MULTI-INNO TECHNOLOGY CO., LTD.

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LCD MODULE SPECIFICATION

Model : MI0700XT-5

For Customer's Acceptance:

Customer	
Approved	
Comment	

Revision	1.1
Engineering	
Date	2012-08-20
Our Reference	

REVISION RECORD

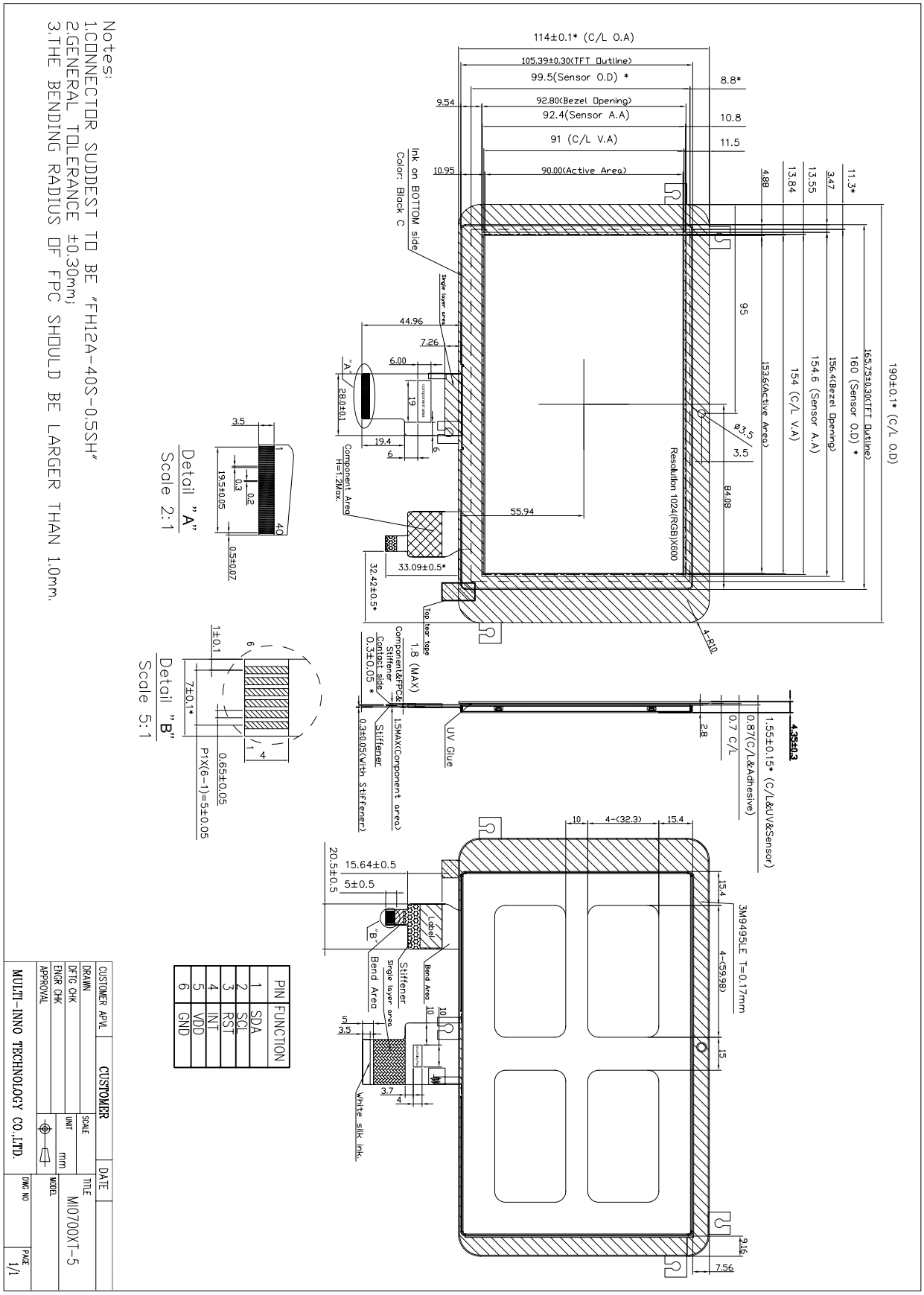
REV NO.	REV DATE	CONTENTS	REMARKS
1.0	2012-05-24	First release	
1.1	2012-08-20	TFT thickness change	

CONTENTS

■ GENERAL INFORMATION

Item	Contents	Unit/note
LCD type	TFT/Transmissive/Normally white	/
Size	7.0	Inch
Viewing direction	6:00	O ' Clock
Module area (W × H x D)	190.00 × 114.00 ×4.35	mm^3
Active area (W×H)	153.60×90.00	mm^2
Dot pitch (W × H)	0.05 × 0.15	mm^2
Number of Dots	1024×(3RGB)× 600	/
Surface treatment	Plant,Glare	/
Color arrangement	RGB-stripe	/
Colors	262K/16.7M	/
Backlight Type	LED	/
Interface Type	LVDS	/
Input voltage	3.3	V
Module weight	--	g
With/Without TSP	With CTP	/

■ EXTERNAL DIMENSIONS



■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Power supply voltage	DVDD	-0.3	5.0	V
	AVDD	6.5	13.5	V
	VGH	-0.3	42.0	V
	VGL	-20.0	0.3	V
	VGH-VGL	-	40.0	V
Operating temperature	Top	-10	60	°C
Storage temperature	TST	-20	70	°C
Humidity	RH	10%	90%(Max60 °C)	RH
LED reverse voltage (each led)	VR	-	5	V
LED forward current(each led)	IF	-	35	mA

Note 1: The absolute maximum rating values of this product are not allowed to be exceeded at any times. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

■ ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	DVDD	3.0	3.3	3.6	V
	VGH	19.7	20.0	20.3	V
	VGL	-6.5	-6.8	-7.1	V
	AVDD	10.8	11	11.2	V
VCOM	VCOM	2.7	3.7	4.7	V
Input voltage 'H' level	VIH	0.7DVDD	-	DVDD	V
Input voltage 'L' level	VIL	0	-	0.3DVDD	V

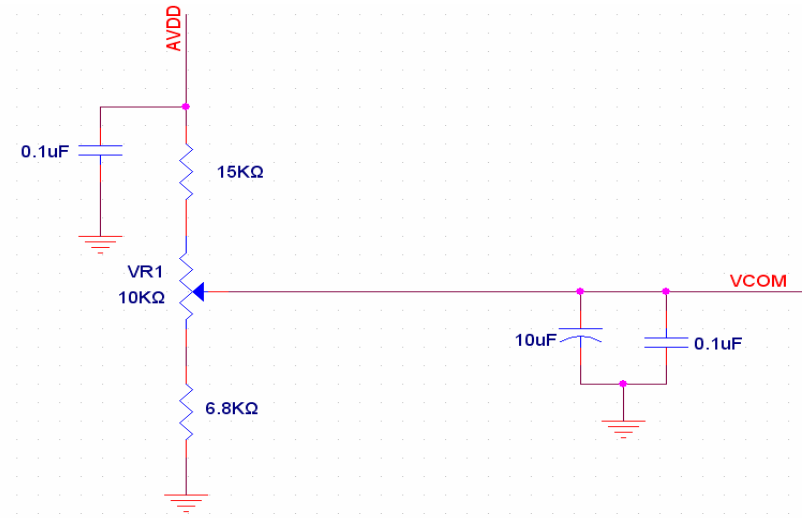
$_{DD}$ and V_{GL} to the LCD first, and then apply V_{GH}

Note 2: DV_{DD} setting should match the signals output voltage (refer to Note 3) of customer's system board.

Note 3: LVDS, Reset.

$_{COM}$ is only a reference value, it must be optimized according to each LCM.

Be sure to use VR;



CURRENT CONSUMPTION

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Current for Driver	I_{GH}	-	0.25	1.0	mA	V_{GH} =20V
	I_{GL}	-	0.25	1.0	mA	V_{GL} = -6.8V
	IDV_{DD}	-	38	60	mA	DV_{DD} =3.3V
	IAV_{DD}	-	20	30	mA	AV_{DD} =11V

■ BACKLIGHT CHARACTERISTICS

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Voltage for LED backlight	V_L	--	9.3	10.2	V	Note 1
Current for LED backlight	I_L	--	160	200	mA	
LED life time	-	-	20,000	-	Hr	Note 2

Note 1: The LED Supply Voltage is defined by the number of LED at Ta=25℃ and $_L$ =160mA.

Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and I_L =160mA. The LED lifetime could be decreased if operating I_L is lager than 160mA.

■ ELECTRO-OPTICAL CHARACTERISTICS

Item of electro-optical characteristics	Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time	Tr+Tf	θ=0° ∅=0° Ta=25℃	-	25	50	--	FIG 1.	4
Contrast ratio	Cr		500	700	-	--	FIG 2.	1
Luminance uniformity	δ WHITE		70	75	-	%	FIG 2.	3
Surface Luminance	Lv		170	212	-	cd/m^2	FIG 2.	2
Viewing angle range	θ	∅ = 90°	60	70	-	deg	FIG 3.	6
		∅ = 270°	65	75	-	deg	FIG 3.	
		∅ = 0°	65	75	-	deg	FIG 3.	
		∅ = 180°	65	75	-	deg	FIG 3.	
CIE (x, y) chromaticity	Red x	θ=0° ∅=0° Ta=25℃	-	-	-	-	FIG 2.	5
	Red y		-	-	-	-		
	Green x		-	-	-	-		
	Green y		-	-	-	-		
	Blue x		-	-	-	-		
	Blue y		-	-	-	-		
	White x		0.260	0.310	0.360	-		
	White y		0.280	0.330	0.380	-		

Note1. Contrast Ratio(CR) is defined mathematically by the following formula. For more information see FIG 2.:

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P 1,P2, P 3,P4, P5)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P 3,P4, P5)}}$$

Note2. 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)

Note3. 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.

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

Note4. 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..

Note5. CIE (x, y) chromaticity ,The x,y value is determined by screen active area position 5. For more information see FIG 2.

Note6. 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.

Note7. 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 and CIE， the testing data is base on TOPCON's BM-5 photo detector.

Note8. For TFT module, Gray scale reverse occurs in the direction of panel viewing angle

FIG.1. The definition of Response Time

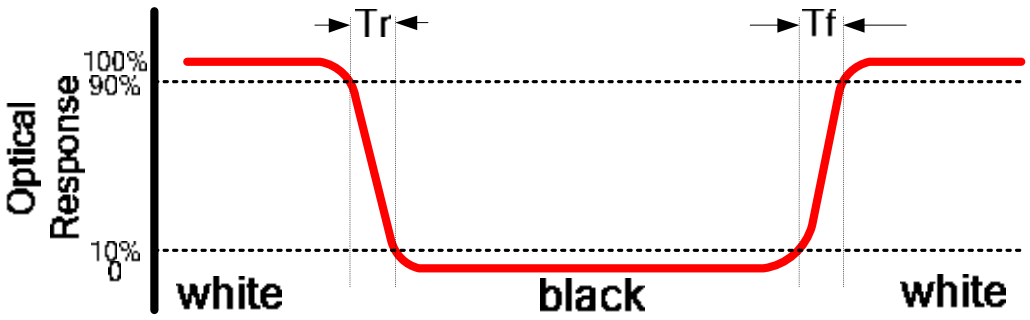


FIG.2. Measuring method for Contrast ratio,surface luminance, Luminance uniformity , CIE (x, y) chromaticity

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

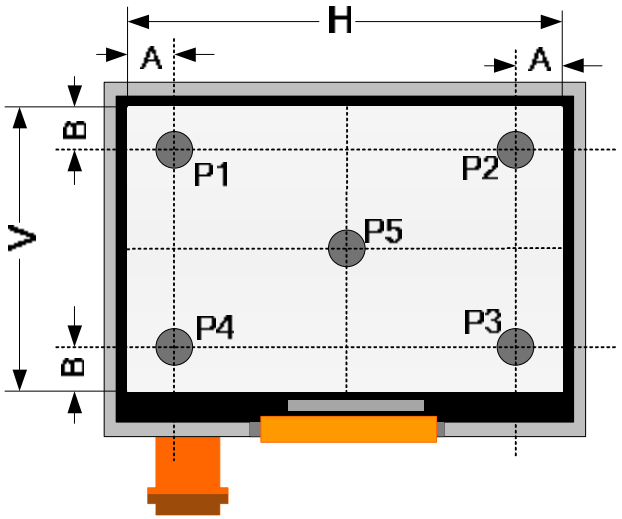
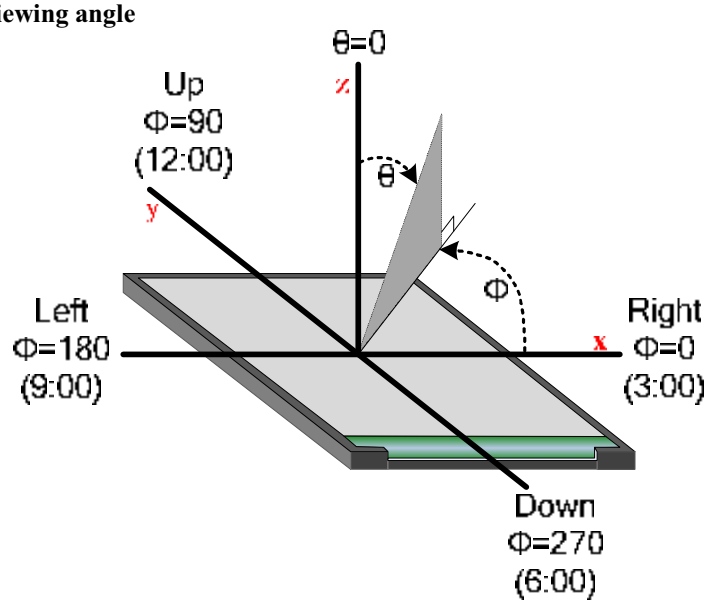


FIG.3. The definition of viewing angle



■ INTERFACE DESCRIPTION

FPC Connector is used for the module electronics interface. The recommended model is FH12A-40S-0.5SH manufactured by Hirose.

Pin No.	Symbol	I/O	Function	Remark
1	VCOM	P	Common Voltage	
2	VDD	P	Power Voltage for digital circuit	
3	VDD	P	Power Voltage for digital circuit	
4	NC	---	No connection	
5	Reset	I	Global reset pin	
6	STBYB	I	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	P	Ground	
8	RXIN0-	I	- LVDS differential data input	
9	RXIN0+	I	+ LVDS differential data input	
10	GND	P	Ground	
11	RXIN1-	I	- LVDS differential data input	
12	RXIN1+	I	+ LVDS differential data input	
13	GND	P	Ground	
14	RXIN2-	I	- LVDS differential data input	
15	RXIN2+	I	+ LVDS differential data input	
16	GND	P	Ground	
17	RXCLKIN-	I	- LVDS differential clock input	
18	RXCLKIN+	I	+ LVDS differential clock input	
19	GND	P	Ground	
20	RXIN3-	I	- LVDS differential data input	
21	RXIN3+	I	+ LVDS differential data input	
22	GND	P	Ground	
23	NC	---	No connection	
24	NC	---	No connection	
25	GND	P	Ground	
26	NC	---	No connection	

27	DIMO	O	Backlight CABC controller signal output	
28	SELB	I	6bit/8bit mode select	Note1
29	AVDD	P	Power for Analog Circuit	
30	GND	P	Ground	
31	LED-	P	LED Cathode	
32	LED-	P	LED Cathode	
33	L/R	I	Horizontal inversion	Note3
34	U/D	I	Vertical inversion	Note3
35	VGL	P	Gate OFF Voltage	
36	CABCEN1	I	CABC H/W enable	Note2
37	CABCEN0	I	CABC H/W enable	Note2
38	VGH	P	Gate ON Voltage	
39	LED+	P	LED Anode	
40	LED+	P	LED Anode	

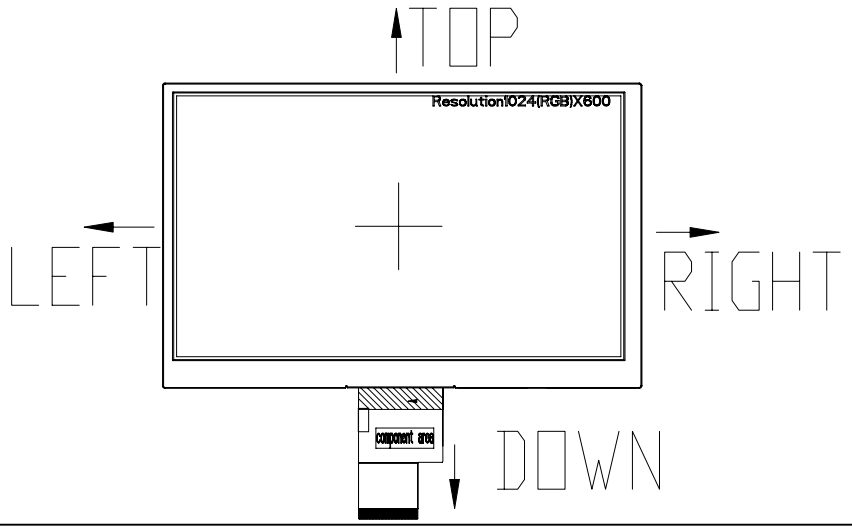
I: input, O: output, P: Power

Note1: 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.

Note2: 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.

Note3: 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.

Note: Definition of scanning direction.
Refer to the figure as below:



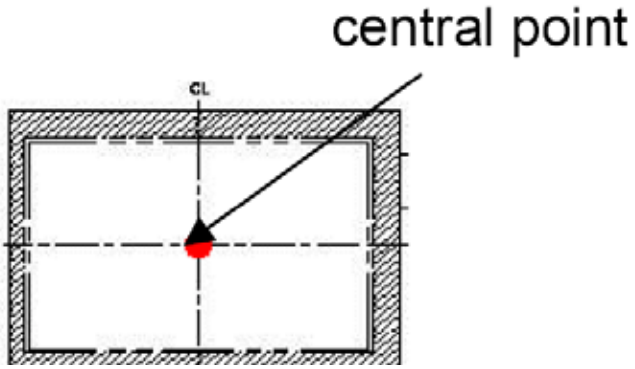
■ TOUCH SCREEN PANEL SPECIFICATIONS

1. GENERAL SPECIFICATIONS

Composition: 7inch Capacitive Touch Panel (CTP).
Interface: I^2C for the CTP.

Item	Specification	Unit
Type	Transparent type projected capacitive touch panel	
Input mode	Human's finger	
Finger	5	
Resolution	1024 x 600	dots
Outline Dimension	190(W) x 114(H) x 1.55(D)	mm
Sensor Active Area	154.6(W)(typ.) x92.4(H)(typ.)	mm
Transparency	≧85%	%
Haze	≦5.0%	%
Hardness	7H (typ.)[by JIS K5400]	Pencil hardness
Weight	74	g
Report rate	Max：122	Points/sec
Response time	15	ms
Point hitting life time	1,000,000 times min.	Note 1

Note 1: 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. ABSOLUTE MAXIMUM RATINGS

Symbol	Description	Min	Typ	Max	Unit	Notes
VDD	Supply voltage	-0.3	-	6.5	V	
VIO	DC input voltage	-0.3	-	VDD+0.3	V	

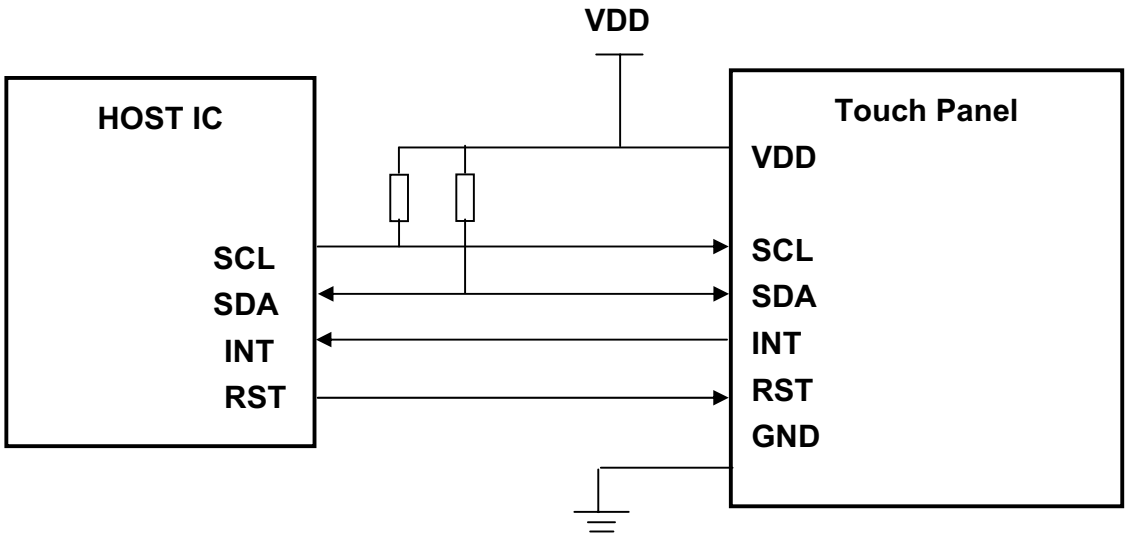
3. ELECTRICAL CHARACTERISTICS

Symbol	Description	Fingers	F_{scan}(Hz)	Min	Typ	Max	Unit
VDD	Supply voltage			2.5	3.3	3.6	V
GND	Supply voltage			-	0	-	V
V_{IH}	Input H voltage			0.8VDD	-	VDD	V
V_{IL}	Input L voltage			0	-	0.2VDD	V
	System clock frequency					20	MHz
	CPU clock frequency					20	MHz
I	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
	bootload	-			-	6.2	mA
	Calibration	-			-	6.2	mA

4. PIN CONNECTIONS

No.	Name	I/O	Description
1	SDA	I/O	Serial data access
2	SCL	I	Clock; 100KHz
3	RST	I	Reset
4	INT	O	Active low when data output from touch panel
5	VDD	P	Power; VDD=3.3V(typ.)
6	GND	P	Ground

5. BLOCK DIAGRAM



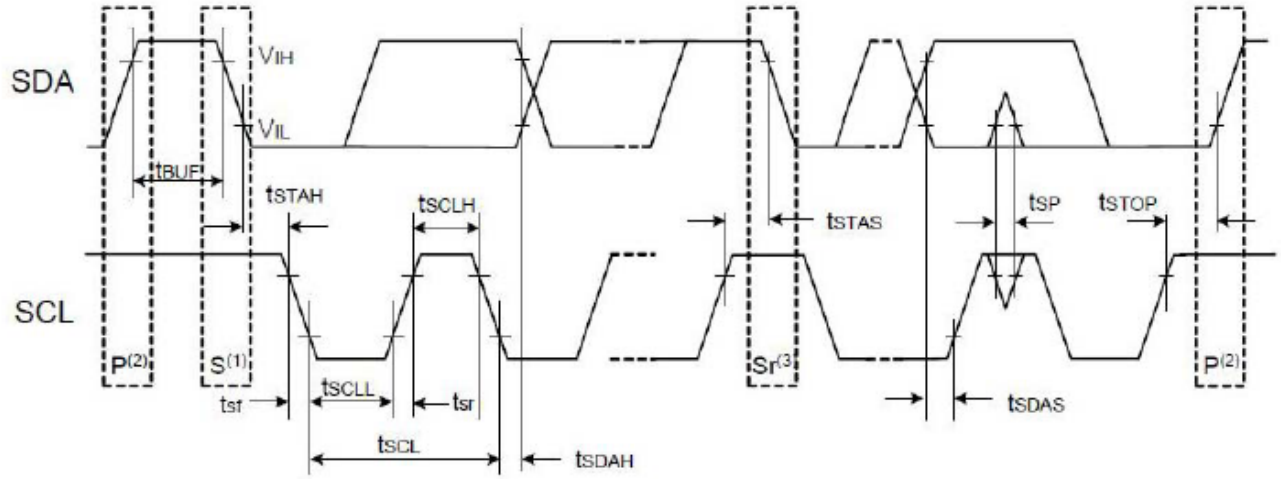
Note：1. USE APPROPRIATE RESISTOR VALUE DURING HIGH SPEED SCL CLOCK.
SUGGESTION : RESISTOR RECOMMENDATION：1K ohm.
2. To reduce the noise from the power, we suggest you use the independent power for the touch panel (VDD)

6. TIMING SPECIFICATIONS

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

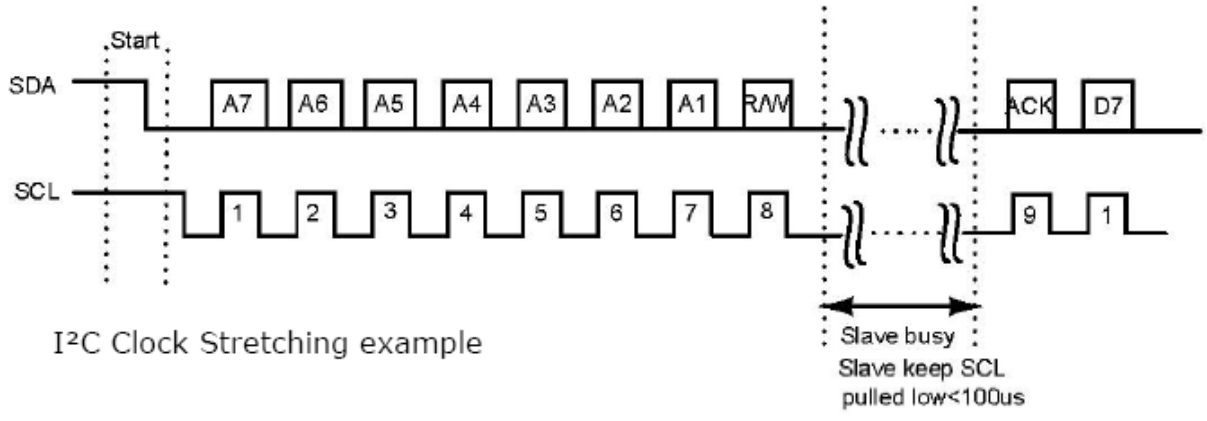
Communication protocol: I^2C

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	
tSUF	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		



I²C Clock Stretching example

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.

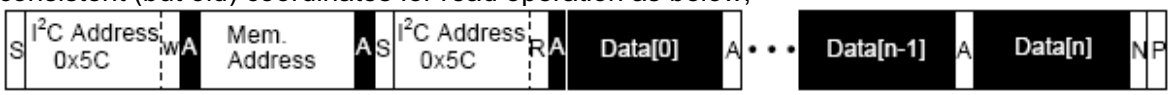
S	START
P	STOP
A	Acknowledge
N	No acknowledge
W	WRITE
R	READ
DATA	8-bit

From slave to Master	From Master to Slave

6.2 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,

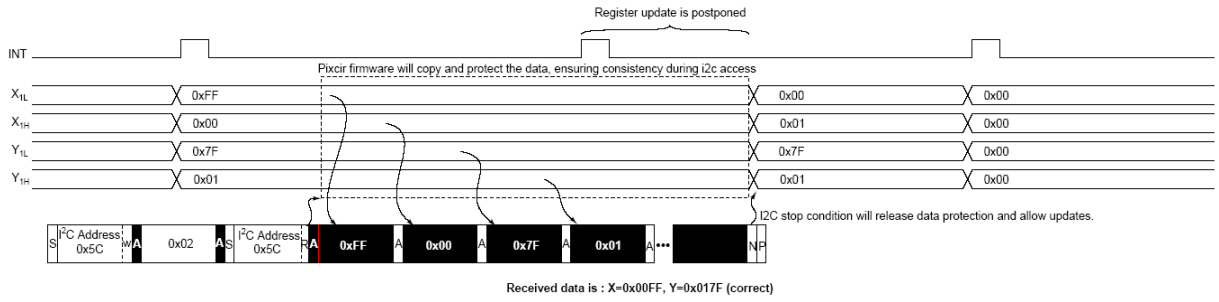


Read operation

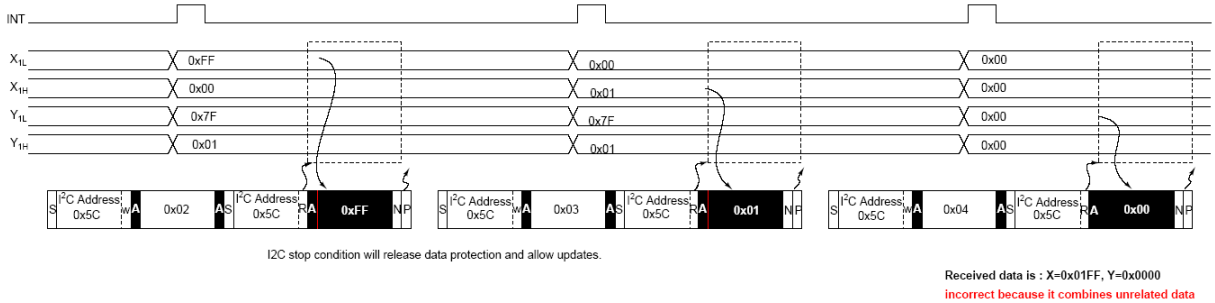
In a sequential read operation, the first data sent by the MSI device is therefore the touching register, and then the X and Y coordinates of the first finger, then 2nd finger, 3rd finger, 4th finger and then coordinates of the 5th finger, and so on. Refer in below,

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

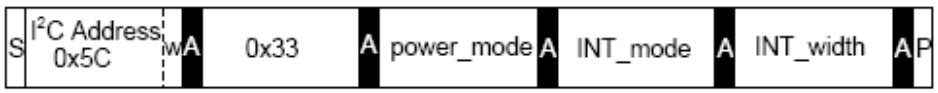


Coordinates read operation explanation

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) 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	

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		
43 50	char	button1 button8	Signal level of the buttons	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 I²c, to send "hyperterminal like commands" for engineering modes	
62 (lsb) 63 (msb)	int	CRC	FLASH CRC value (must be requested by SPECOP), excluding "EEPROM" zone	version
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 Bit 1	Choose function (0: history buffer, 1: RAW data, 2: system info) See table 15
Bit 2	Method (0 0r 1)
Bit 3	Show offset correction (and low-pass fiter 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	

6.3 Operating Mode Register

6.3.1 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

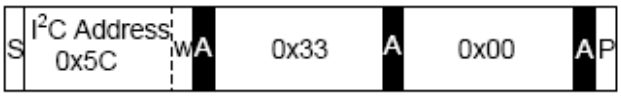
6.3.2 INT_MODE Register

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)

7.3.3 Power management

Active mode

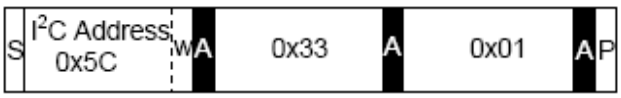
In this mode, the slave resumes with a new scan directly after each I²C transfer (after INT rising edge). This is used to reach the highest refresh rate, but also has the highest current consumption. Below shows how to force the slave into Active mode.



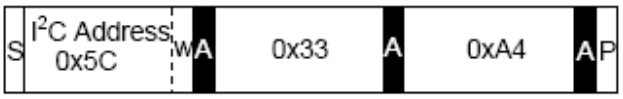
Active mode sequence

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.



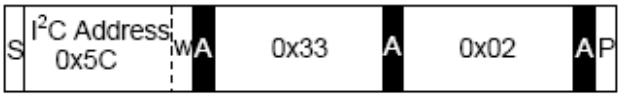
Sleep mode sequence



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.

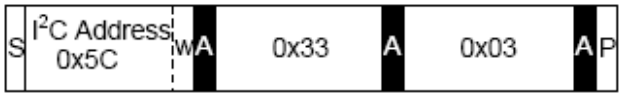


Deep Sleep mode sequence

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.

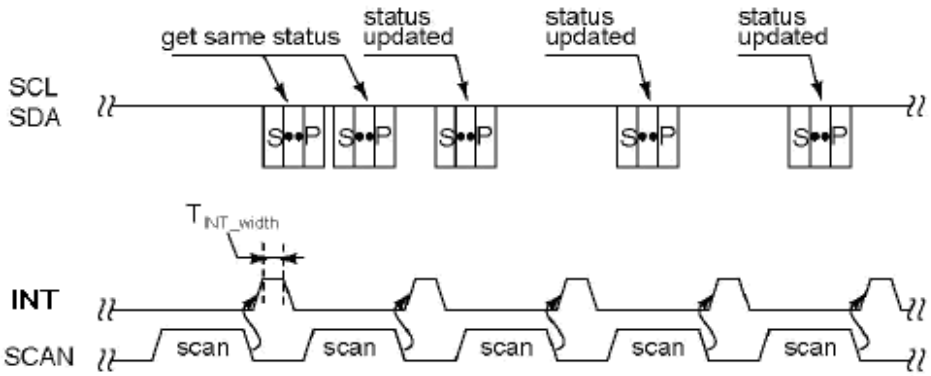
- RST pin pull down (connect to the Ground) (default)
- INT pin change (“1 to 0” or “0 to 1”)



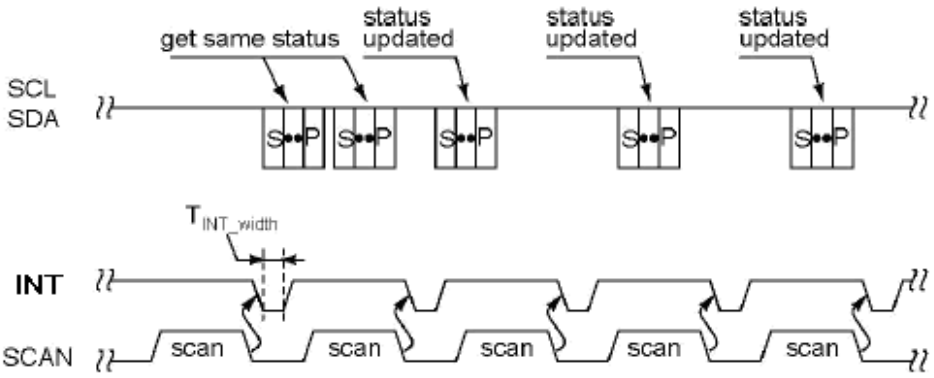
Freeze mode sequence

6.3.4 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

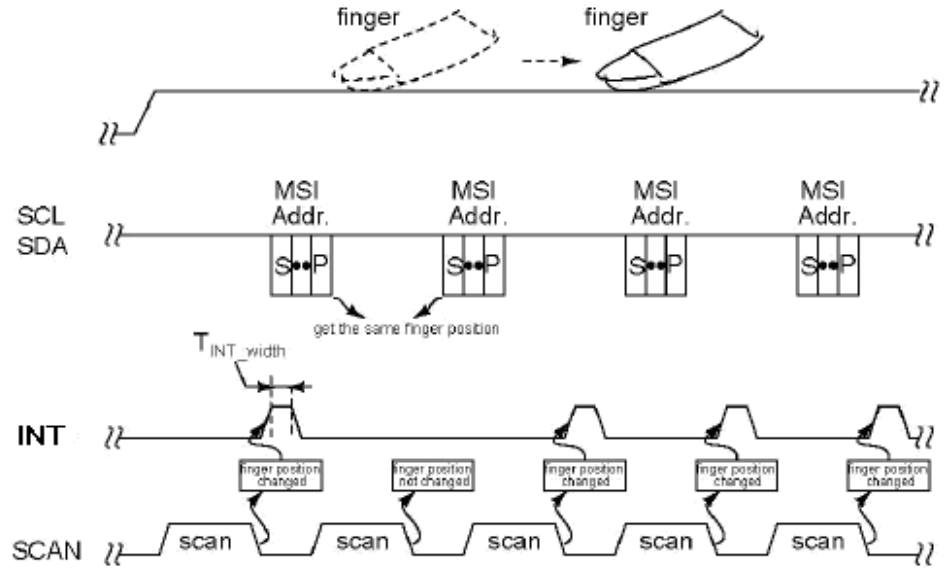


INT line pull up by slave (INT_POL=1, INT_MODE=00 in the INT mode register)



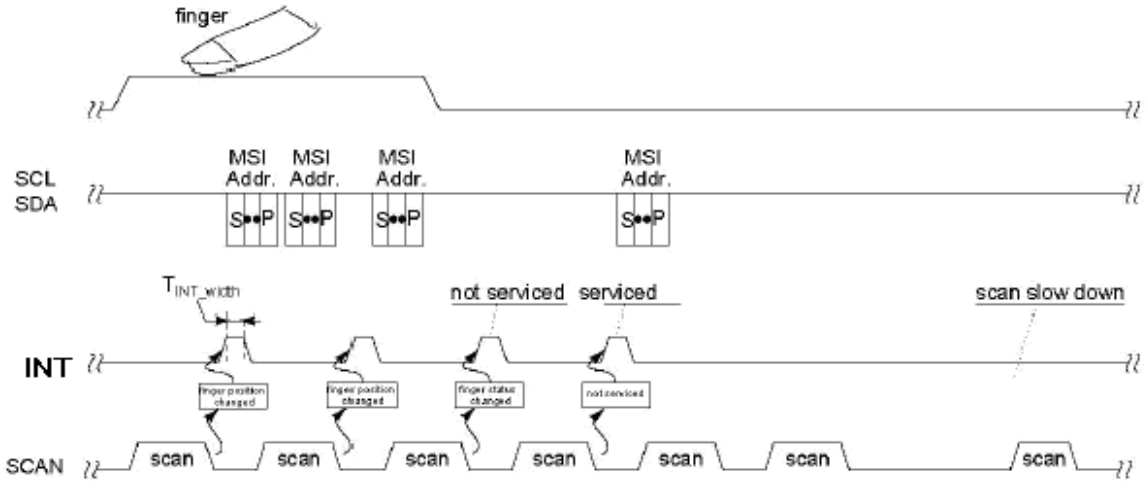
INT line pull down by slave (INT_POL=0, INT_MODE=00 in the INT mode register)

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.



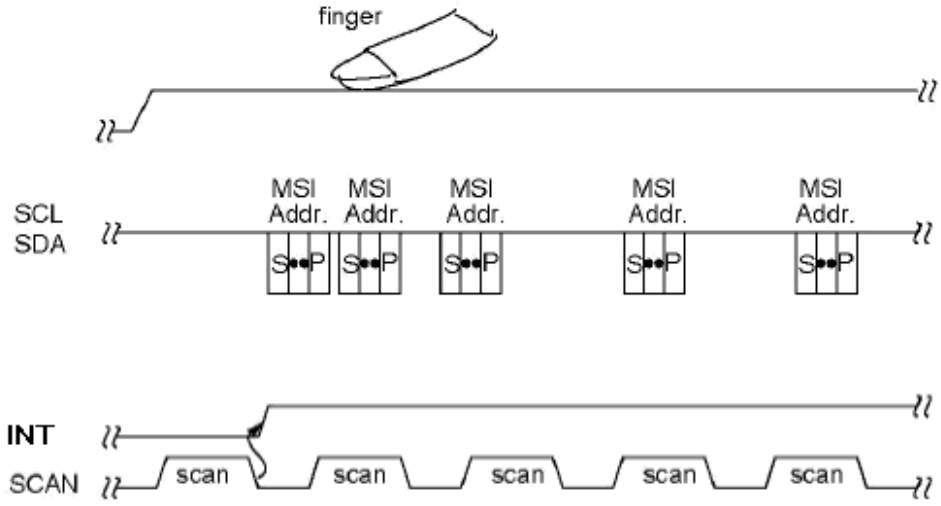
INT line pull up when finger moving (INT_POL=1, INT_MODE=01 in the INT mode register)

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



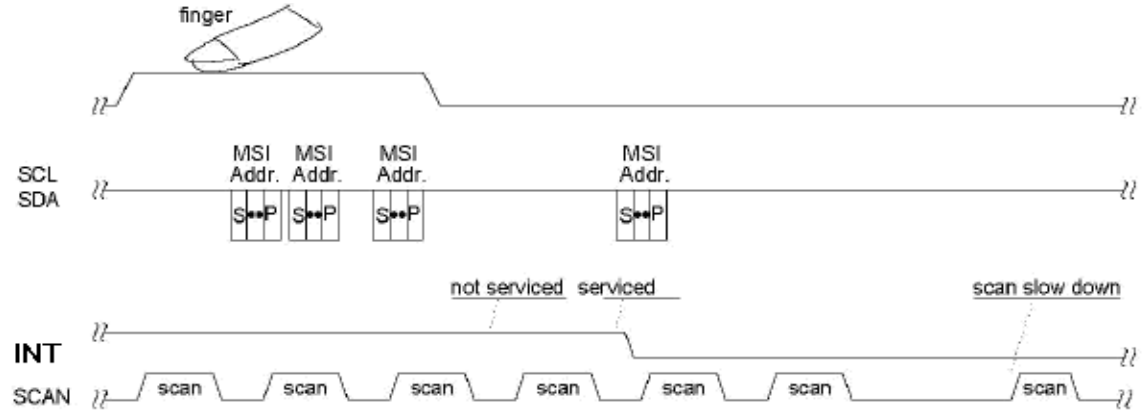
INT line will stop pulse when finger leaves and master has acknowledge the situation (INT_POL=1 in the INT mode register)

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)

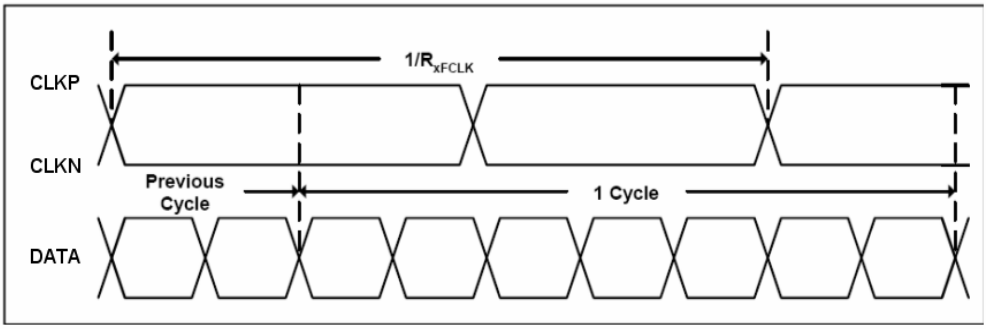
■ REFERENCE APPLICATION NOTES

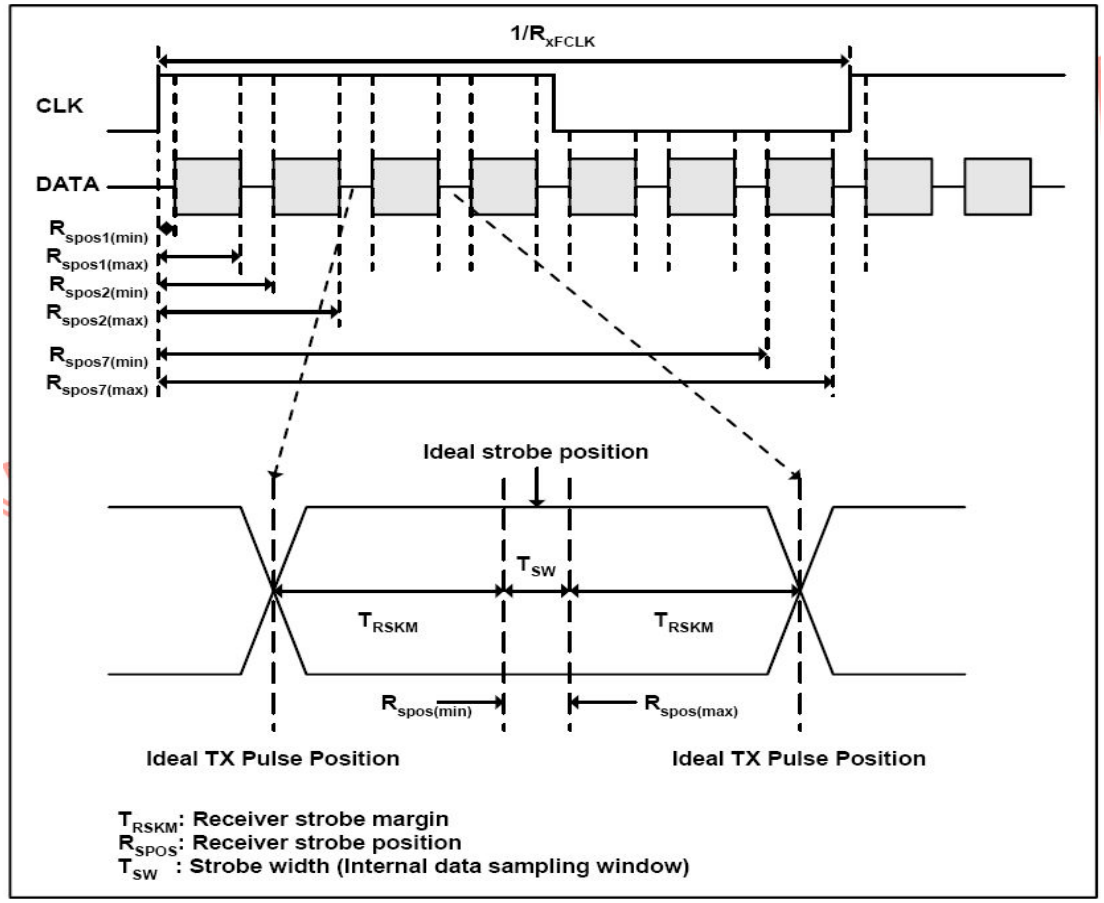
1. Timing Characteristics

1.1 AC Electrical Characteristics

Parameter	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Clock frequency	R_{xFCLK}	40.8	51.2	67.2	MHz	
Input data skew margin	T_{RSKM}	500	-	-	ps	
Clock high time	T_{LVCH}	-	4/(7* R_{xFCLK})	-	ns	
Clock low time	T_{LVCL}	-	3/(7* R_{xFCLK})	-	ns	

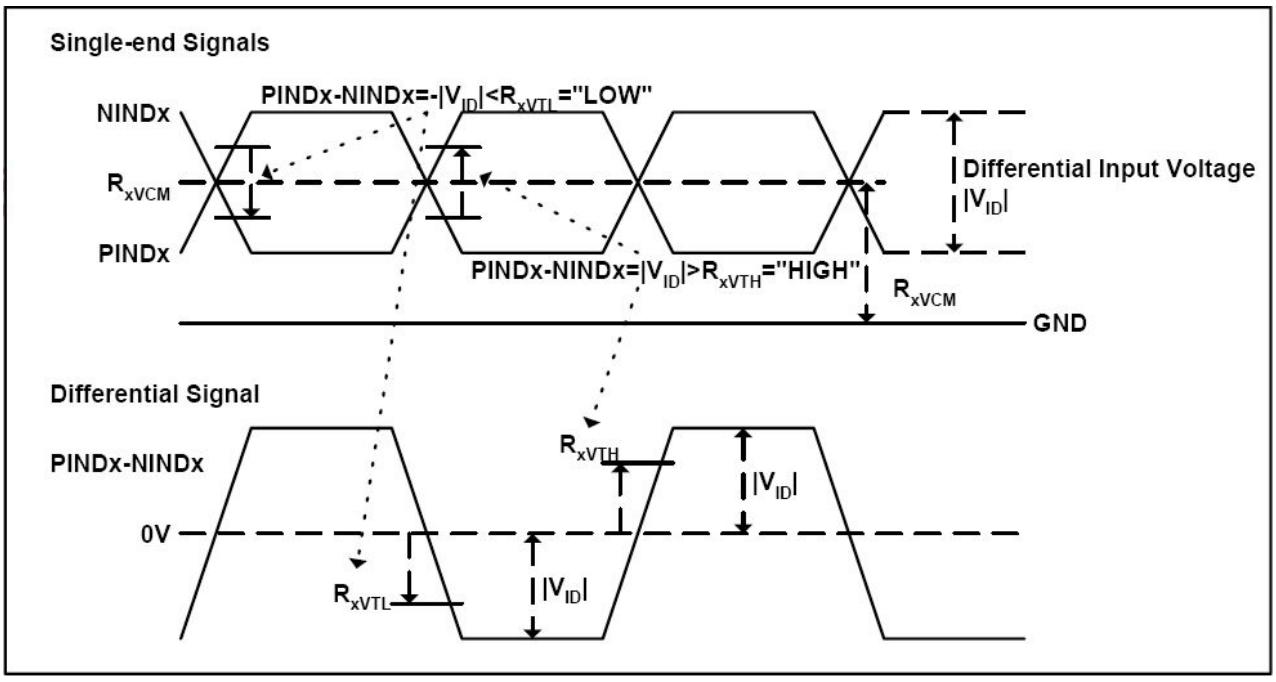
1.2 Input Clock and Data Timing Diagram





1.3 DC Electrical Characteristics

Parameter	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Differential input high Threshold voltage	R_{xVTH}	-	-	+0.1	V	R_{XVCM}=1.2V
Differential input low Threshold voltage	R_{xVTL}	-0.1	-	-	V	
Input voltage range (singled-end)	R_{xVIN}	0	-	2.4	V	
Differential input common mode voltage	R_{xVCM}	$\|V_{ID}\|/2$	-	$2.4-\|V_{ID}\|/2$	V	
Differential voltage	$\|V_{ID}\|$	0.2	-	0.6	V	
Differential input leakage current	RV_{xliz}	-10	-	+10	uA	

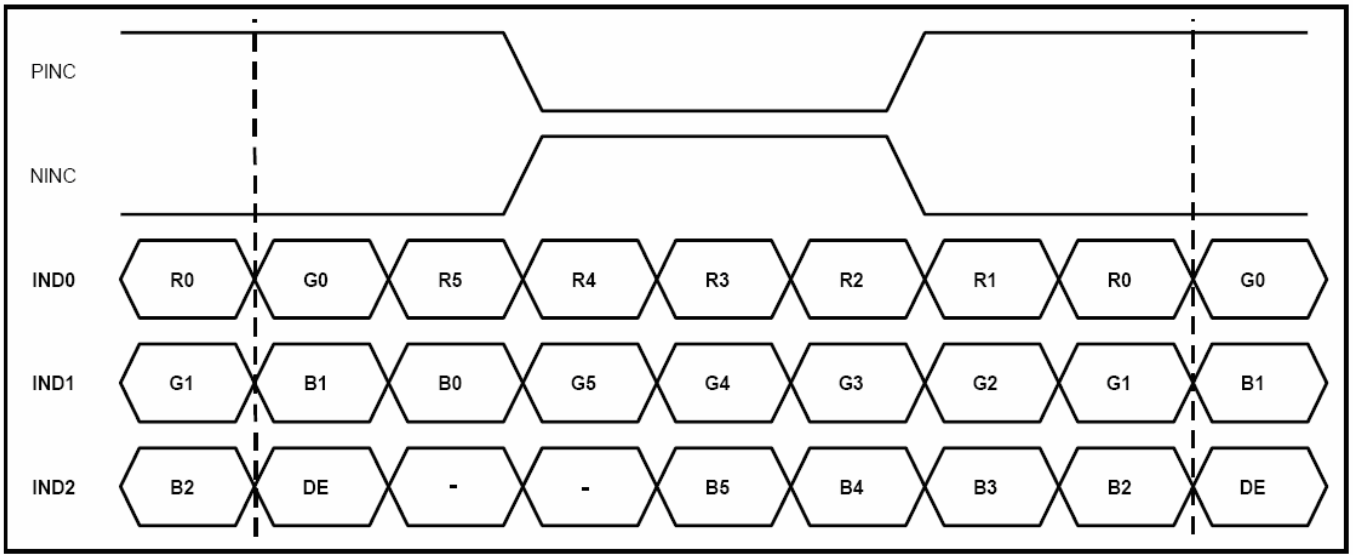


1.4 Timing

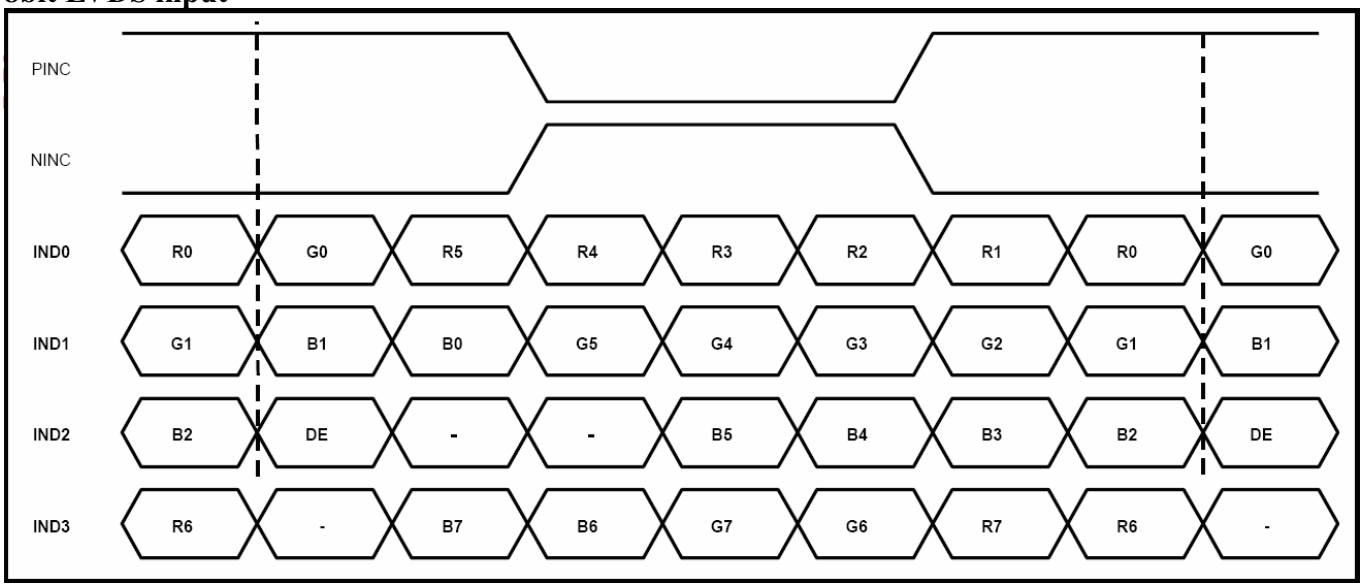
Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Clock Frequency	fclk	40.8	51.2	67.2	MHz	Frame rate =60Hz
Horizontal display area	thd		1024		DCLK	
HS period time	th	1114	1344	1400	DCLK	
HS Blanking	thb	90	320	376	DCLK	
Vertical display area	tvd		600		H	
VS period time	tv	610	635	800	H	
VS Blanking	thb	10	35	200	H	

1.5 Data Input Format

6bit LVDS input



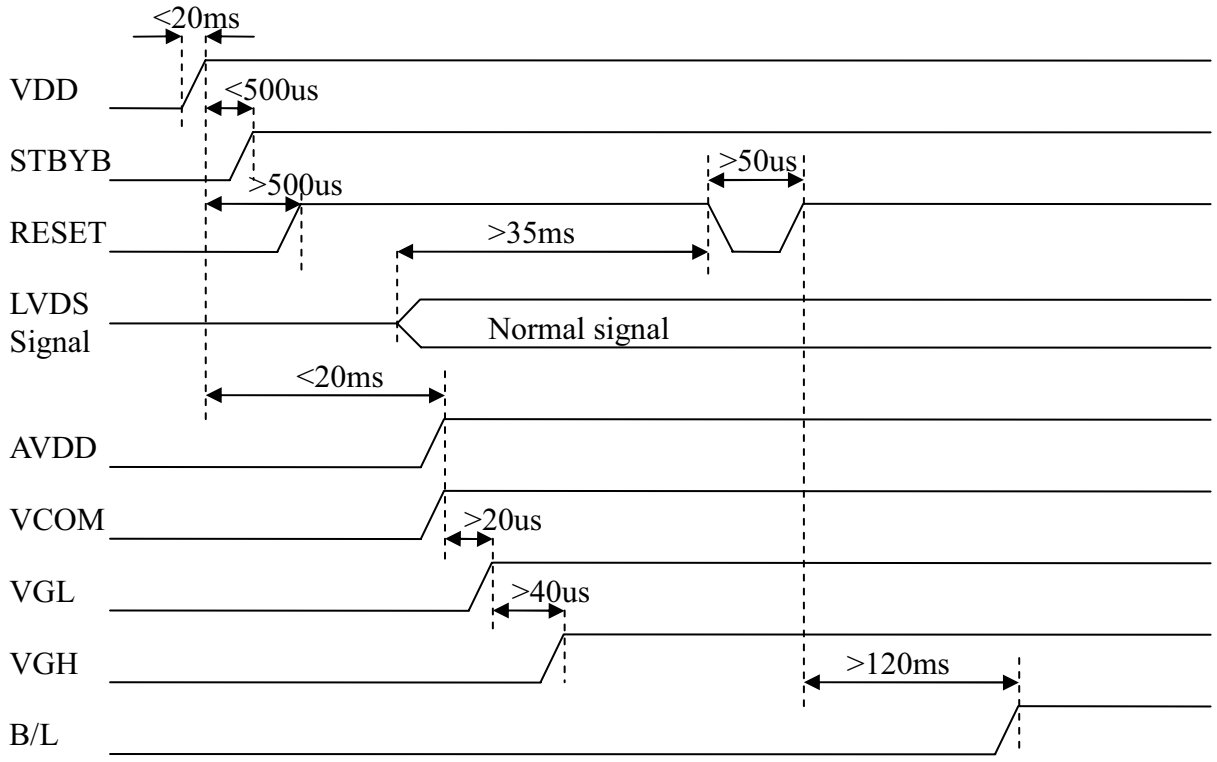
8bit LVDS input



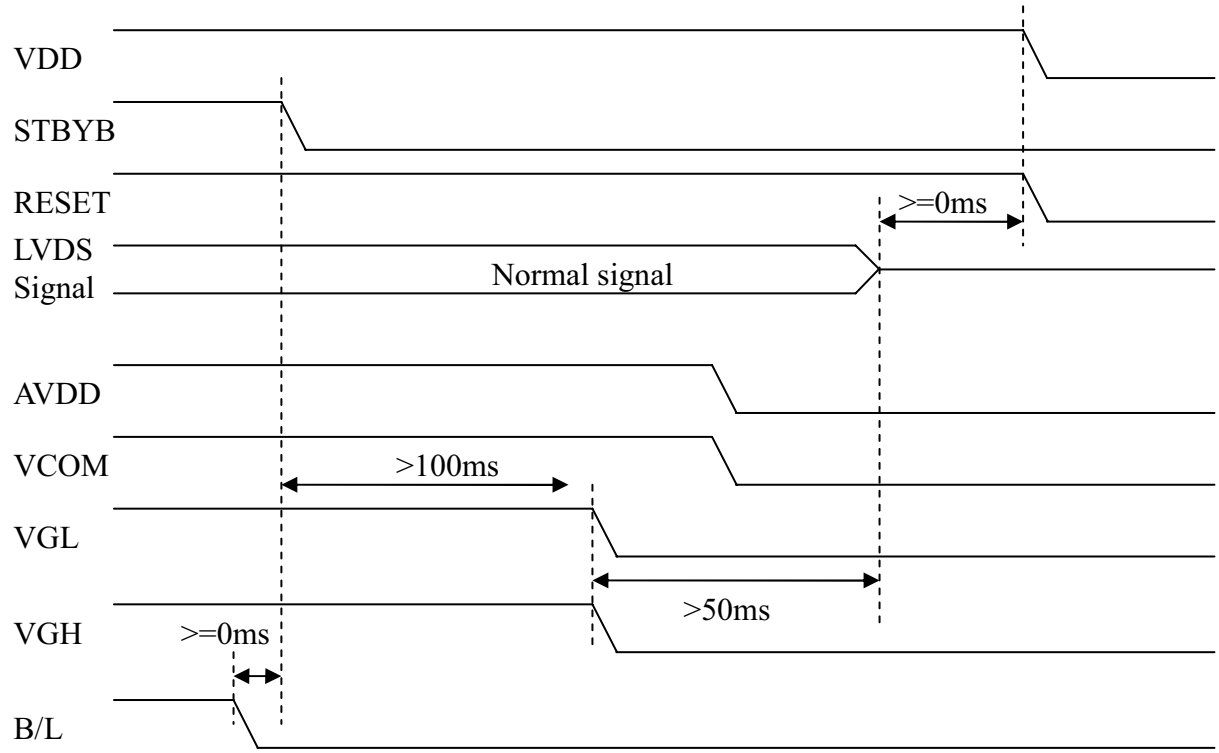
Note: Support DE timing mode only, SYNC mode not supported.

2. Power Sequence

a. Power on:



b. Power off:



■ RELIABILITY TEST

No.	Test Item	Test Condition	Inspection after test
1	High Temperature Storage	70±2℃/240 hours	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Air bubble in the LCD; 2.Sealleak; 3.Non-display; 4.missing segments; 5.Glass crack; 6.Current Idd is twice higher than initial value. 7. The surface shall be free from damage. 8.Linearity must be no more than 1.5% by the linearity tester. 9..The Electric charact eristics requirements shall be satisfied.
2	Low Temperature Storage	-20±2℃/240 hours	
3	High Temperature Operating	60±2℃/240 hours	
4	Low Temperature Operating	-10±2℃/240 hours	
5	Temperature Cycle	-20±2℃~25~70±2℃×10cycles	
6	Damp Proof Test	40℃±5℃×90%RH/240 hours	
7	Vibration Test	Frequency：10Hz~55Hz~10Hz Amplitude：1.5mm, X，Y，Z direction for total 3hours (Packing condition)	
8	Drooping test	Drop to the ground from 1m height, one time, every side of carton. (Packing condition)	
9	ESD test	Voltage:±8KV R: 330Ω C: 150pF Air discharge, 10time	

Remark:
1.The test samples should be applied to only one test item.
2.Sample size for each test item is 5~10pcs.
3.For Damp Proof Test, Pure water(Resistance＞10MΩ) should be used.
4.In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.
5.EL evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
6.Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

■ INSPECTION CRITERION

OUTGOING QUALITY STANDARD	PAGE 1 OF 7
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	

This specification is made to be used as the standard acceptance/rejection criteria for Color mobile phone LCM with touch panel.

1 Sample plan

Sampling plan according to GB/T2828.1-2003/ISO 2859-1：1999 and ANSI/ASQC Z1.4-1993, normal level 2 and based on:

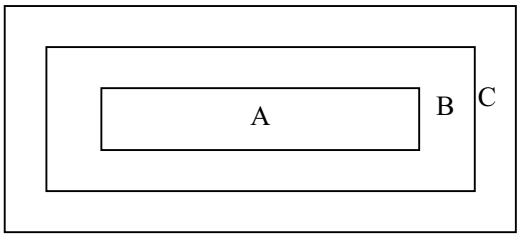
Major defect: AQL 0.65

Minor defect: AQL 1.5

2. Inspection condition

Viewing distance for cosmetic inspection is about 30cm with bare eyes, and under an environment of 20~40W light intensity, all directions for inspecting the sample should be within 45° against perpendicular line.

3. Definition of inspection zone in LCD.



Zone A: character/Digit area

Zone B: viewing area except Zone A (ZoneA+ZoneB=minimum Viewing area)

Zone C: Outside viewing area (invisible area after assembly in customer's product)

Fig.1 Inspection zones in an LCD.

Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

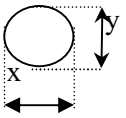
4. Inspection standards

4.1 Major Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects
4.1.1	All functional defects	1) No display 2) Display abnormally 3) Missing vertical， horizontal segment 4) Short circuit 5) Back-light no lighting, flickering and abnormal lighting.	Major
4.1.2	Missing	Missing component	
4.1.3	Outline dimension	Overall outline dimension beyond the drawing is not allowed.	

4.2 Cosmetic Defect

<table>
<tr><th>Item No</th><th>Items to be inspected</th><th>Inspection Standard</th><th>Classification of defects</th></tr>
<tr><td rowspan="2">4.2.1</td><td>Clear Spots

Black and white Spot defect Pinhole, Foreign Particle, Dirt under polarizer</td><td>For dark/white spot, sizeΦis defined as Φ= $\frac{(x+y)}{2}$ 
1.
<table>
<tr><th rowspan="2">Zone
Size(mm)</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.10</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.10＜Φ≤0.15</td><td colspan="2">2</td></tr>
<tr><td>0.15＜Φ≤0.20</td><td colspan="2">1</td></tr>
<tr><td>Φ＞0.20</td><td colspan="2">0</td></tr>
</table></td><td>Minor</td></tr>
<tr><td>Dim Spots

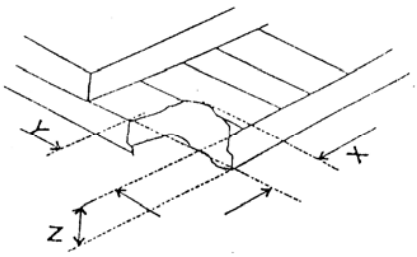
Circle shaped and dim edged defects</td><td>2.
<table>
<tr><th rowspan="2">2. Zone
Size(mm)</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.20＜Φ≤0.40</td><td colspan="2">3</td></tr>
<tr><td>0.40＜Φ≤0.60</td><td colspan="2">2</td></tr>
<tr><td>0.60＜Φ≤0.80</td><td colspan="2">1</td></tr>
<tr><td>0.80＜Φ</td><td colspan="2">0</td><td></td></tr>
</table></td><td>Minor</td></tr>
</table>

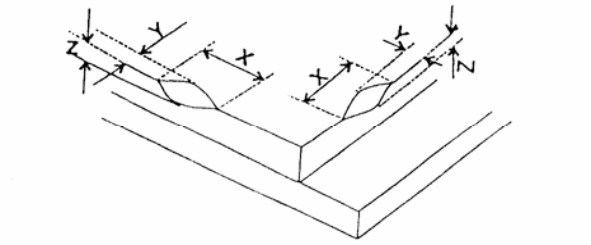
4.2. Cosmetic Defect

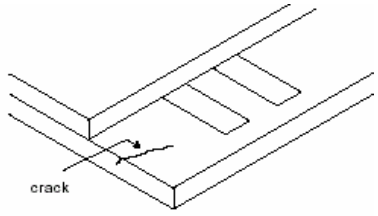
<table>
<tr><th>Item No</th><th>Items to be inspected</th><th>Inspection Standard</th><th>Classification of defects</th></tr>
<tr><td>4.2.2</td><td>Line defect
Black line,
White line,
Foreign material under polarizer,</td><td>
<table>
<tr><th colspan="2">Size(mm)</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th rowspan="2">L(Length)</th><th rowspan="2">W(Width)</th><th colspan="3">Zone</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Ignore</td><td>W≤0.02</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>L≤3.0</td><td>0.02＜W≤0.03</td><td colspan="2">2</td></tr>
<tr><td>L≤2.0</td><td>0.03＜W≤0.05</td><td colspan="2">1</td></tr>
<tr><td></td><td>0.05＜W</td><td colspan="2">Define as spot defect</td></tr>
</table>
</td><td>Minor</td></tr>
<tr><td>4.2.3</td><td>Polarizer scratch</td><td>If the Polarizer scratch can be seen after mobile phone cover assembling or in the operating condition, judge by the line defect of 4.2.2.
If the Polarizer scratch can be seen only in non-operating condition or some special angle, judge by the following.
<table>
<tr><th colspan="2">Size(mm)</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th rowspan="2">L(Length)</th><th rowspan="2">W(Width)</th><th colspan="3">Zone</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Ignore</td><td>W≤0.03</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>5.0＜L≤10.0</td><td>0.03＜W≤0.05</td><td colspan="2">2</td></tr>
<tr><td>L≤5.0</td><td>0.05＜W≤0.08</td><td colspan="2">1</td></tr>
<tr><td></td><td>0.08＜W</td><td colspan="2">0</td></tr>
</table>
</td><td>Minor</td></tr>
<tr><td>4.2.4</td><td>Polarize
Air bubble</td><td>Air bubbles between glass & polarizer
<table>
<tr><th rowspan="2">2. Zone
Size(mm)</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.20＜Φ≤0.30</td><td colspan="2">2</td></tr>
<tr><td>0.30＜Φ≤0.50</td><td colspan="2">1</td></tr>
<tr><td>0.50＜Φ</td><td colspan="2">0</td></tr>
</table>
</td><td>Minor</td></tr>
</table>

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

4.3. Cosmetic Defect

<table>
<tr><th>Item No</th><th>Items to be inspected</th><th>Inspection Standard</th><th>Classification of defects</th></tr>
<tr><td rowspan="3">4.3.5</td><td rowspan="3">Glass defect</td><td>(i) Chips on corner
 

<table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤2.0</td><td>≤S</td><td>Disregard</td></tr></table>Notes: S=contact pad length
Chips on the corner of terminal shall not be allowed to extend into the ITO pad or expose perimeter seal.</td><td>Minor</td></tr>
<tr><td>(ii)Usual surface cracks
 

<table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤3.0</td><td><Inner border line of the seal</td><td>Disregard</td></tr></table></td><td>Minor</td></tr>
<tr><td>(iii) Crack
Cracks tend to break are not allowed.
 
</td><td>Major</td></tr>
<tr><td>4.3.6</td><td>Parts alignment</td><td>1) Not allow IC and FPC/heat-seal lead width is more than 50% beyond lead pattern.
2) Not allow chip or solder component is off center more than 50% of the pad outline.</td><td>Minor</td></tr>
<tr><td>4.3.7</td><td>SMT</td><td>According to the <Acceptability of electronic assemblies> IPC-A-610C class 2 standard. Component missing or function defect are Major defect, the others are Minor defect.</td><td></td></tr>
</table>

■ PRECAUTIONS FOR USING LCD MODULES

1 Handing Precautions

1.1 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.

1.2 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.

1.3 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).

1.4 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 it. 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 in to contact with room temperature air.

1.5 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.

1.6 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 contact with oil and fats.

1.7 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.

1.8 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.

1.9 Do not attempt to disassemble or process the LCD module.

1.10 NC terminal should be open. Do not connect anything.

1.11 If the logic circuit power is off, do not apply the input signals.

1.12 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 removing 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 dry. 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.

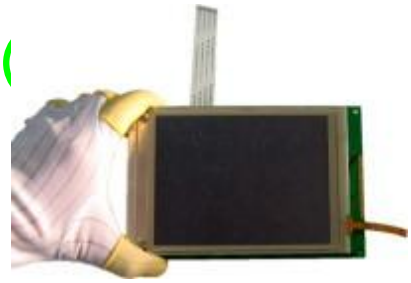
1.13 Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

- 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 the LCM.

2 Handling precaution for LCM

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

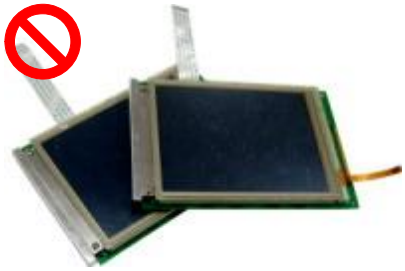
2.2 Correct handling:



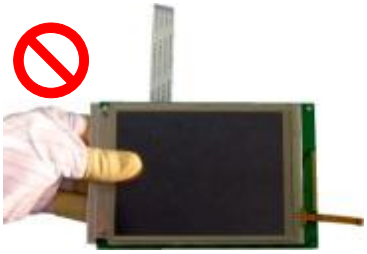
As above picture, please handle with anti-static gloves around LCM edges.

2.3 Incorrect handling:

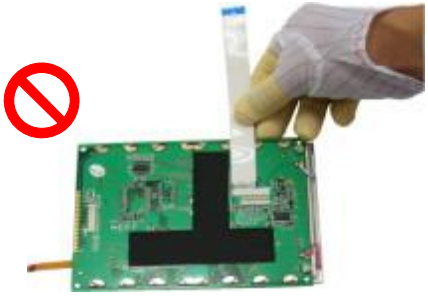
Please don't touch IC directly.



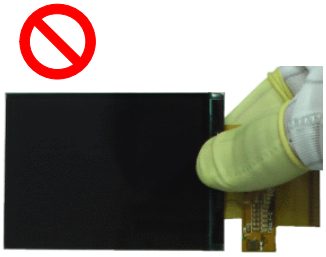
Please don't stack LCM.



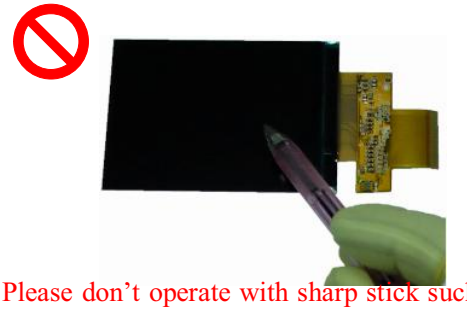
Please don't hold the surface of panel.



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.

3 Storage Precautions

3.1 When storing the LCD modules, the following precaution are necessary.

3.1.1 Store them in a sealed polyethylene bag. If properly sealed, there is no need for the desiccant.

3.1.2 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.

3.1.3 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).

3.2 Others 其它

3.2.1 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.

3.2.2 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.

3.2.3 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.

3.2.3.1 - Exposed area of the printed circuit board.

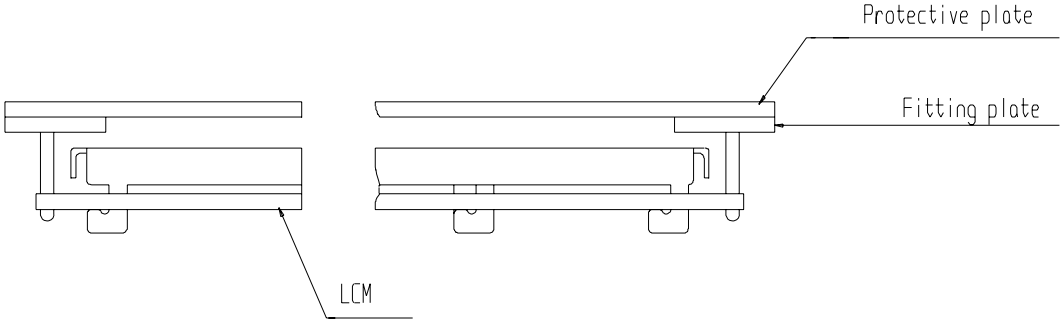
3.2.3.2 -Terminal electrode sections.

4 USING LCD MODULES

4.1 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.

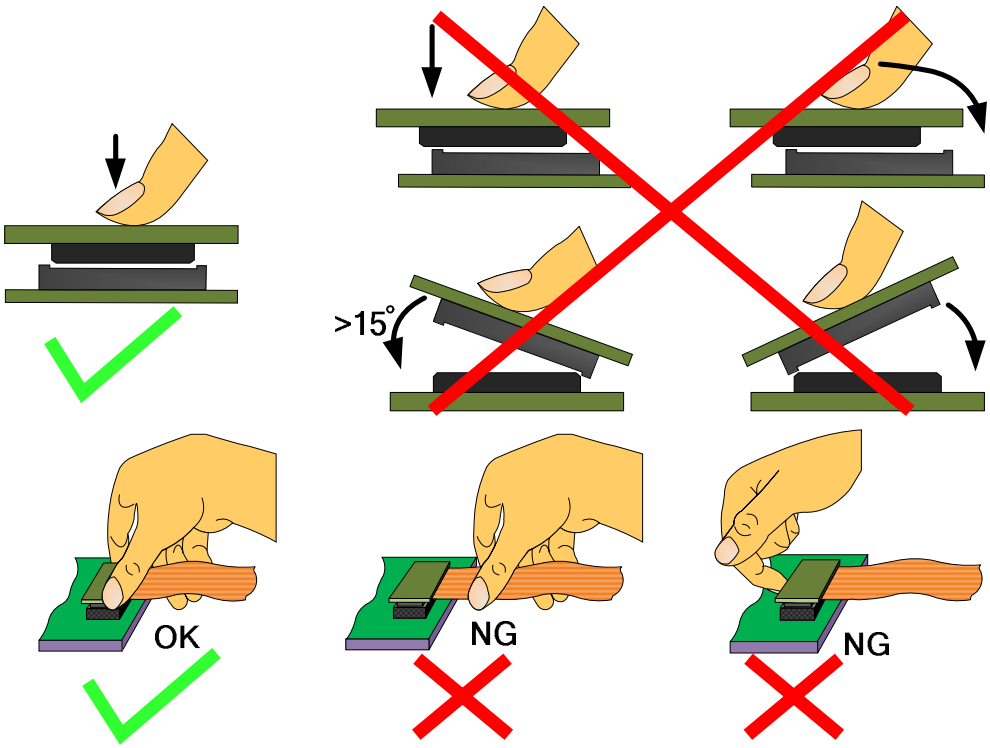
4.1.1 Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



4.1.2 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.

4.2 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



4.3 Precaution for soldering the LCM

	Manual soldering	Machine drag soldering	Machine press soldering
No RoHS Product	290°C ~350°C. Time : 3-5S.	330°C ~350°C. Speed : 15-17 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. Speed : 15-17 mm/s.	330°C ~360°C. Time : 3-6S. Press: 0.8~1.2Mpa

4.3.1 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.

4.3.2 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.

4.3.3 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.

4.4 Precautions for Operation

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

4.4.2 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.

4.4.3 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.

4.4.4 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.

4.4.5 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.

4.4.6 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.

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

4.5 Safety

4.5.1 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.

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

4. 6 Limited Warranty

Unless agreed between Multi-Inno and the 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 replace on the terms set forth above. Multi-Inno will not be responsible for any subsequent or consequential events.

4.7 Return LCM under warranty

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

4.7.1.1 - Broken LCD glass.

4.7.1.2 - PCB eyelet is damaged or modified.

4.7.1.3 -PCB conductors damaged.

4.7.1.4 - Circuit modified in any way, including addition of components.

4.7.1.5 - PCB tampered with by grinding, engraving or painting varnish.

4.7.1.6 - Soldering to or modifying the bezel in any manner.

4.7.2 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.

■ PACKING SPECIFICATION

Please consult our technical department for detail information.

■ PRIOR CONSULT MATTER

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

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

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