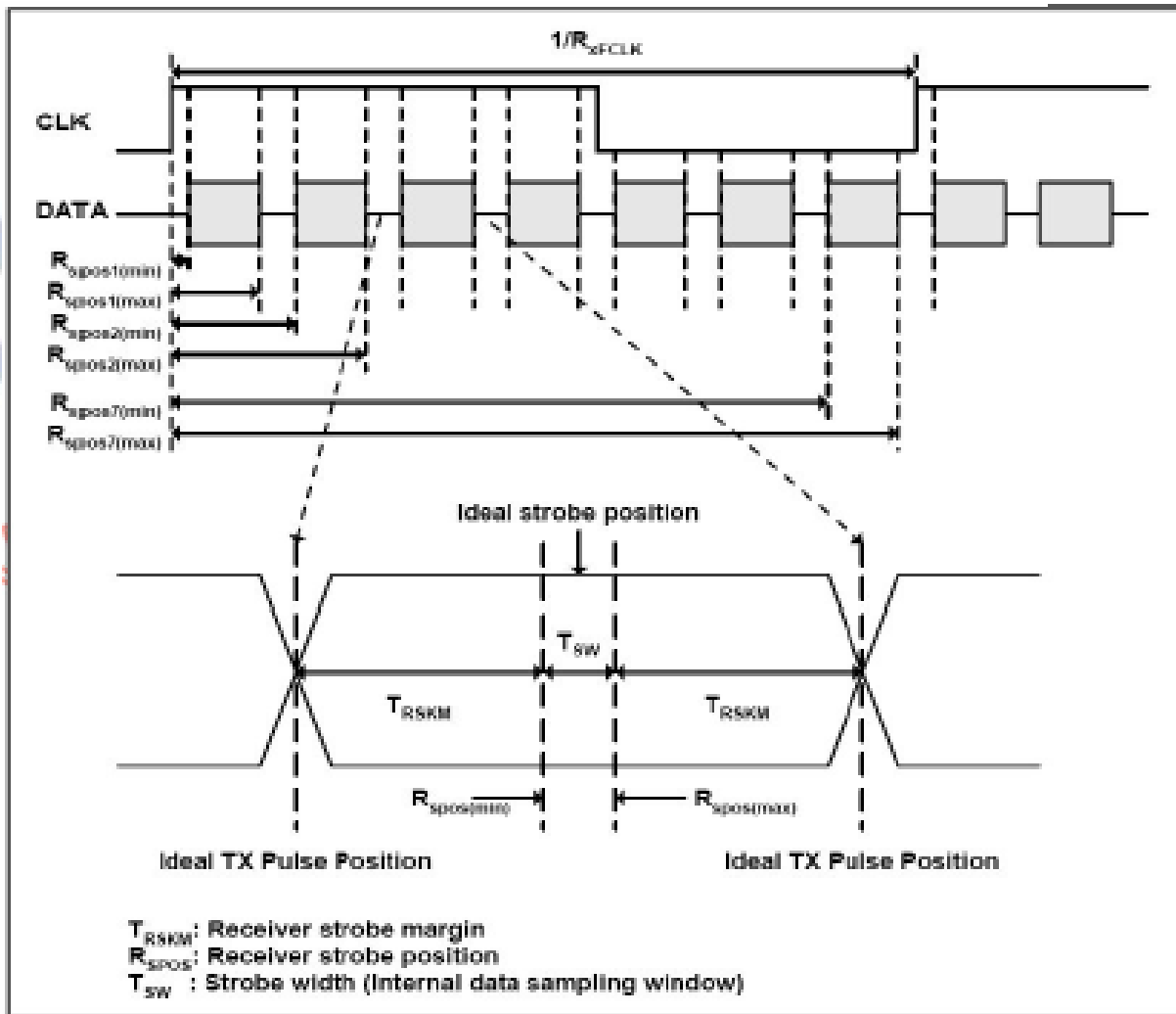
### 1 AC Characteristics

#### 1.1 AC Electrical Characteristics

Parameter	Symbol	MIN.	Typ.	MAX.	Unit	Remark
Clock Frequency	RxFCLK	40.8	51.2	67.2	MHz	Frame rate =60Hz
Input data skew margin	TRSKM	500	-	-	ps	
Clock high time	TLVCH	-	$4/(7 \cdot RxFCLK)$	-	ns	
Clock low time	TLVCL	-	$3/(7 \cdot RxFCLK)$	-	ns	
Horizontal display area	TDEH	-	1024		RxFCLK	
HS period time	TDEH+TDEL	1114	1344	1400	RxFCLK	
HS Blanking	TDEL	90	320	376	RxFCLK	
Vertical display area	TDE	-	600	-	TDEH+TDEL	
VS period time	TDE+TDEB	610	635	800	TDEH+TDEL	
VS Blanking	TDEB	10	35	200	TDEH+TDEL	

#### 1.2 Input Clock and Data Timing Diagram

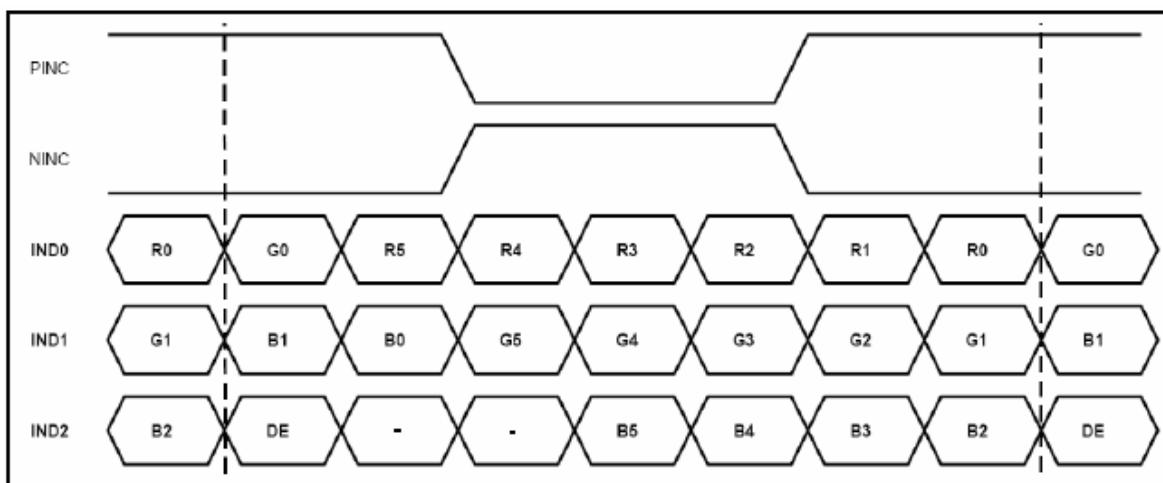




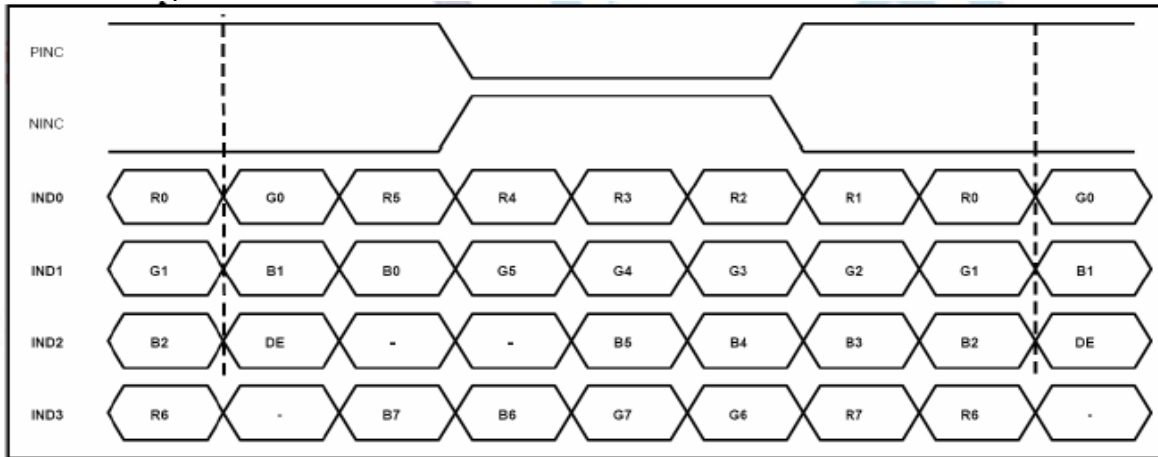
## 2 Timing Controller Timing Chart

### 2.1 Data Input format

6bit LVDS input



### 8bit LVDS input



Note: Support DE timing mode only, SYNC mode not supported

## CTP GENERAL SPECIFICATIONS

### 1 ABSOLUTE MAXIMUM RATINGS

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

### 2 ELECTRICAL CHARACTERISTICS

Symbol	Description	Min	Typ	Max	Unit
VDD1	Supply voltage	2.5	3.3	3.6	V
GND	Supply voltage	-	0	-	V
VIH	Input H voltage	0.8VDD1	-	VDD1	V
VIL	Input L voltage	0	-	0.2VDD1	V

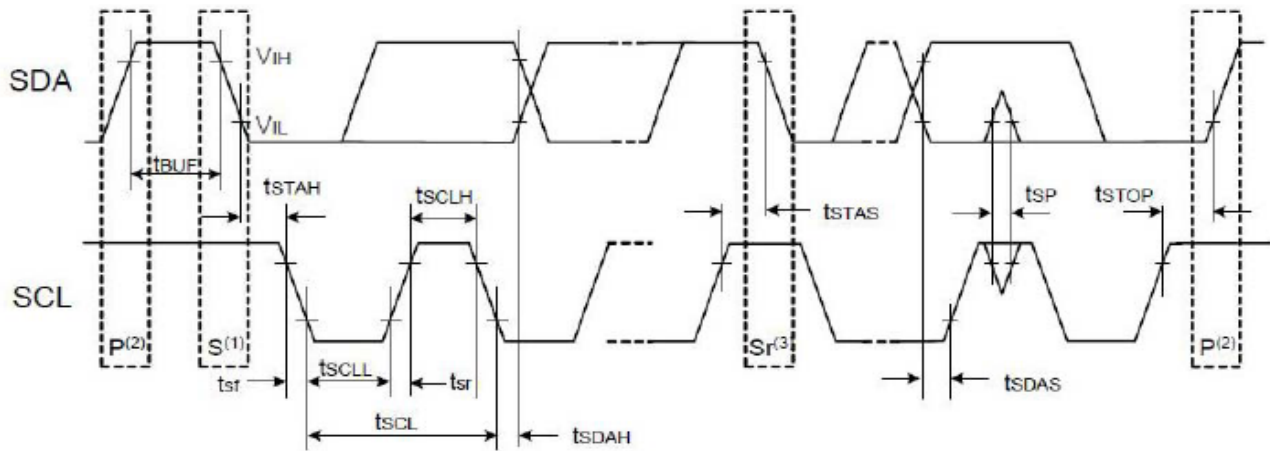
### 3 Power consumption

Symbol	Description	Fingers	F <sub>scan</sub> (Hz)	Min	Typ	Max	Unit
IVDD1	Active mode	1	130		-	4	mA
		2	60		-	5	mA
		3	50		-	5.2	mA
		4	45		-	5.4	mA
		5	40		-	5.6	mA
Isleep	Sleep mode	0	10		-	0.11	mA
	Deep sleep mode	-			-	50	uA
Ifreeze	Freeze mode	-			-	2	uA
	Boot load	-			-	6.2	mA
	Calibration	-			-	6.2	mA

#### 4 CTP Interface and Data Format [Slave address is 0x5C ( 7 bit addressing )]

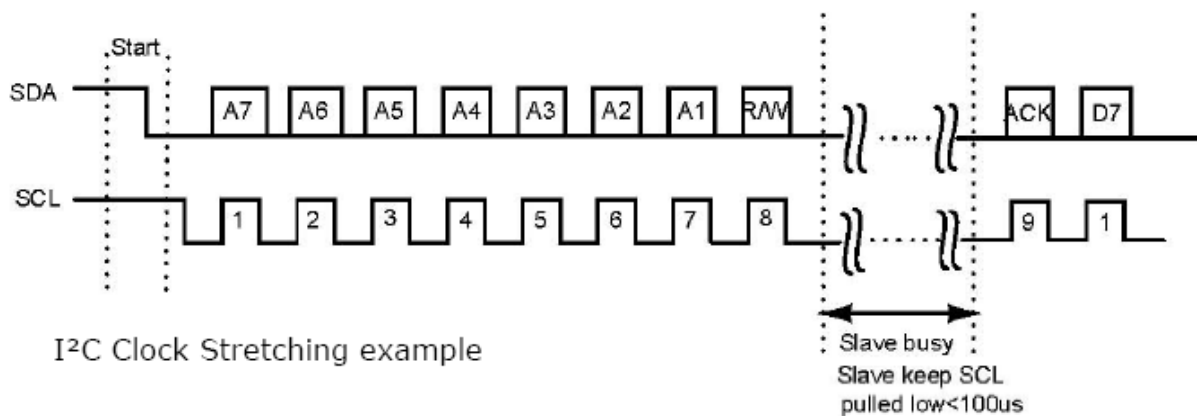
Communication protocol: I<sup>2</sup>C

Clock frequency: 100 KHz (400 KHz Fast mode)



Note : (1) Start Condition ;(2)Stop Condition;(3)Retransmit start condition

Symbol	Description	Min	Max	Unit
tSCL	SCL input cycle time	12tcyc+600	-	ns
tSCLH	SCL input H width	3tcyc+300	-	
tSCLL	SCL input L width	5tcyc+500	-	
tSF	SCL, SDA input fall time		300	
tSP	SCL, SDA input spike pulse rejection time		1 tcyc	
tSU	SDA input bus-free time	5tcyc		
tSTAH	Start condition input hold time	3tcyc		
tSTAS	Retransmit start condition input setup time	3tcyc		
tSTOP	Stop condition input setup time	3tcyc		
tSDAS	Data input setup time	1tcyc+40		
tSDAH	Data Input hold time	10		



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

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

S	START
P	STOP
A	Acknowledge
N	No acknowledge
W	WRITE
R	READ
DATA	8-bit

From slave to Master      From Master to Slave

## 5 Timing Characteristic

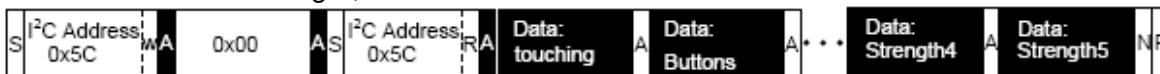
### Read Operation

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 9, table 11, table 12, and table 15. 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 as below:



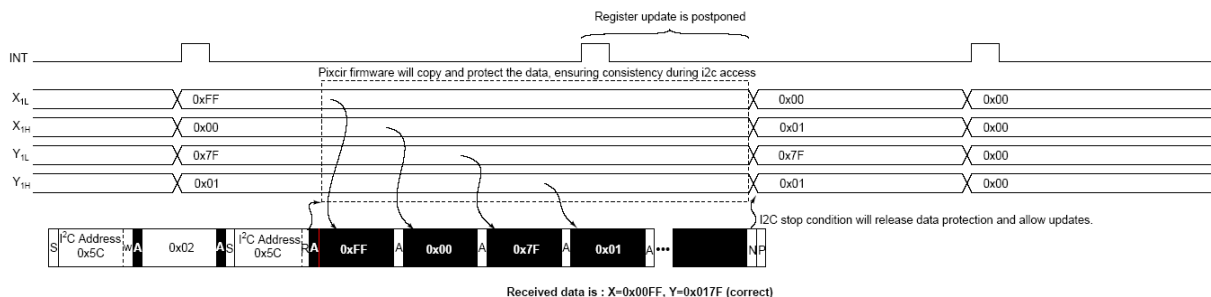
### Read operation

In a sequential read operation, the first data sent by the MSI device is therefore the touching register, and then the X and Y coordinates of the first finger, then 2nd finger, 3<sup>rd</sup> finger, 4th finger and then coordinates of the 5th finger, and so on. Refer in below:



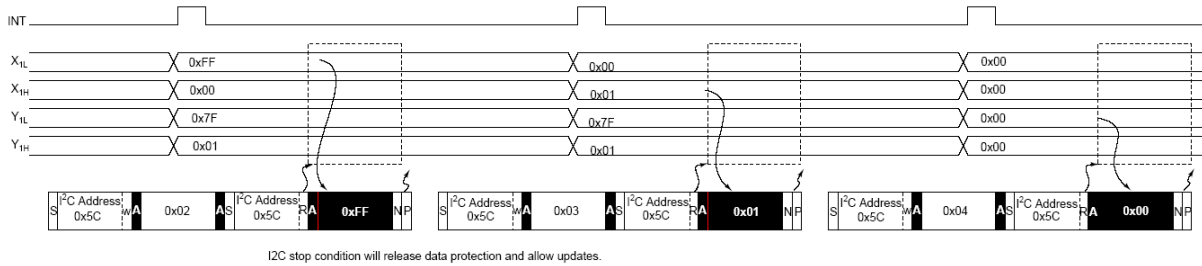
### Coordinates read operation

If the host does 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 below



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 change to give incorrect data when it gets the coordinates data with single read operation. Because the host sends many times for I2C stop condition in each multi-fingers coordinate's position reading, it will give the slave firmware chance to update the coordinates registers for I2C read operation, the host will give a combine unrelated data combines new and old coordinates together, referred to below

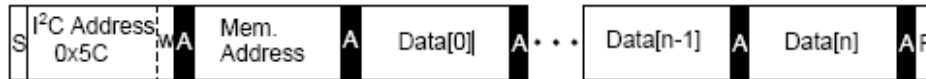




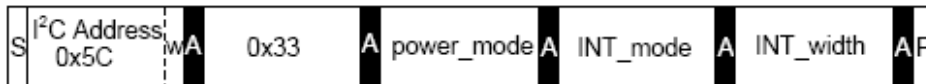
## Coordinates read operation explanation

### 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 below. Following the I2C device address, the first byte of the write packet is always the destination register address, referred in table 9, table 11, table 12, and table 15. Subsequent data values 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.



Write operation.



Write mode setting operation .

### Note1: MSI Registers

Address	Type	Name	Description	Category
0	char	touching	Bitfield, see table 10	touch
1	char	buttons	Buttons bitfield	
2 (lsb)	int	posx1	Finger #1 X position	
3 (msb)				
4 (lsb)	int	posy1	Finger #1 Y position	
5 (msb)				
6	char	id1	Finger #1 identifier	
7 (lsb)	int	posx2	Finger #2 X position	
8 (msb)				
9 (lsb)	int	posy2	Finger #2 Y position	
10 (msb)				
11	char	id2	Finger #2 identifier	
12 (lsb)	int	posx3	Finger #3 X position	
13 (msb)				
14 (lsb)	int	posy3	Finger #3 Y position	
15 (msb)				
16	char	id3	Finger #3 identifier	
17 (lsb)	int	posx4	Finger #4 X position	
18 (msb)				
19 (lsb)	int	posy4	Finger #4 Y position	
20 (msb)				
21	char	id4	Finger #4 identifier	
22 (lsb)	int	posx5	Finger #5 X position	
23 (msb)				
24 (lsb)	int	posy5	Finger #5 Y position	
25 (msb)				
26	char	id5	Finger #5 identifier	
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	

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)

Address	Type	Name	Description	Category
32 (lsb) 33 (msb)	int	initial_distance	Distance separating fingers on the first time multitouch 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		buttons
43 50	char	button1 button8	Signal level of the buttons	
51	char	power_mode	Power management register. See §2.2.3 and table 16	power management
52	char	INT_mode	Control of the ATTb pin, see §2.2.4 and table 17	
53	char	INT_width	ATTb pulse width	
54-57	char		reserved for future use	special operations
58	char	SPECOP	Special operation . See table 13	
59 (lsb) 60 (msb)	int	EEPROM_read_addr	Address used during special operation	
61	char	Engineering_cmd	Allows, with I <sup>2</sup> c, to send "hyperterminal like commands" for engineering modes	version
62 (lsb) 63 (msb)	int	CRC	FLASH CRC value (must be requested by SPECOP), excluding "EEPROM" zone	
64-95	char	version[0..31]	Customer version control (32bytes) (imap to "eeprom")	

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 14	
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) 142 (msb)	int	cross_node	Measurement result for method 1	
142 (lsb) 143 (msb) 144 (lsb) 145 (msb) etc.	int int int	RAW[0..69] shared with history_buffer	Raw data, content controlled by RAW_CTRL register, or alternatively, history buffer (see below)	RAW data

0	Normal operation
1	"EEPROM" read operation, start address must be written in EEPROM_read_addr
2	"EEPROM" write operation NOT IMPLEMENTED
3	Calibration
4	CRC checksum of the application in Flash

Bit 0	Choose function (0: history buffer, 1: RAW data, 2: system info) See table 15
Bit 1	
Bit 2	Method (0 Or 1)
Bit 3	Show offset correction (and low-pass filter 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	

Address	Type	Name	Description	Category
142	char	interval	Subsampling 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	posx	Coordinate X of the reported point, at time=0	
146 (lsb) 147 (msb)	int	posy	Coordinate Y of the reported point, at time=0	
148 (lsb) 149 (msb)	int	posx	Coordinate X of the reported point at time=1	
150 (lsb) 151 (msb)	int	posy	Coordinate Y of the reported point at time=1	
...				
298 (lsb) 299 (msb)	int	posx	Coordinate X of the reported point, at time=19	
300 (lsb) 301 (msb)	int	posy	Coordinate Y of the reported point, at time=19	

## 6 Operating Mode Register

### 6.1 POWER\_MODE Register

Address	Name	Description of POWER_MODE Register
7-4	IDLE_PERIOD[3-0]	Refer to ALLOW_SLEEP function description Idle_period_time = k * 16 * Active_scan_period_time [s], with k = value of IDLE_PERIOD[3-0] Active_scan_period_time = duration [s] of a scan period in active mode.
3	-	Not used
2	ALLOW_SLEEP	Allow self demotion from active to sleep mode, provide that this flag is set. If the MSI device is in active mode and no fingers is detected for more than IDLE_PERIOD time, then it allow AUTO JUMP 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 of the MSI device: 00:Active Mode 01:Sleep Mode 10:Deep Sleep Mode 11:Freeze Mode

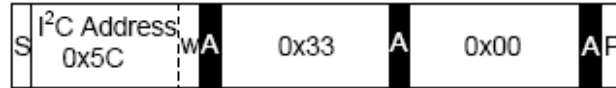
### 6.2 INT\_MODE Register

Address	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 10:INT assert only when finger touch(default)

### 6.3 Power management

#### Active mode

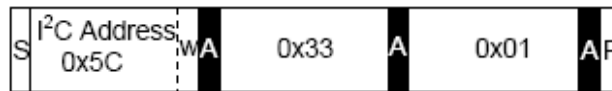
In this mode, the slave resumes with a new scan directly after each I<sup>2</sup>C transfer (after INT rising edge). This is used to reach the highest refresh rate, but also has the highest current consumption. Below shows how to force the slave into Active mode.



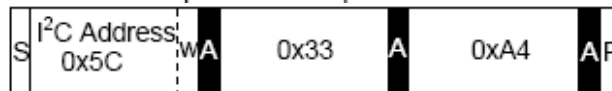
Active mode sequence

#### 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). The MSI can automatically switch to Active mode(when finger is detected, provided that ALLOW\_SLEEP bit is set in the POWER\_MODE register) or by set POWER\_MODE register. Also, the MSI 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. Figure 44 shows how to force the slave into Sleep mode. Below shows how to force the slave into Sleep mode can automatically switch, provided IDLE\_PERIOD=10.



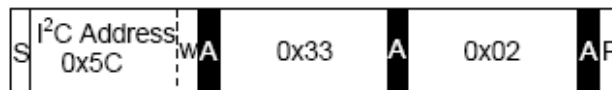
Sleep mode sequence



Sleep mode automatically switch sequence

#### Deep Sleep mode

This mode is selected to achieve the minimum consumption during very low activity phases on the sensor, which need a lowest refresh rate (1Hz). The MSI only can switch to Deep Sleep mode by set POWER\_MODE register. Below shows how to force the slave into Deep Sleep mode.

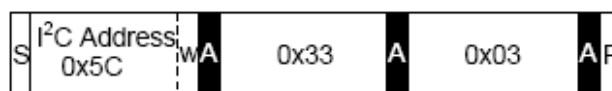


Deep Sleep mode sequence

#### 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.

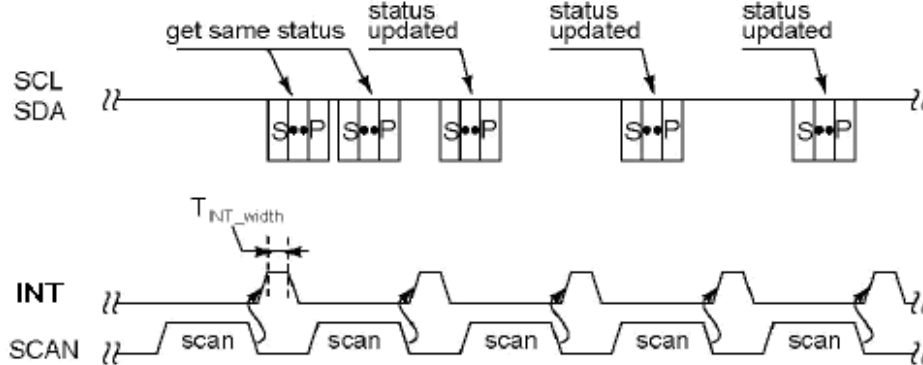
- RST pin pull down (connect to the Ground) (default)
- INT pin change ("1 to 0" or "0 to 1")



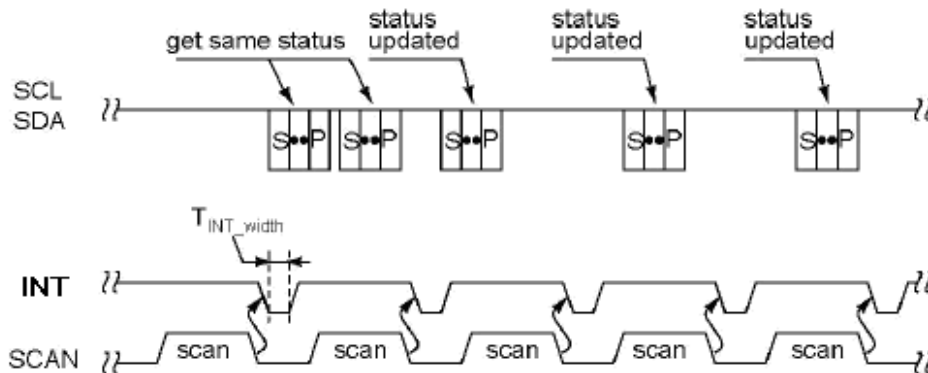
Freeze mode sequence

#### 6.4 Transition of INT line

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 below

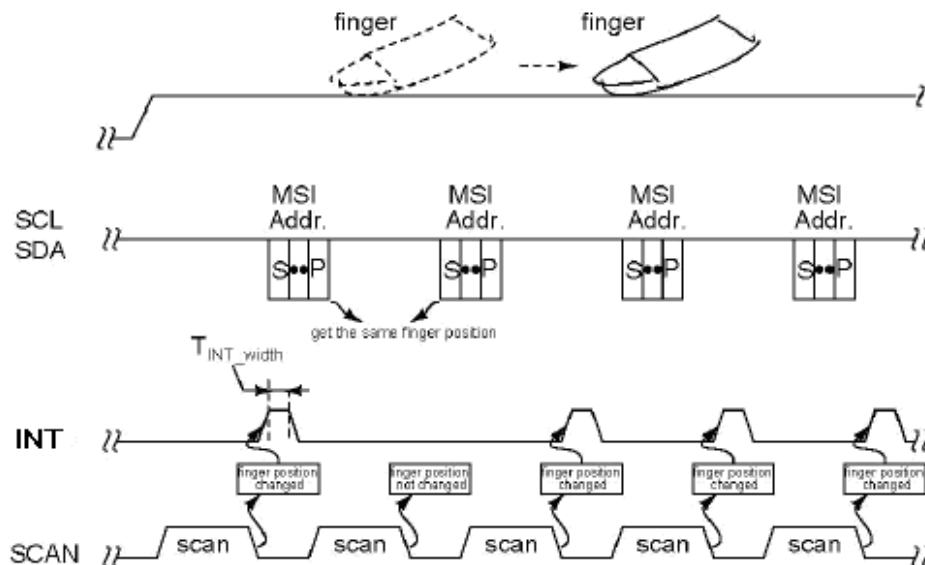


INT line pull up by slave (INT\_POL=1, INT\_MODE=00 in the INT mode register)



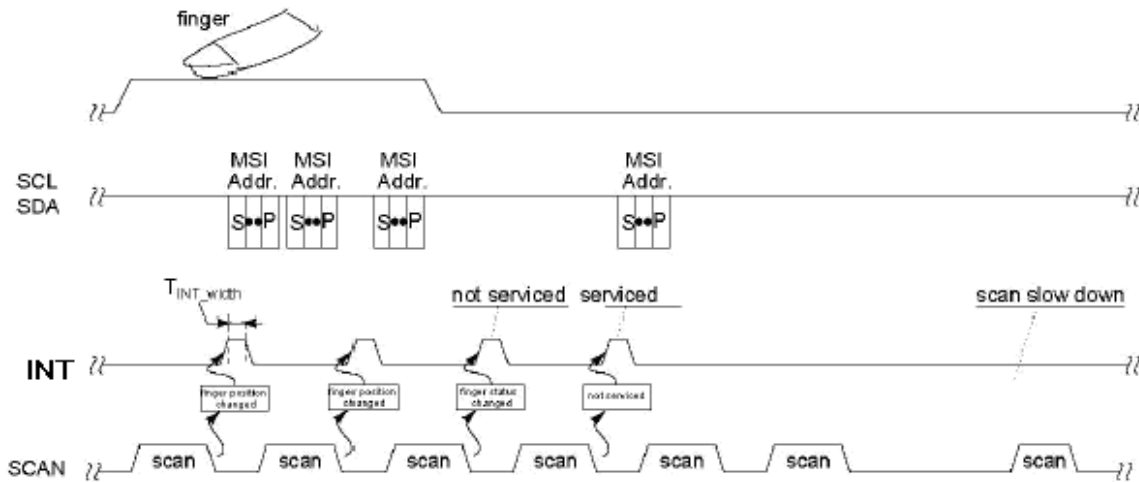
INT line pull down by slave (INT\_POL=0, INT\_MODE=00 in the INT mode register)

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 below.



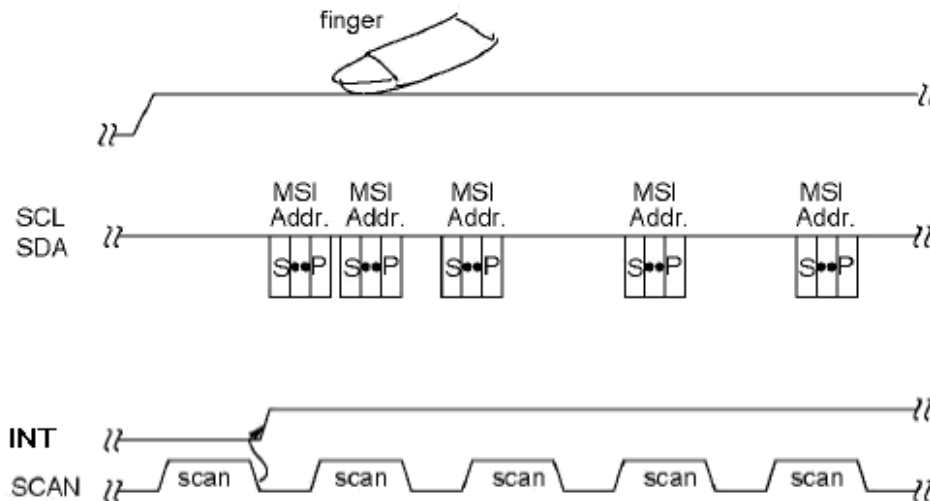
INT line pull up when finger moving (INT\_POL=1, INT\_MODE=01 in the INT mode register)

When fingers 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 below



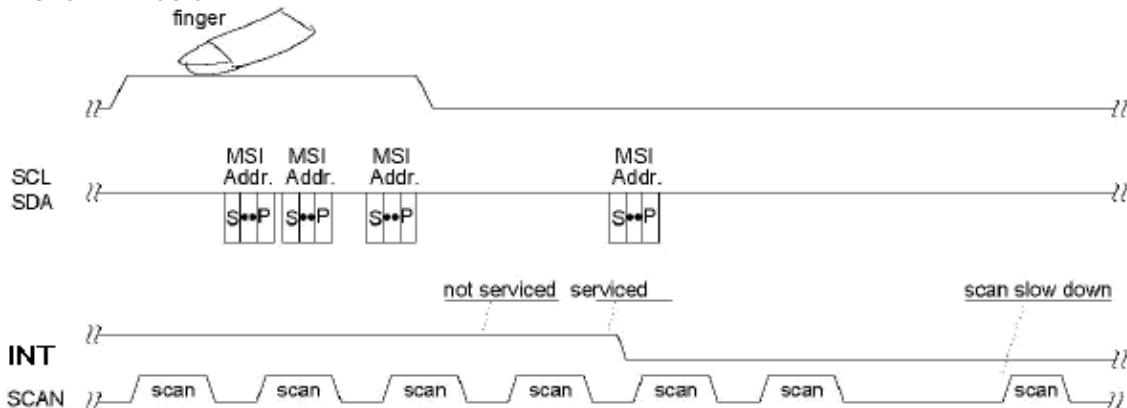
INT line will stop pulse when finger leaves and master has acknowledge the situation (INT\_POL=1 in the INT mode register)

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 below.



INT line pull up when finger touch (INT\_POL=1, INT\_MODE=10 in the INT mode register)

When fingers 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 below



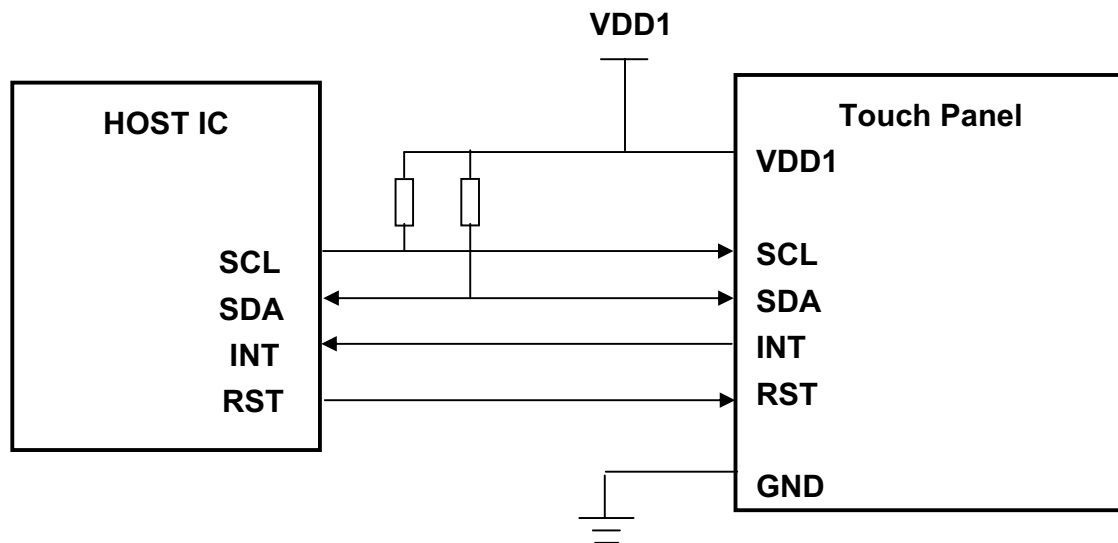
INT line will stop pulse when finger leaves and master has acknowledge the situation (INT\_POL=1 in the INT mode register)



## 7. PIN CONNECTIONS

No.	Name	I/O	Description
1	VDD1	P	Power;(VDD1=3.3V)
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

## 8. BLOCK DIAGRAM

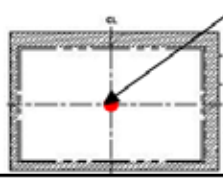
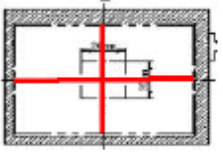


Note : 1. Use appropriate resistor value during high speed SCL clock.

Recommend resistor: 1K Ohm.

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

## 9 CTP Life Test

1	Point hitting life	> 1,000,000 ; Use 8 mm diameter silicon rubber/force 3N to knock on the same point twice per second (no-operating), after test function check pass.	
2	Line Drawing life (no contact CTP)	> 100,000; Use 11mm diameter/copper column to draw straight lines back and forth as the following red lines at the speed of 100mm/sec under system operating.	



**■ RELIABILITY TEST**

No.	Test Item	Test Condition
1	High Temperature Storage	$70 \pm 2^{\circ}\text{C}$ /120 hours
2	Low Temperature Storage	$-20 \pm 2^{\circ}\text{C}$ /120 hours
3	High Temperature Operating	$60 \pm 2^{\circ}\text{C}$ /120 hours
4	Low Temperature Operating	$-10 \pm 2^{\circ}\text{C}$ /120 hours
5	Temperature Cycle storage	$-20 \pm 2^{\circ}\text{C} \sim 25 \sim 70 \pm 2^{\circ}\text{C} \times 200$ cycles (30min.) (5min.) (30min.)
6	Damp proof Test operating	$40^{\circ}\text{C} \pm 5^{\circ}\text{C} \times 90\%\text{RH}$ /120 hours
7	Vibration Test (no-operation)	Frequency: 0~55Hz Amplitude: 1.5mm Sweep time: 11min 6 cycles for each direction of X.Y.Z
8	ESD test (No operation)	Air: $\pm 15\text{KV}$ ;Contact: $\pm 8\text{KV}$

## ■ INSPECTION CRITERION

### 1. 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.

### 2. Inspection and Environment conditions

1.1 Temperature:  $25 \pm 5^{\circ}\text{C}$

1.2 Humidity:  $55 \pm 10\% \text{ RH}$

1.3 Light source: Fluorescent Light

1.4 Inspection: Viewing distance:  $35 \pm 5\text{cm}$

1.5 Ambient Illumination:

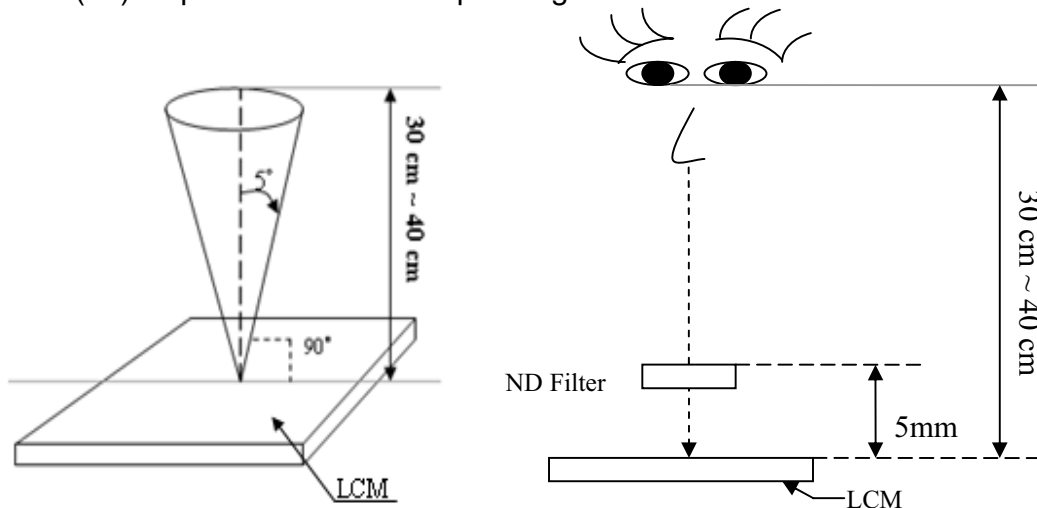
(1) Cosmetic Inspection: 500 ~ 800 lux

(2) Functional Inspection: 400 ~ 600 lux

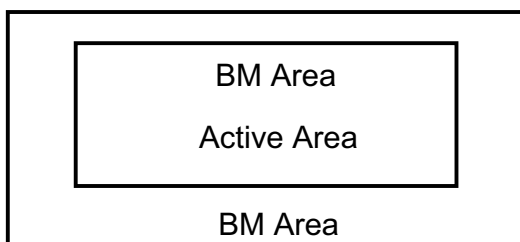
1.6 Inspection View angle:

( 1 ) Inspection under operating condition :  $\pm 5^{\circ}$

( 2 ) Inspection under non-operating condition :  $\pm 45^{\circ}$



### 3. Definition of applicable Zones






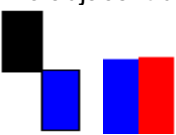
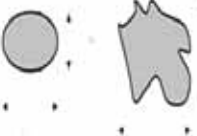
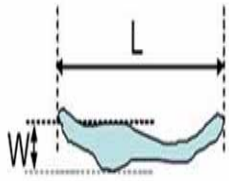
#### 4. Judgment standard

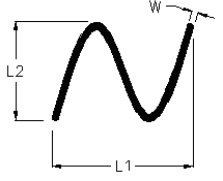
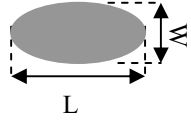
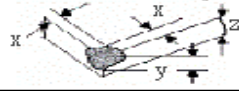
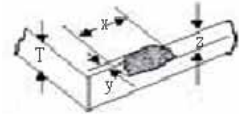
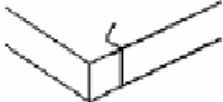
The Judgment of the above test should be made after exposure in room temperature for two hours as follow:

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.

#### 5. Cosmetic Specification and Inspection Items

Inspection Item	Inspection Criteria	Illustration												
Display function	No Display malfunction													
Contrast ratio	Does not meet specified range in the spec.	(Major) (Note:2)												
Line Defect	No obvious Vertical and Horizontal line defect in black and White.													
Point Defect	<table border="1"> <thead> <tr> <th>Item</th><th>Acceptable number</th><th>Total</th></tr> </thead> <tbody> <tr> <td>Bright</td><td>2</td><td>5</td></tr> <tr> <td>Dark</td><td>4</td><td></td></tr> <tr> <td>Two adjacent dot</td><td>2</td><td>2</td></tr> </tbody> </table>	Item	Acceptable number	Total	Bright	2	5	Dark	4		Two adjacent dot	2	2	<p>One Dot</p>  <p>Two adjacent dot</p> 
Item	Acceptable number	Total												
Bright	2	5												
Dark	4													
Two adjacent dot	2	2												
Foreign material (Black or White spots shape)	<table border="1"> <thead> <tr> <th>Zone Dimension</th><th>Acceptable number</th><th>Class of Defects</th></tr> </thead> <tbody> <tr> <td><math>D &gt; 0.8 \text{ mm}</math></td><td>0</td><td rowspan="3">Minor</td></tr> <tr> <td><math>0.3 \text{ mm} \leq D \leq 0.8 \text{ mm}</math></td><td>5</td></tr> <tr> <td><math>D &lt; 0.3 \text{ mm}</math></td><td>*</td></tr> </tbody> </table>	Zone Dimension	Acceptable number	Class of Defects	$D > 0.8 \text{ mm}$	0	Minor	$0.3 \text{ mm} \leq D \leq 0.8 \text{ mm}$	5	$D < 0.3 \text{ mm}$	*	 <p><math>D = (L + W) / 2</math></p>		
Zone Dimension	Acceptable number	Class of Defects												
$D > 0.8 \text{ mm}$	0	Minor												
$0.3 \text{ mm} \leq D \leq 0.8 \text{ mm}$	5													
$D < 0.3 \text{ mm}$	*													
Foreign Material (Line shape)	<table border="1"> <thead> <tr> <th>Zone Dimension</th><th>Acceptable number</th><th>Class of Defects</th></tr> </thead> <tbody> <tr> <td><math>W &gt; 0.1 \text{ mm}</math> or <math>L &gt; 10 \text{ mm}</math></td><td>0</td><td rowspan="3">Minor</td></tr> <tr> <td><math>0.05 \text{ mm} \leq W \leq 0.1 \text{ mm}</math> and <math>L \leq 10 \text{ mm}</math></td><td>5</td></tr> <tr> <td><math>W &lt; 0.05 \text{ mm}</math></td><td>*</td></tr> </tbody> </table>	Zone Dimension	Acceptable number	Class of Defects	$W > 0.1 \text{ mm}$ or $L > 10 \text{ mm}$	0	Minor	$0.05 \text{ mm} \leq W \leq 0.1 \text{ mm}$ and $L \leq 10 \text{ mm}$	5	$W < 0.05 \text{ mm}$	*	 <p>L : Long W : Width</p>		
Zone Dimension	Acceptable number	Class of Defects												
$W > 0.1 \text{ mm}$ or $L > 10 \text{ mm}$	0	Minor												
$0.05 \text{ mm} \leq W \leq 0.1 \text{ mm}$ and $L \leq 10 \text{ mm}$	5													
$W < 0.05 \text{ mm}$	*													
Non-uniformity	Visible through 5 %ND filter White, R, G, B and gray 50% pattern.	(Minor)												
Dimension	Outline	(Major)												
Bezel appearance	uneven	(Minor)												

Scratch on the Touch panel	<table> <tr> <th>Zone Dimension</th><th>Acceptable number</th><th>Class of Defects</th></tr> <tr> <td><math>W &gt; 0.1\text{mm}</math> or <math>L &gt; 10\text{mm}</math></td><td>0</td><td rowspan="2">Minor</td></tr> <tr> <td><math>W \leq 0.1\text{ mm}</math> <math>L \leq 10\text{mm}</math></td><td>5</td></tr> </table>	Zone Dimension	Acceptable number	Class of Defects	$W > 0.1\text{mm}$ or $L > 10\text{mm}$	0	Minor	$W \leq 0.1\text{ mm}$ $L \leq 10\text{mm}$	5	
Zone Dimension	Acceptable number	Class of Defects								
$W > 0.1\text{mm}$ or $L > 10\text{mm}$	0	Minor								
$W \leq 0.1\text{ mm}$ $L \leq 10\text{mm}$	5									
Dent on the Touch panel	<table> <tr> <th>Zone Dimension</th><th>Acceptable number</th><th>Class of Defects</th></tr> <tr> <td><math>D &gt; 0.5\text{ mm}</math></td><td>0</td><td rowspan="2">Minor</td></tr> <tr> <td><math>0.3\text{mm} \leq D \leq 0.5\text{ mm}</math></td><td>5</td></tr> </table>	Zone Dimension	Acceptable number	Class of Defects	$D > 0.5\text{ mm}$	0	Minor	$0.3\text{mm} \leq D \leq 0.5\text{ mm}$	5	 <p><math>D = (L + W) / 2</math></p>
Zone Dimension	Acceptable number	Class of Defects								
$D > 0.5\text{ mm}$	0	Minor								
$0.3\text{mm} \leq D \leq 0.5\text{ mm}$	5									
Polarizer flaw or leak out resin	Defect is defined as the active area.									
Corner Chipping	$X < 3\text{ mm}$ , $Y < 3\text{ mm}$ , $Z < \text{Glass thickness}$									
Edge Chipping	$X < 3\text{ mm}$ , $Y < 3\text{ mm}$ , $Z < \text{Glass thickness}$									
Crack	reject									

## ■PRECAUTIONS FOR USING LCD MODULES

### Handling 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.

### Handling precaution for LCM

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

#### Correct handling:

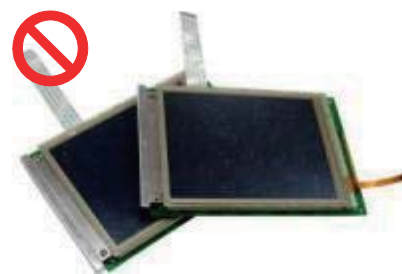


As above picture, please handle with anti-static gloves around LCM edges.

#### Incorrect handling:



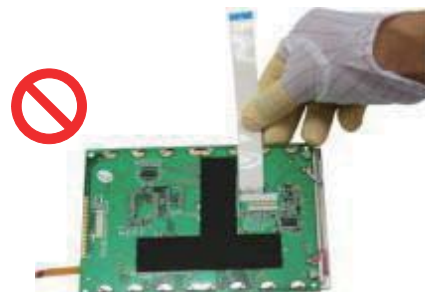
Please don't touch IC directly.



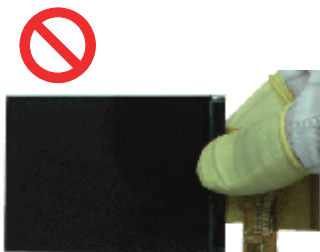
Please don't stack LCM.



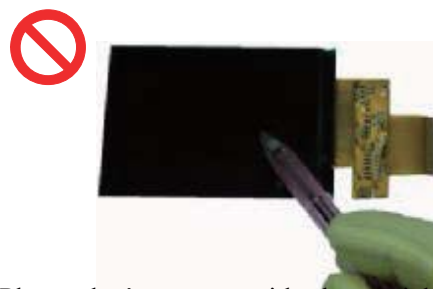
Please don't hold the surface of panel.



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



Please don't hold the surface of IC.



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

### 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.

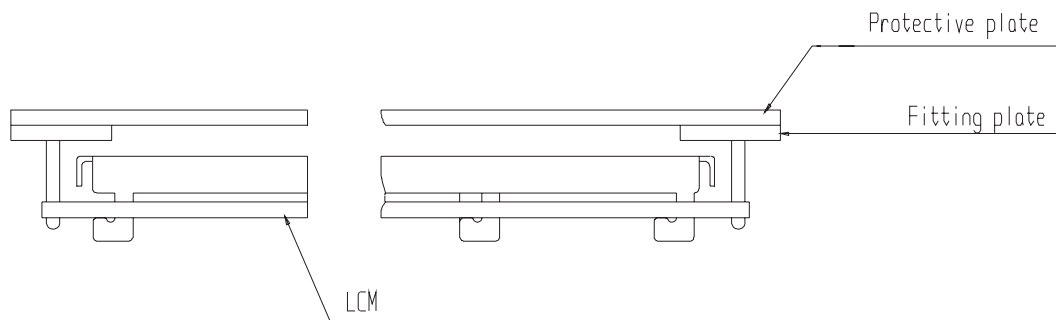
- Exposed area of the printed circuit board.
- Terminal electrode sections.

## ■ 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.

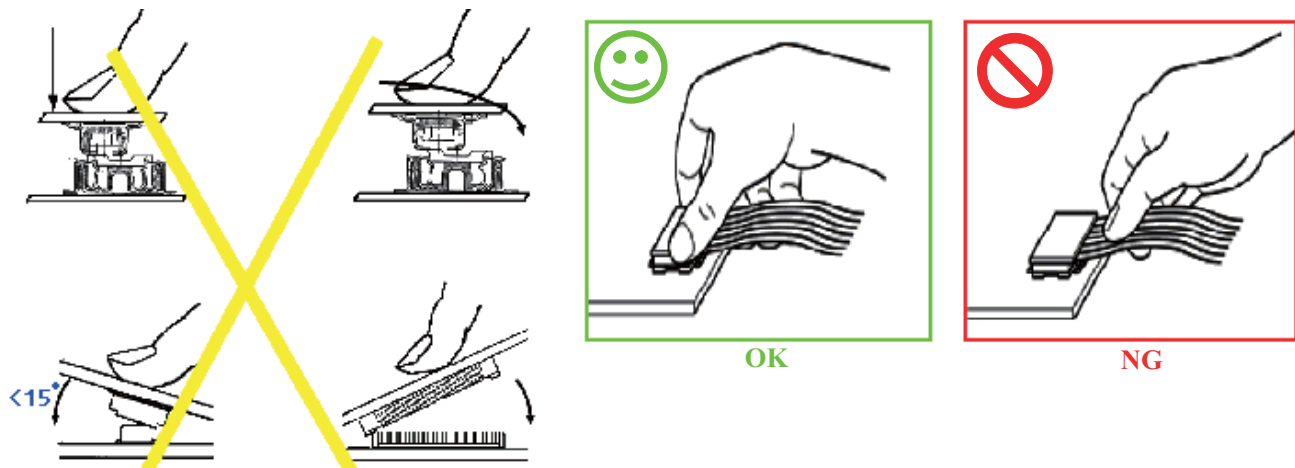
- (1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



- (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  $\pm 0.1$  mm.

### 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 the LCM

	Manual soldering	Machine drag soldering	Machine press soldering
<b>No ROHS product</b>	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
<b>ROHS product</b>	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 logic voltage before apply analog high voltage such as LCD driving voltage when power on. Remove analog high voltage before logic voltage when power off the module. 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 between Multi-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.