MULTI-INNO TECHNOLOGY CO., LTD.

www.multi-inno.com

LCD MODULE SPECIFICATION

Model : MI0700ZT

For Customer's Acceptance:

Customer	
Approved	
Comment	

Revision	1.0
Engineering	
Date	2011-11-12
Our Reference	

REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
1.0	2011-11-12	Preliminary Specification Release	

CONTENTS

■ GENERAL INFORMATION

■ EXTERNAL DIMENSIONS

■ ABSOLUTE MAXIMUM RATINGS

■ ELECTRICAL CHARACTERISTICS

■ BACKLIGHT CHARACTERISTICS

■ POWER CONSUMPTION

■ ELECTRO-OPTICAL CHARACTERISTICS

■ INTERFACE DESCRIPTION

■ REFERENCE APPLICATION NOTES

■ APPLICATION CIRCUITS

■ CTP GENERAL SPECIFICATIONS

■ RELIABILITY TEST

■ INSPECTION CRITERION

■ PRECAUTIONS FOR USING LCD MODULES

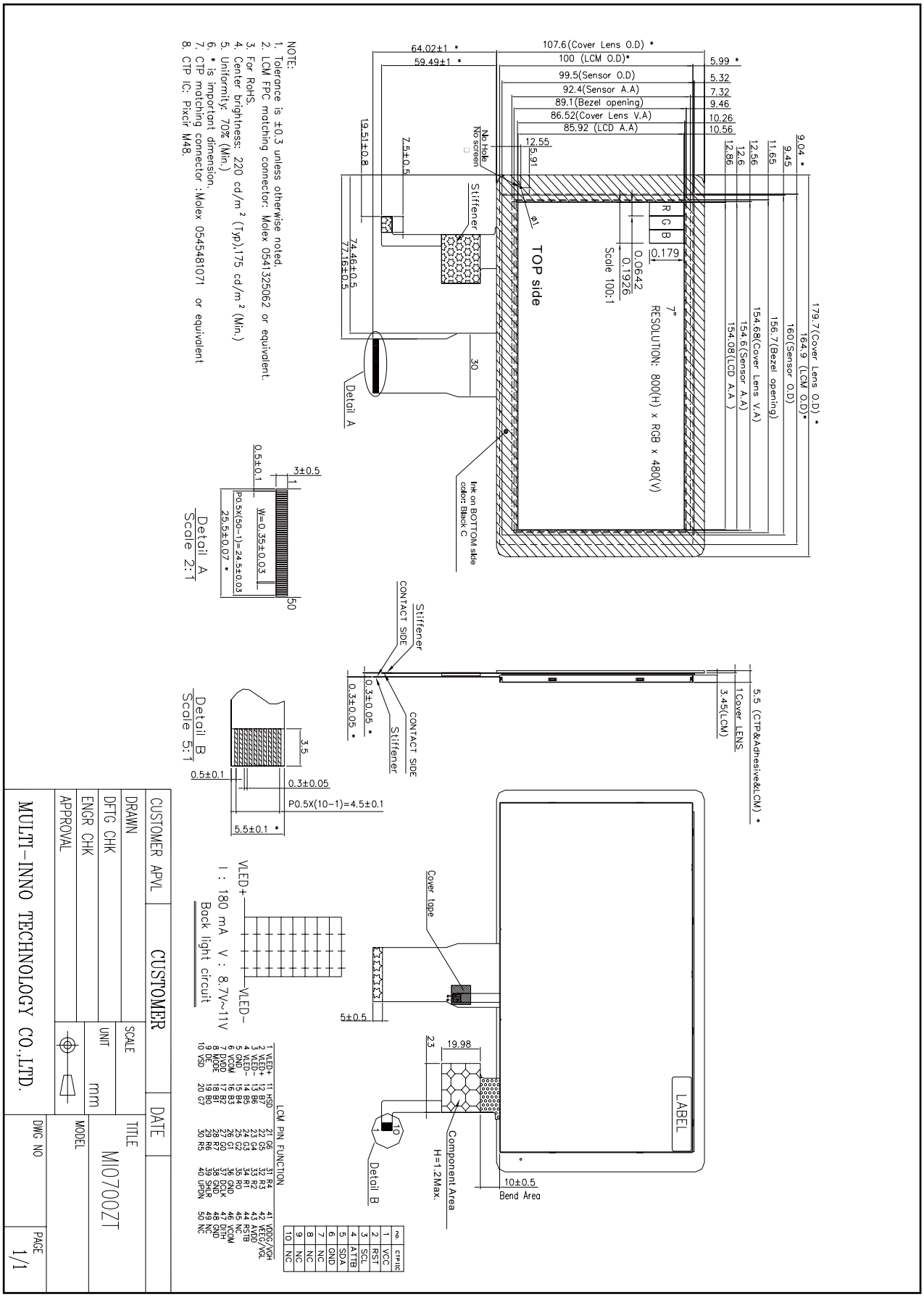
■ PRIOR CONSULT MATTER

■ 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)	179.70×107.60×5.50	mm^3
Active area (W×H)	154.08×85.92	mm^2
Pixel pitch (W×H)	0.0642×0.1790	mm^2
Number of dots	800 (RGB) × 480	/
Backlight type	27 LEDs	/
Interface type	24bits RGB	/
Color depth	16.7M	/
Pixel configuration	Stripe	/
Input voltage	3.3	V
With/Without TSP	With CTP	/
Weight	200	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		DVCC	-0.3	5.0	V
		AVCC	-0.5	13.5	V
		VCCG/VGH	-0.3	42	V
		VEEG/VGL	-20	0.3	V
Logic input voltage		VI	-0.3	5.0	V
		VCCG/VGH-VEEG/VGL	12	40	V
Operating temperature		TOP	-10	60	°C
Storage temperature		TST	-20	70	°C
Humidity	Operation	20%-90% relative humidity (Ta<=38°C)			
	Non operation	5%-90% relative humidity (Ta<=38°C)			

■ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS

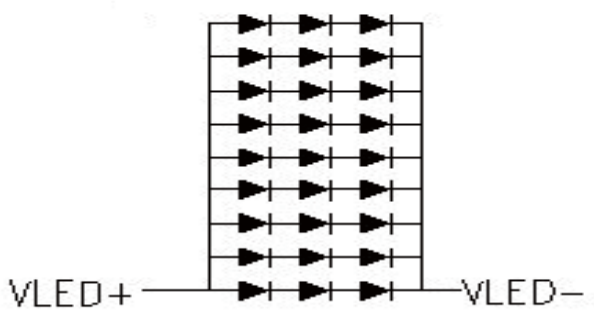
Parameter	Symbol	Min	Typ	Max	Unit
Power supply voltage	DVCC	3.0	3.3	3.6	V
	AVCC	9.4	9.6	9.8	V
	VCCG/VGH	17	18	19	V
	VEEG/VGL	-6.6	-6	-5.4	V
Common power voltage	VCOM	3.8	4.0	4.2	V
Input voltage ' H ' level	V_{IH}	0.7DVCC	-	DVCC	V
Input voltage ' L ' level	V_{IL}	0	-	0.3DVCC	V

Note1: VCOM:Please use Adjustable resistance to adjust VCOM to make the flicker level be minimum.

■ BACKLIGHT CHARACTERISTICS

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
VLED voltage	V_L	8.7	10.5	11	V	If= 20mA,Ta=25℃
LED current (1+2+…+9)	I_L	-	180	-	mA	-
Operating life time	-	30000	-	-	Hrs	-

Note1: There are 9 Groups (1 Group of 3 LEDs).



Note2: The “LED dice life time” is defined as the brightness decrease to 50% original brightness that the ambient temperature is 18℃~28℃ and LED dice current=20mA.

■ POWER CONSUMPTION

Parameter	Symbol	Conditions	MIN.	TYP.	MAX	Unit	Remark
Digital current	I_{DVCC}	DVCC＝3.3V	--	8	15	mA	Note 1
Analog current	I_{AVCC}	AVCC＝9.6V	--	30	40	mA	
Gate On Voltage	$I_{VGH/VCCG}$	VGH/VCCG=18V	--	0.5	1	mA	
Gate On Current	$I_{VGL/VEEG}$	VGL/VEEG=-6V	--	0.5	1	mA	
LCD Panel Power onsumption			--	327	458	mW	

Note1 ： Typ. specification：Gray-level test Pattern

Max. specification：Black test Pattern

■ELECTRO-OPTICAL CHARACTERISTICS

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time		Tr+ Tf	θ=0° ∅=0° Ta=25℃	---	25	35	ms	Fig.1	4
Contrast ratio		Cr		320	400	---	---	FIG 2.	1
Luminance uniformity				70	---	---	%	FIG 2.	3
Surface Luminance		Lv		175	220	---	cd/m^2	FIG 2.	2
Viewing angle range		θ	∅ = 90°	55	65	---	deg	FIG 3.	6
			∅ = 270°	45	55	---	deg	FIG 3.	
			∅ = 0°	60	70	---	deg	FIG 3.	
			∅ = 180°	60	70	---	deg	FIG 3.	
CIE (x, y) chromaticity	Red	x	θ=0° ∅=0° Ta=25℃	0.552	0.602	0.652		FIG 2.	5
		y		0.287	0.337	0.387			
	Green	x		0.299	0.349	0.399			
		y		0.537	0.587	0.637			
	Blue	x		0.113	0.163	0.213			
		y		0.064	0.114	0.164			
	White	x		0.263	0.313	0.363			
		y		0.279	0.329	0.379			

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

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

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

Lv = Average Surface Luminance with all white pixels $(P_1, P_2, P_3, P_4, P_5)$

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

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

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

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

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

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,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".

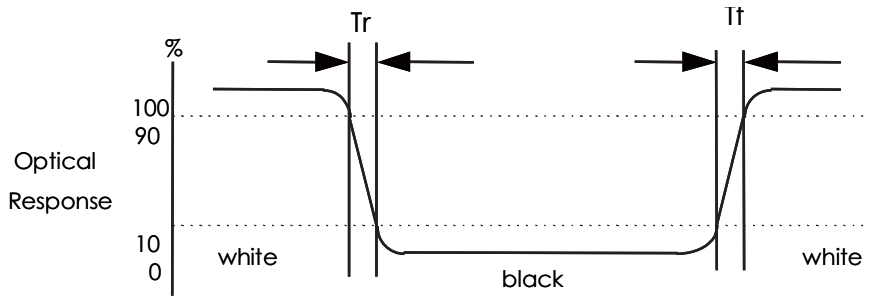
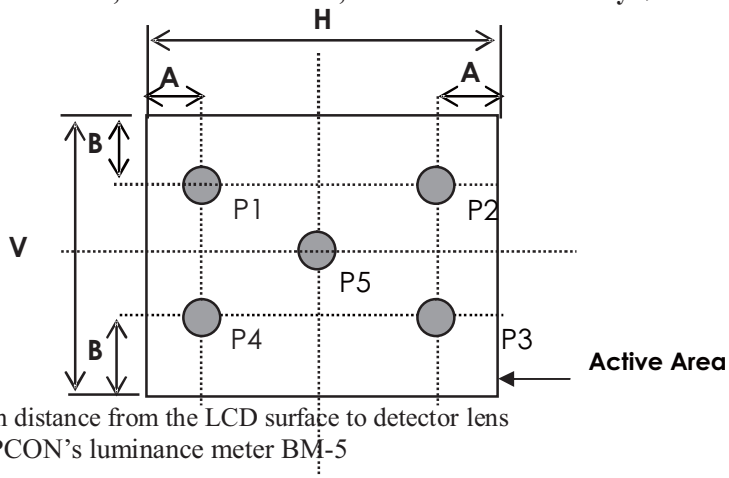
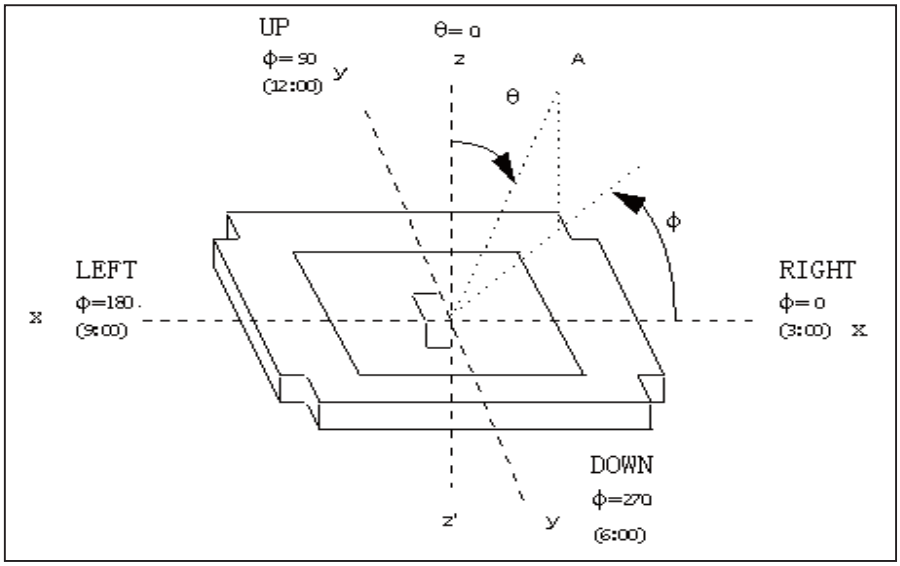


FIG. 2 Measuring method for Contrast ratio,surface luminance, Luminance uniformity , CIE (x, y) chromaticity



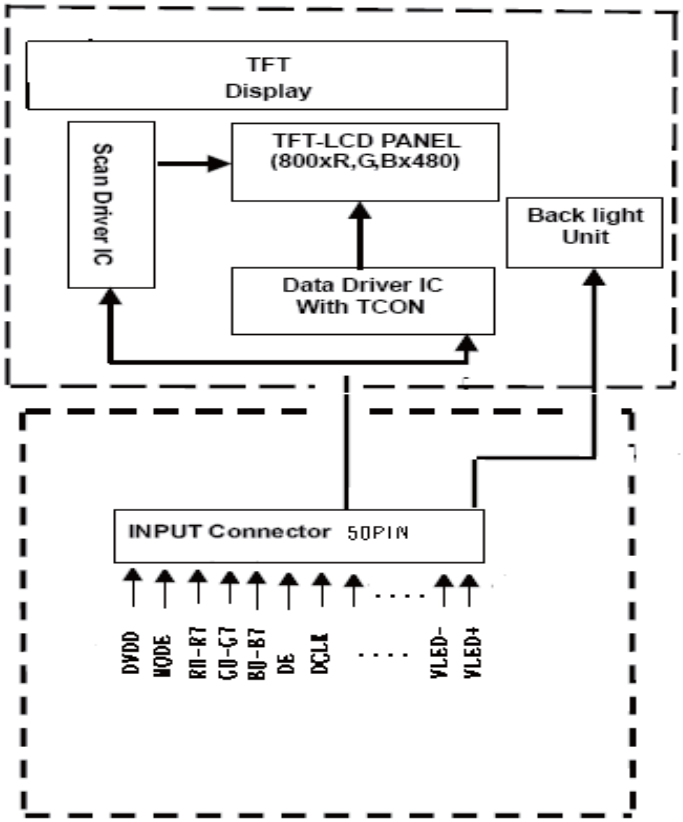
A : 5 mm
B : 5 mm
H,V : Active Area
Light spot size ∅=7mm, 500mm distance from the LCD surface to detector lens
measurement instrument is TOPCON's luminance meter BM-5

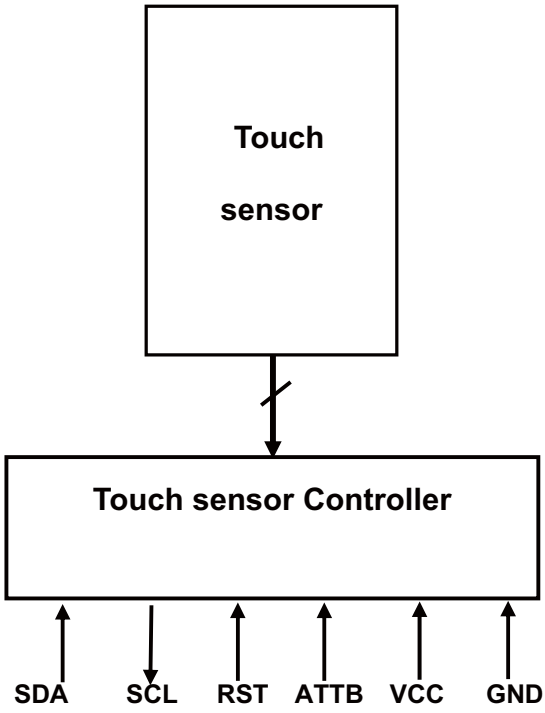
FIG. 3 The definition of viewing angle



■ INTERFACE DESCRIPTION

1. BLOCK DIAGRAM





2. PIN CONNECTIONS

Pin NO.	SYMBOL	DESCRIPTION
1	VLED+	Power for LED backlight (Anode)
2	VLED+	Power for LED backlight (Anode)
3	VLED-	Power for LED backlight (Cathode)
4	VLED-	Power for LED backlight (Cathode)
5	GND	Power ground
6	VCOM	Common Voltage
7	DVCC	Digital Power
8	MODE	H: DE mode. L: HSD/VSD mode
9	DE	Data Enable signal
10	VSD	Vertical sync input. Negative polarity
11	HSD	Horizontal sync input. Negative polarity
12	B7	Blue Data Input(MSB)
13	B6	Blue Data Input
14	B5	Blue Data Input
15	B4	Blue Data Input
16	B3	Blue Data Input
17	B2	Blue Data Input
18	B1	Blue Data Input
19	B0	Blue Data Input(LSB)
20	G7	Green Data Input(MSB)
21	G6	Green Data Input
22	G5	Green Data Input
23	G4	Green Data Input
24	G3	Green Data Input
25	G2	Green Data Input
26	G1	Green Data Input
27	G0	Green Data Input(LSB)
28	R7	Red Data Input(MSB)
29	R6	Red Data Input
30	R5	Red Data Input
31	R4	Red Data Input
32	R3	Red Data Input
33	R2	Red Data Input
34	R1	Red Data Input
35	R0	Red Data Input(LSB)
36	GND	Power ground
37	DCLK	Clock input
38	GND	Power ground
39	SHLR	Left or Right Display Control; 1: Left → Right (default)
40	UPDN	Up / Down Display Control ; 0: Up → Down (default)
41	VCCG/VGH	Positive Power for TFT
42	VEEG/VGL	Negative Power for TFT
43	AVCC	Analog Power
44	RSTB	Global reset pin.
45	NC	Not connect
46	VCOM	Common Voltage
47	DITH	DITH=”H” 6bit resolution; DITH=”L” 8bit resolution
48	GND	Power ground
49	NC	Not connect
50	NC	Not connect

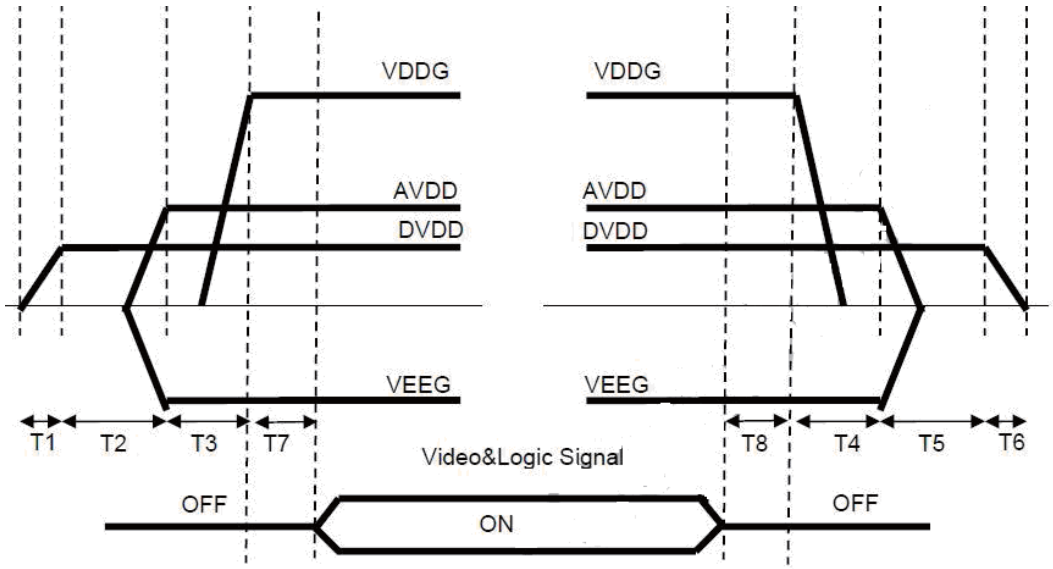
Note:

The LCM support both DE mode and Sync mode timing. When MODE is pulled low, which is Sync mode. When MODE is pulled high , which is DE mode.

Remarks:

Power On：DVCC→AVCC/VEEG→VCCG→Video &Logic Signal

Power Off：Video &Logic Signal→VCCG→AVCC/VEEG→DVCC

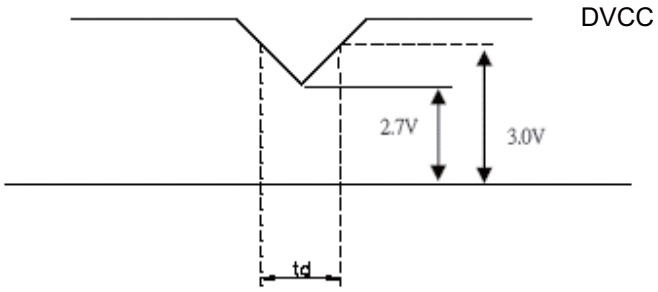


0＜T1≦10ms	T5＞0ms
T2＞20ms	T6＞0ms
T3＞ 10ms	0＜T7≦10
T4＞0ms	0＜T8≦10ms

DVCC -dip condition:

(1) 2.7V ≤DVCC≤3.0V: td ≤10 ms

(2) DVCC >3.0V: DVCC -dip condition should be the same with DVCC,-turn-on condition.



■ APPLICATION NOTES

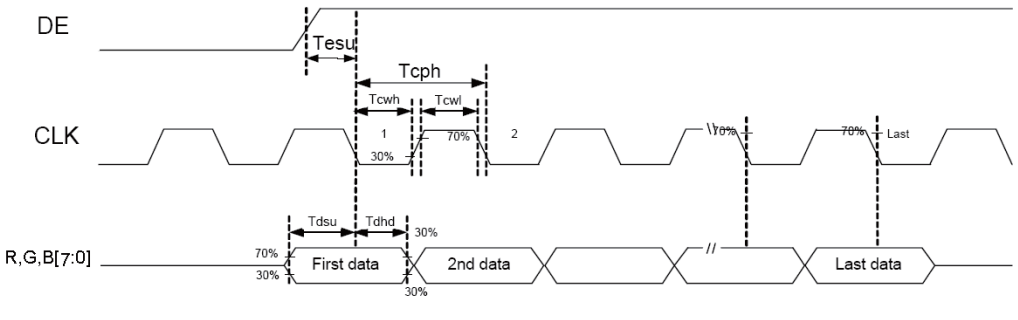
1. INPUT SIGNAL CHARACTERISTICS

1.1 AC Characteristics

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	Note
DCLK	Dot Clock	$1/T_{cph}$	29	33	38	MHz	
	DCLK pulse duty	Tcwh	40	50	60	%	
DE	Setup Time	Tesu	8	-	-	ns	
	Hold time	Tehd	8	-	-	ns	
	Horizontal Period	$T_{DEL}+T_{DEH}$	1026	1056	1086	t_{CLK}	
	Horizontal Valid	T_{DEH}		800		t_{CLK}	
	Horizontal Blank	T_{DEL}	-	256	-	t_{CLK}	
	Vertical Period	$T_{DE}+T_{DEB}$	515	525	535	t_H	
	Vertical Valid	T_{DE}		480		t_H	
	Vertical Blank	T_{DEB}	-	45	-	t_H	
SYNC	HSYNC Setup Time	Thst	8	-	-	ns	
	HSYNC Hold Time	Thhd	8	-	-	ns	
	VSYNC Setup Time	Tvst	8	-	-	ns	
	VSYNC Hold Time	Tvhd	8	-	-	ns	
	Horizontal Period	th	1026	1056	1086	t_{CLK}	
	Horizontal Pulse Width	thpw	-	30	-	t_{CLK}	thb + thpw=46DCLK is fixed
	Horizontal Back Porch	thb	-	16	-	t_{CLK}	
	Horizontal Front Porch	thfp	180	210	240	t_{CLK}	
	Horizontal Valid	thd		800		t_{CLK}	
	Vertical Period	tv	515	525	535	th	
	Vertical Pulse Width	tvpw	-	13	-	th	tvpw + tvb = 23th is fixed
	Vertical Back Porch	tvb	-	10	-	th	
	Vertical Front Porch	tvfp	12	22	32	th	
	Vertical Valid	tvd		480		th	
DATA	Setup Time	Tdsu	8	-	-	ns	
	Hold Time	Tdhd	8	-	-	ns	

1.2 Timing Controller Timing Chart

1.2.1 Clock and Data input waveforms



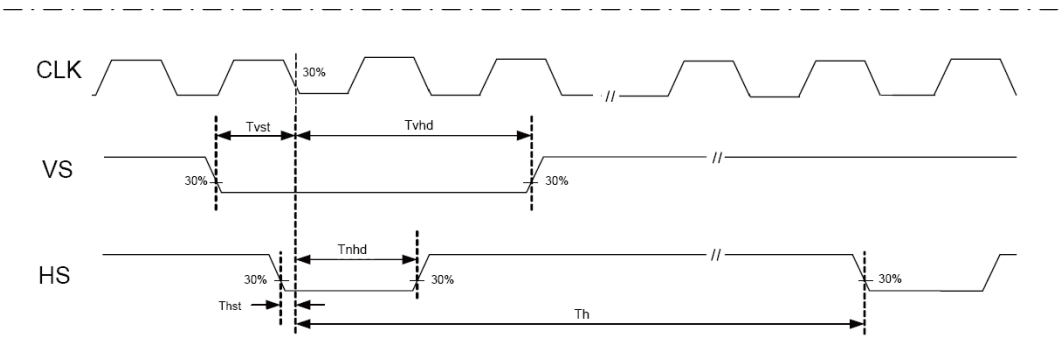


Figure 1 Clock and Data input waveforms.

1.2.2 SYNC Mode Data format

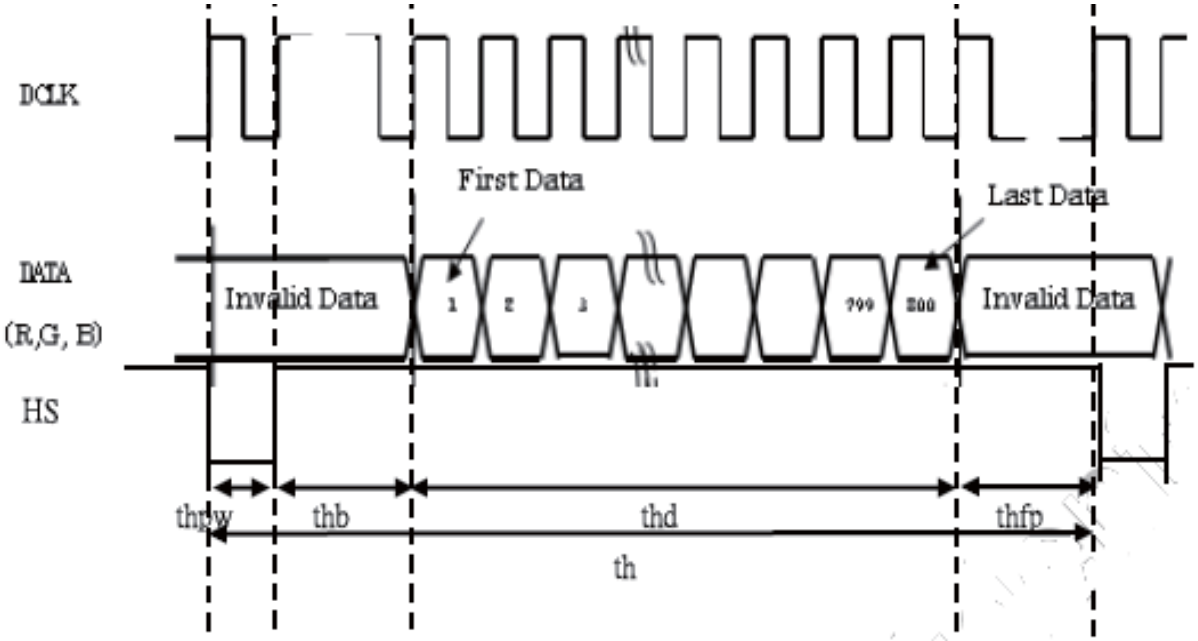


Figure 2 SYNC Mode Horizontal Data Format

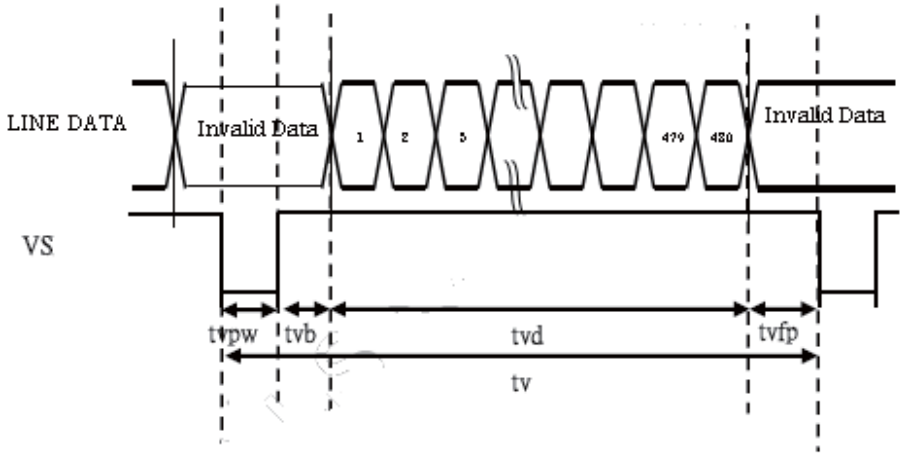


Figure 3 SYNC Mode Vertical Data Format

1.2.3 DE Mode Data Format

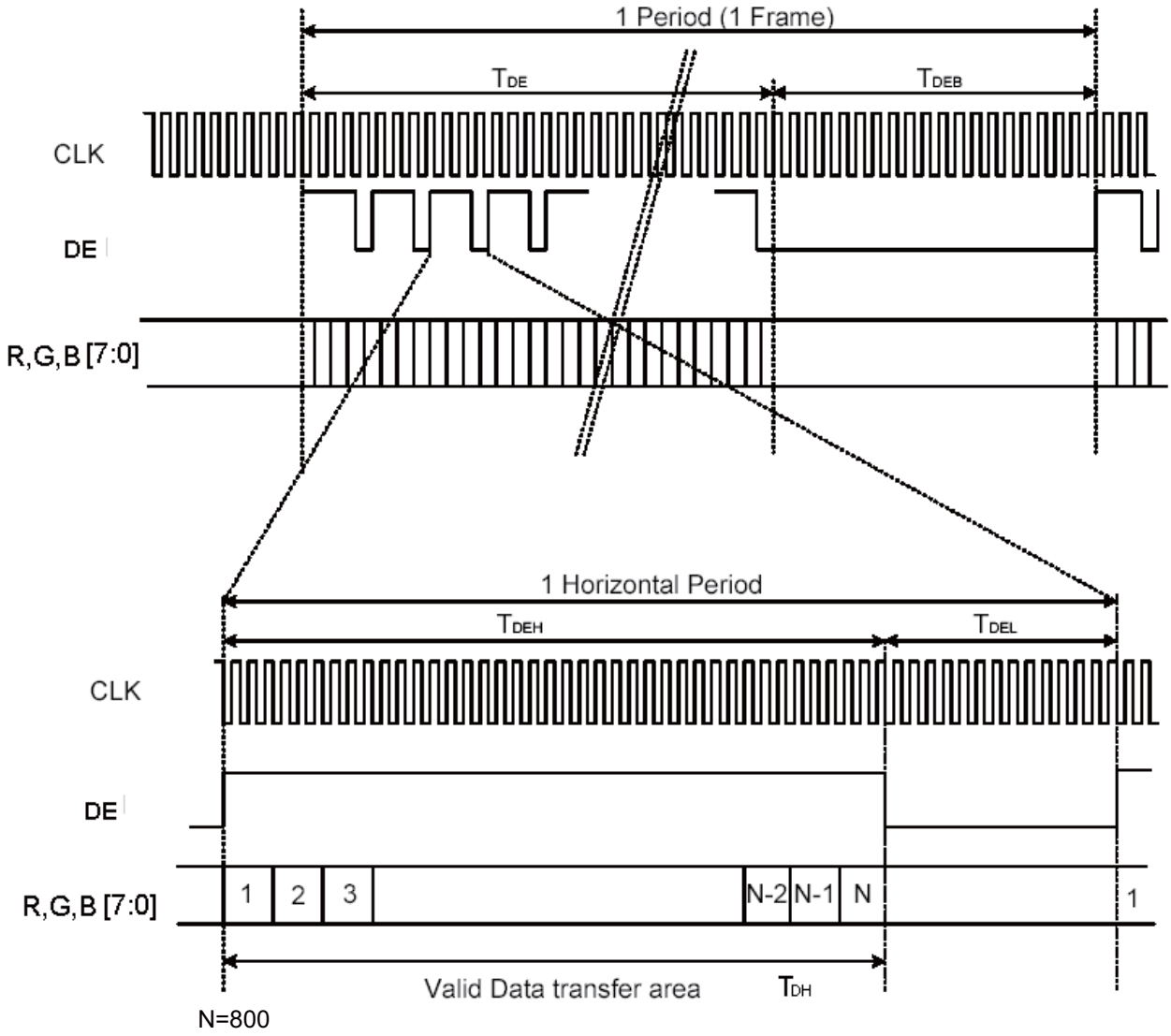


Figure 4 DE Mode Data Format

1.3 Color Data Input Assignment

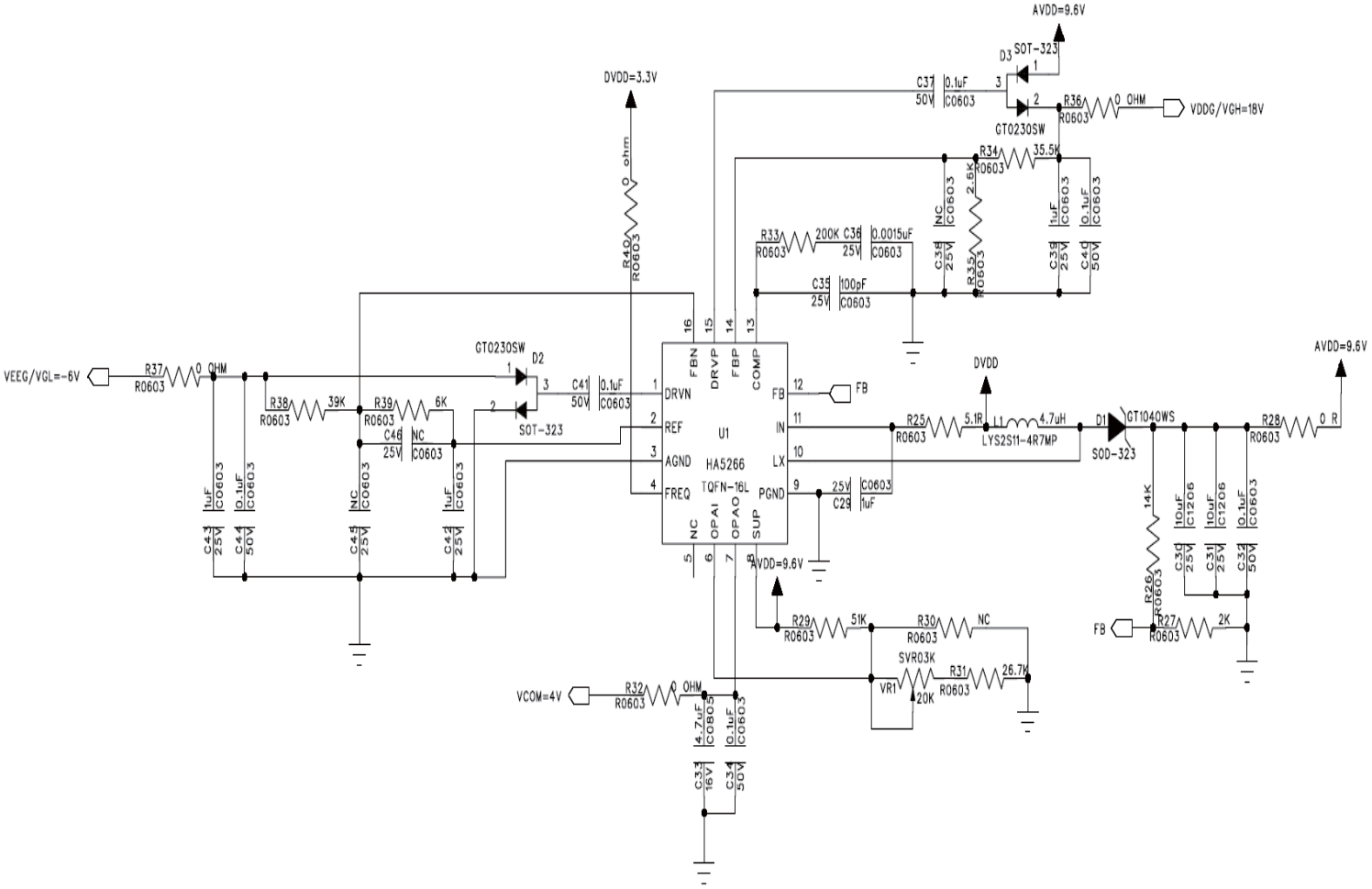
COLOR	DISPLAY	DATA SIGNAL																								GRAY SCALE LEVEL
		RED								GREEN								BLUE								
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0
	DARK ↑	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R252
	↓ LIGHT	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
		1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R253
		0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R254
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R255
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	DARK ↑	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
		:			:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	G3~G252
	↓ LIGHT	:			:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	
		0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G253
		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G254
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G255
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B252
	↓ LIGHT	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	B253
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	B254
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B255

Note) Definition of Gray :

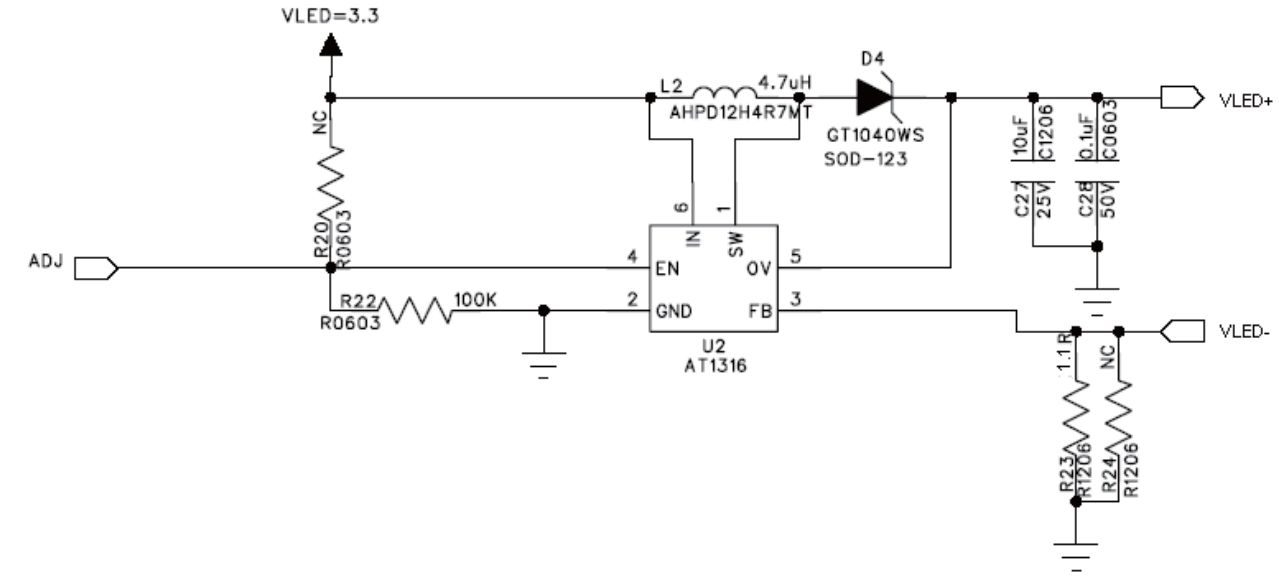
Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

■ APPLICATION CIRCUITS



DC-DC circuit



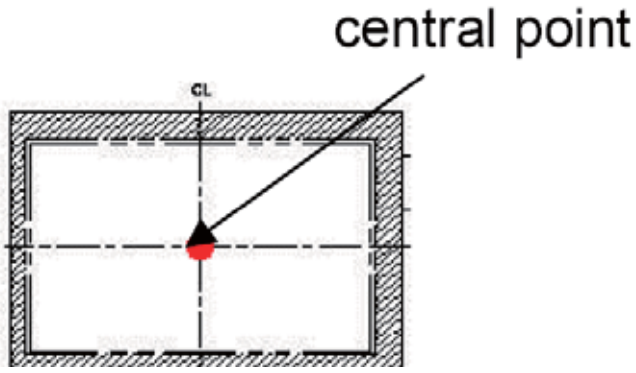
B/L circuit

■ CTP GENERAL SPECIFICATIONS

1.1 CTP main feature

Item	Specification	Unit
Type	Transparent type projected capacitive touch panel	
Input mode	Human's finger	
Outline Dimension	179.7(W) x 107.6(H) x 1.85 (D)	mm
Sensor Active area	154.6(W)(typ.) x92.4(H)(typ.)	mm
Transparency	≧85%	%
Haze	≦1.0%	%
Hardness	7H (min) [by JIS K5400]	Pencil hardness
Report rate	Max：122	Points/sec
Response time	15	ms
Point hitting life time (no contact)	1,000,000 times min.	Note 1

Note 1: Use 11 mm diameter/copper colum to knock on the same point twice per second under system operating.



1.2 CTP Absolute Maximum Rating

Symbol	Description	Min	Typ	Max	Unit	Notes
VCC	Supply voltage	-0.3	-	6.5	V	
VIO	DC input voltage	GND-3.0	-	VCC+0.3	V	
ESD	Electrostatic discharge voltage	-	2000	-	V	
VCC	Supply voltage	3.0	3.3	5.5	V	
GND	Supply voltage	-	0	-	V	
I	Active Mode	-	-	7.0	mA	At VCC=3.3V
VIH	Input H voltage		0.8VCC	-	VCC	
VIL	Input L voltage		0		0.2VCC	
	System clock frequency			20	MHz	
	CPU clock frequency			20	MHz	
ISLEEP	Sleep mode(52Hz)	-	-	2.0	mA	At VCC=3.3V
	Sleep mode(26Hz)	-	-	1.1	mA	At VCC=3.3V
	Sleep mode(17Hz)	-	-	0.75	mA	At VCC=3.3V
	Sleep mode(13Hz)	-	-	0.56	mA	At VCC=3.3V
	Sleep mode(10Hz)	-	-	0.42	mA	At VCC=3.3V
	Deep Sleep mode(1Hz)	-	-	46	uA	At VCC=3.3V
IFREEZE	Freeze Mode	-	-	1.9	uA	At VCC=3.3V

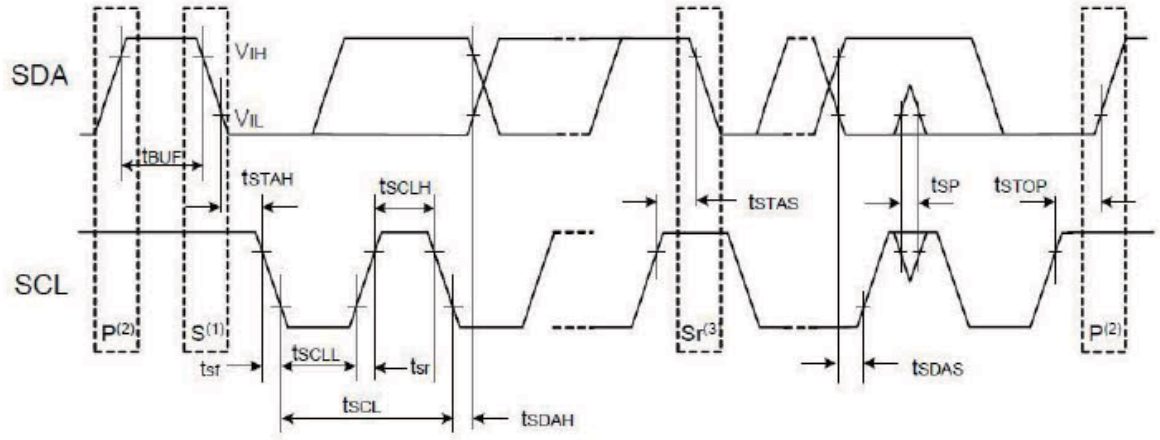
1.3 CTP Pin Connections

No.	Name	I/O	Description
1	VCC	-	Power; VCC=3.3V(typ.)
2	RST	-	Reset
3	SCL	I	Clock;100KHz
4	ATTB	O	Active low when data output from touch panel
5	SDA	I/O	Signal
6	GND	-	Ground
7	NC	-	No connection
8	NC	-	No connection
9	NC	-	No connection
10	NC	-	No connection

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

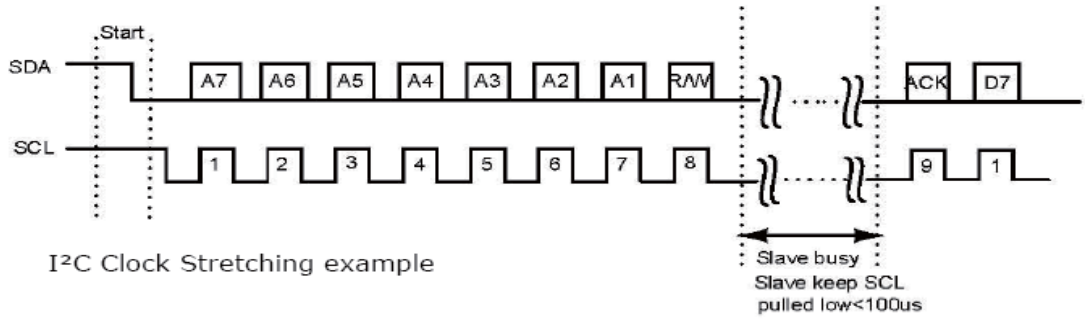
Communication protocol: I^2C

Clock frequency : 100Khz （400Khz 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		



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 operation 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
R	READ
W	WRITE
A	Acknowledge
N	No acknowledge
DATA	8-bit

From slave to Master	From Master to Slave

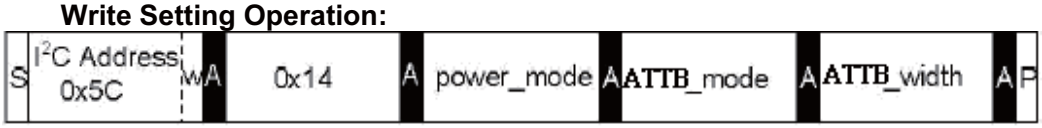
1.5 Timing Characteristic

Write Bytes to I2C Slave：

Write packets have variable content length decided by the host. Write operation stops when host issue and I²C STOP symbol. The write packet is illustrated in below Write Operation & Write Setting Operation protocol. Following the I²C device address, the first byte of the write packet is always the destination register address, referred in Note1 MSI registers table. Subsequent data value are written at the register pointed by the address, immediately upon reception of the byte. The address counter is automatically incremented. Subsequent data bytes are treated in continuations of the writing operation.

Write Operation:

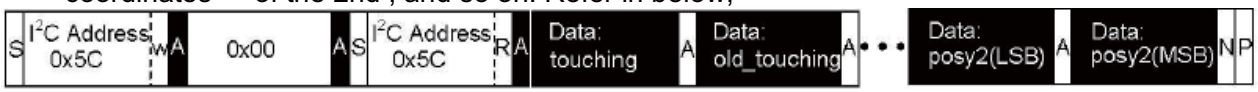
Write Setting Operation:



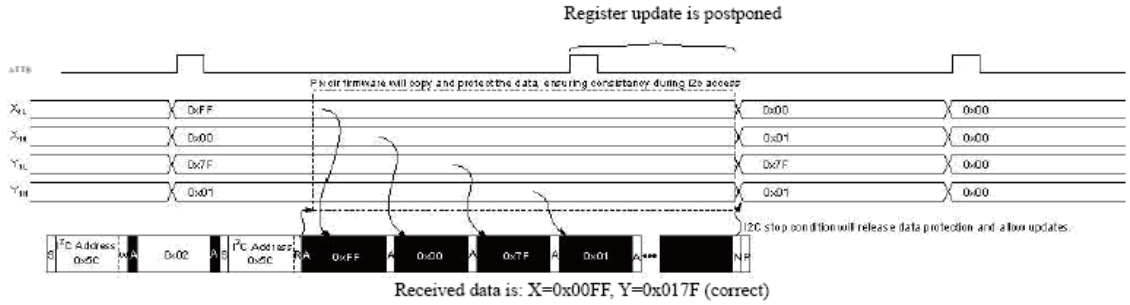
Read Bytes from Slave

Read packets have variable content length decided by the host. It's available to do a single read operation or a sequential read operation. Therefore, the beginning register address is need to set before a read operation. And the data sent exactly follow the Note1 MSI register table afterward. And the firmware in the slave will use a memory copy of the register fro I²C slave read operation, so that it can continue updates and I²C slave is still using a consistent but old coordinates for read operation as below,

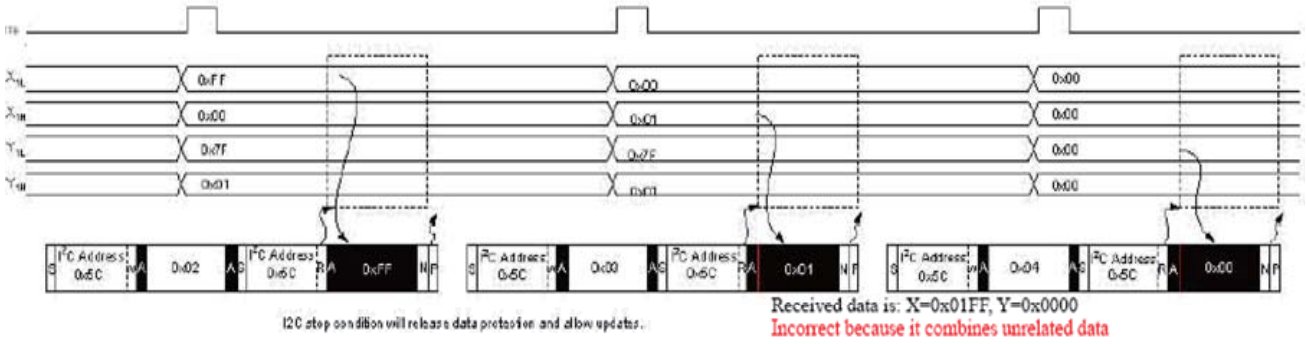
In a sequential read operation, the first data sent by the MSI device is therefore the touching register, and then the old touching, then X and Y coordinates of the 1st finger, then coordinates of the 2nd , and so on. Refer in below,



If the host does not finish the read operation when the ATTB 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



Note1：MSI Registers

Address	Name	Description	R/W
0	touching	Number of fingers touching	R
1	old touching	Previous scan number of fingers touching	R
2 (low part) 3 (high part)	posX	X coordinate of the first finger Only valid if touch>0	R
4 (low part) 5 (high part)	posY	Y coordinate of the first finger Only valid if touch>0	R
6 (low part) 7 (high part)	posX2	X coordinate of the first finger Only valid if touch>1	R
8 (low part) 9 (high part)	posY2	Y coordinate of the first finger Only valid if touch>1	R
20	power_mode	power_mode switching register	R/W
53-54	CRC	Whole program memory checksum	R
55	specop	Special operation	R/W

1.6 Operating Mode Register

1.6.1 POWER_MODE Register

Address	Name	Description of POWER_MODE Register
7-4	IDLE_PERIOD[3-0]	Refer to ALLOW_SLEEP function description
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

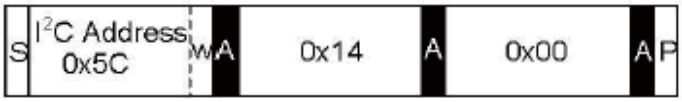
1.6.2 ATTB_MODE Register

Address	Name	Description
7-4	-	Not used
3	EN_ATTB	0:disable interrupt mode 1:enable interrupt mode
2	ATTB_POL	0:the interrupt is low active(default) 1:the interrupt is high active
1-0	ATTB_MODE[1-0]	00:ATTB assert periodically 01:ATTB assert only when finger moving 10:ATTB assert only when finger touch(default)

1.6.3 Power management

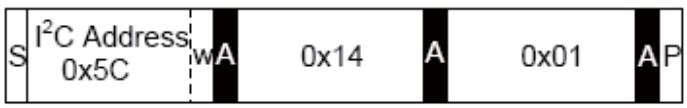
Active mode

In this mode, the slave resumes with a new scan directly after each I²C transfer (after ATTb 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.



Sleep mode

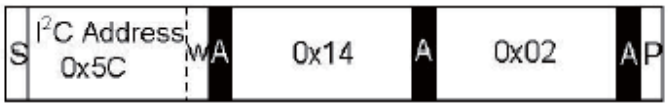
This mode is selected to decrease the current consumption during low activity phases on the sensor, which need a lower refresh rate. The MSI can automatically switch to Active mode(when finger is detected, provided that ALLOW_SLEEP bit is set in the POWER_MODE register. Also, the MSI can automatically 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. Below sequence shows how to force the slave into Sleep mode and how to force the slave into sleep mode can automatically switch, provided IDLE_PERIOD=10.



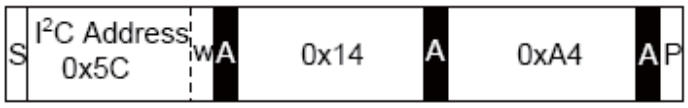
Sleep mode sequence

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

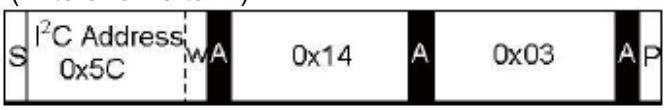


Sleep mode automatically switch sequence

Freeze mode

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

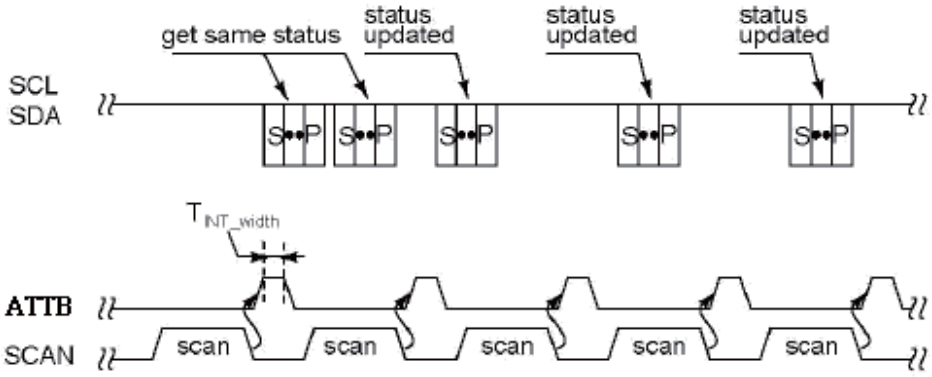
• ATTB pin change (“1 to 0” or “0 to 1”)



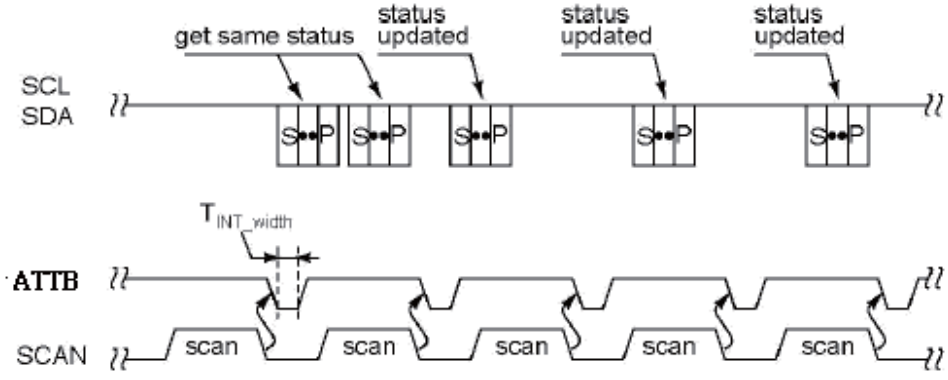
Freeze Mode sequence

1.6.4 Transition of ATTB line

When ATTB_MODE=00 in the ATTB MODE register, the slave will set the ATTB line with ATTB_width pulse width after each scan in order to request the attention from the host, as shown in below

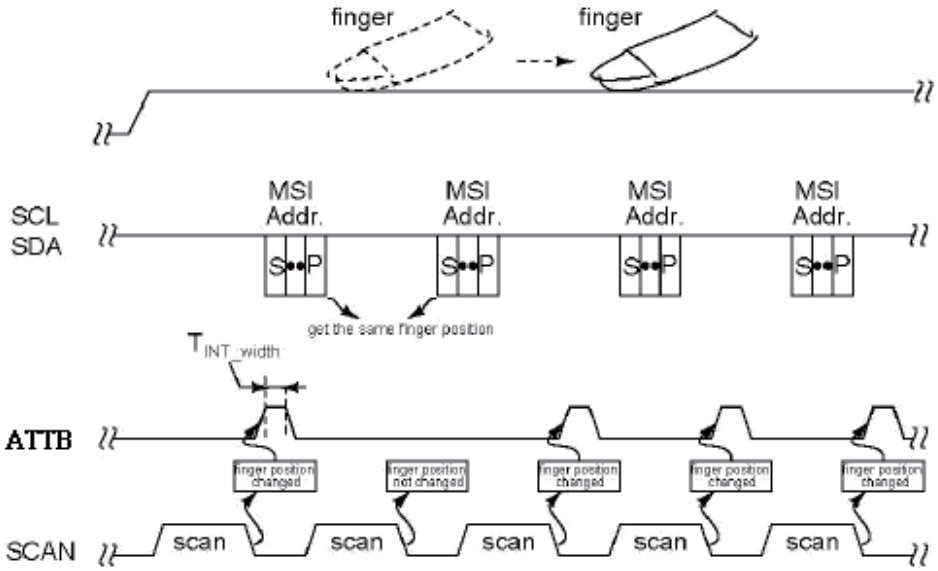


ATTB line pull up by slave (ATTB_POL=1, ATTB_MODE=00 in the ATTB mode register)



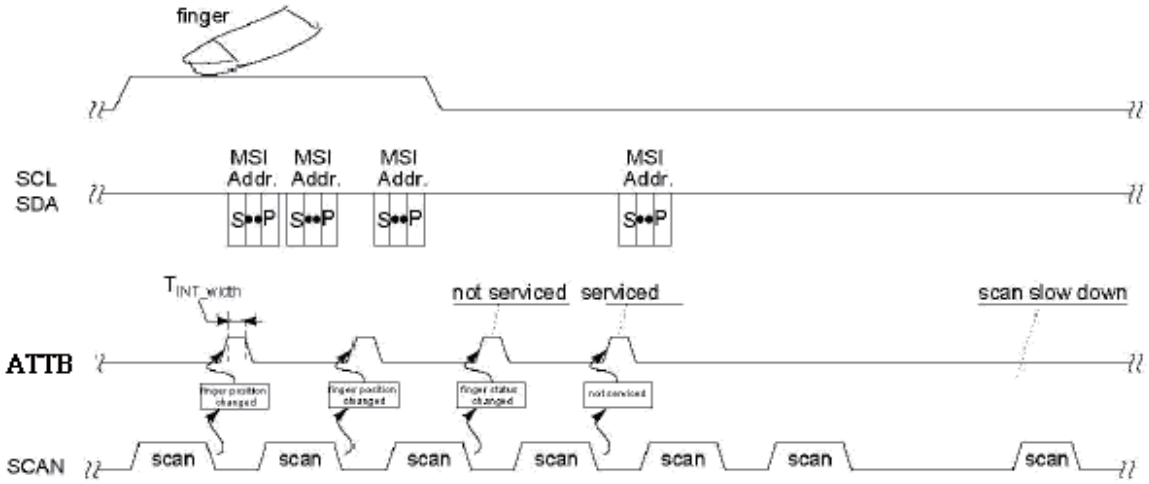
ATTB line pull down by slave (ATTB_POL=0, ATTB_MODE=00 in the ATTB mode register)

When ATTB_Mode=01 in the ATTB mode register and finger moving on the panel, the slave will set The ATTB line after each scan, as shown in below.



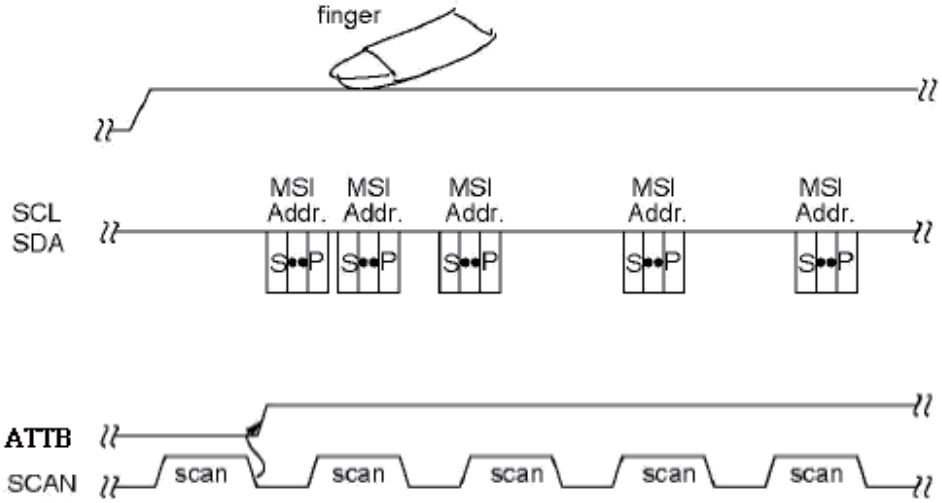
ATTB line pull up when finger moving (ATTB_POL=1, ATTB_MODE=01 in the ATTB mode register)

When fingers leaves the panel, the slave will continue to pulse ATTB 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 ATTB line, and will also gradually reduce the scan speed, as shown in below



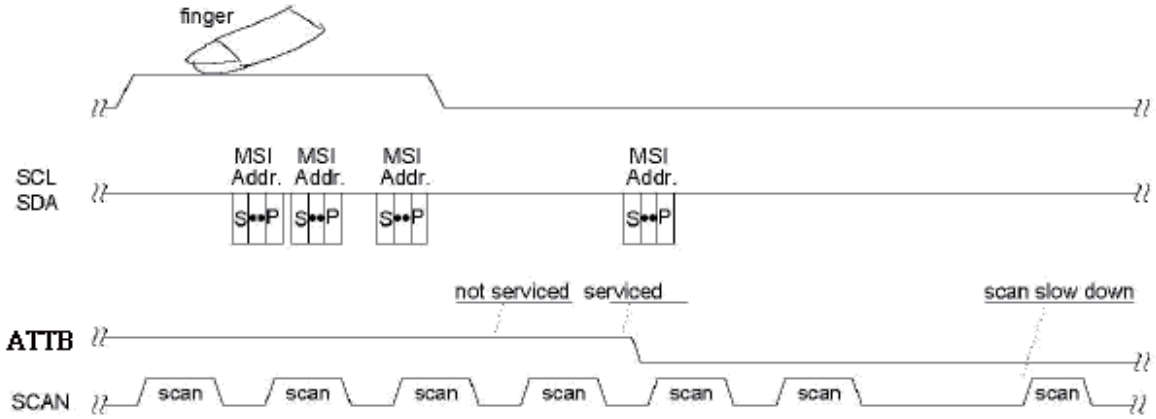
ATTB line will stop pulse when finger leaves and master has acknowledge the situation (ATTB_POL=1 in the ATTB mode register)

When ATTB_Mode=10 in the ATTB mode register and finger touch the panel, the slave will set The ATTB line after each scan as shown in below.



ATTB line pull up when finger touch (ATTB_POL=1, ATTB_MODE=10 in the ATTB mode register)

When fingers leaves the panel, the slave will continue keep ATTB 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 ATTB line, and will also gradually reduce the scan speed, as shown in below



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

■ RELIABILITY TEST

No.	Test Item	Test Condition
1	High Temperature Storage	70±2℃/120 hours
2	Low Temperature Storage	-20±2℃/120 hours
3	High Temperature Operating	60±2℃/120 hours
4	Low Temperature Operating	-10±2℃/120 hours
5	Temperature Cycle storage	-20±2℃~25~70±2℃×100cycles (30min.) (5min.) (30min.)
6	Damp proof Test operating	40℃±5℃×90%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:±15KV;Contact:±8KV

■ INSPECTION CRITERION

OUTGOING QUALITY STANDARD	PAGE 1 OF 8
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	MDS Product

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

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:

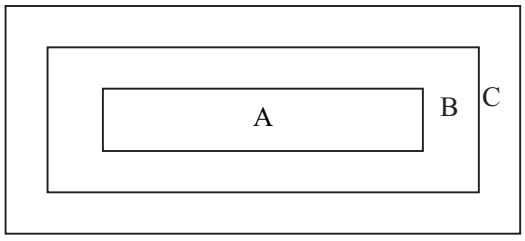
Major defect: AQL 0.65

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.

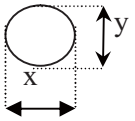
OUTGOING QUALITY STANDARD	PAGE 2 OF 8
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	MDS Product

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.	
4.1.4	linearity	No more than 1.5%	

4.2 Cosmetic Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects
4.2.1	**Clear Spots** Black and white Spot defect Pinhole, Foreign Particle, polarizer Dirt	For dark/white spot, size Φ is defined as $\Phi = \frac{(x+y)}{2}$ 	Minor
		1.	

Zone / Size(mm)	Acceptable Qty		
	A	B	C
Φ ≤0.1	Ignore		Ignore
0.10＜Φ≤0.15	2		
0.15＜Φ≤0.20	1		
Φ＞0.20	0		

Clear Spots

TP Dirt

2.

Zone / Size(mm)	Acceptable Qty A	B	C
Φ≤0.1	Ignore		Ignore
0.10<Φ≤0.15	**3**		
0.15<Φ≤0.25	**2**		
0.25<Φ	0		

Minor

Dim Spots

Circle shaped and dim edged defects

3.

2. Zone / Size(mm)	Acceptable Qty A	B	C
Φ≤0.2	Ignore		Ignore
0.20<Φ≤0.40	2		
0.40<Φ≤0.60	1		
0.60<Φ	0		

Minor

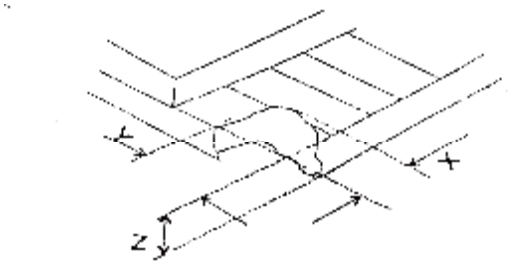
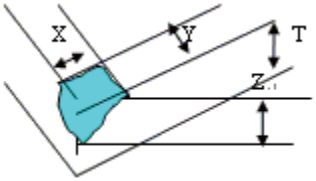
4.2. Cosmetic Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects
4.2.2	**Line defect** Black line, White line, Foreign material on polarizer		Minor

Size(mm) L(Length)	Size(mm) W(Width)	Acceptable Qty Zone A	B	C
Ignore	W≤0.02	Ignore		Ignore
L≤3.0	0.02<W≤0.03	2		
L≤2.0	0.03<W≤0.05	1		
	0.05<W	Define as spot defect		

<table>
<tr><td></td><td></td><td>Foreign material on TP film</td><td>The line can be seen after mobile phone in the operating condition:
<table>
<tr><td colspan="2">size(mm)</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td rowspan="2">L(Length)</td><td rowspan="2">W(Width)</td><td colspan="3">zone</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>Ignore</td><td>W≤0.03</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>L≤5.0</td><td>0.03＜W≤0.05</td><td colspan="2">3</td></tr>
<tr><td></td><td>0.05＜W</td><td colspan="2">Define as spot defect</td></tr>
</table></td><td></td><td></td></tr>
<tr><td></td><td>4.2.3</td><td>Dim line defect
Polarizer scratch
TP film scratch</td><td>If the 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 scratch can be seen only in non-operating condition or some special angle, judge by the following.
<table>
<tr><td colspan="2">Size(mm)</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td rowspan="2">L(Length)</td><td rowspan="2">W(Width)</td><td colspan="3">Zone</td></tr>
<tr><td>A</td><td>B</td><td>C</td></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><td></td></tr>
<tr><td></td><td>4.2.4</td><td>Polarize Air bubble</td><td>Air bubbles between glass & polarizer
<table>
<tr><td>2. Zone
Size(mm)</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td></td><td>A</td><td>B</td><td>C</td></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><td></td></tr>
</table>

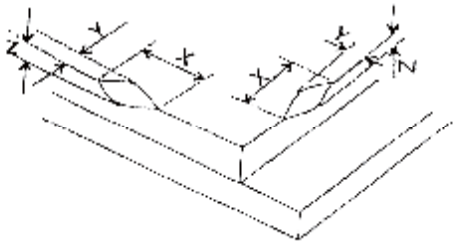
OUTGOING QUALITY STANDARD	PAGE 5 OF 8
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	MDS Product

<table>
<tr><th>Item No</th><th>Items to be inspected</th><th>Inspection Standard</th><th>Classification of defects</th></tr>
<tr><td>4.3.5</td><td>Glass defect</td><td>(i) Chips on corner
A:LCD Glass defect
 
<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.
B:TP Glass defect
 
<table><tr><th>X(mm)</th><th>Y(mm)</th><th>Z(mm)</th></tr><tr><td>≤3.0</td><td>≤3.0</td><td>Disregard</td></tr></table></td><td>Minor</td></tr>
</table>

	OUTGOING QUALITY STANDARD	PAGE 6 OF 8
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA		MDS Product

(ii)Usual surface cracks

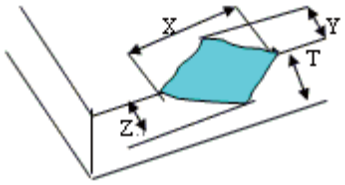
A:LCD Glass defect



X	Y	Z
≤3.0	<Inner border line of the seal	Disregard

Minor

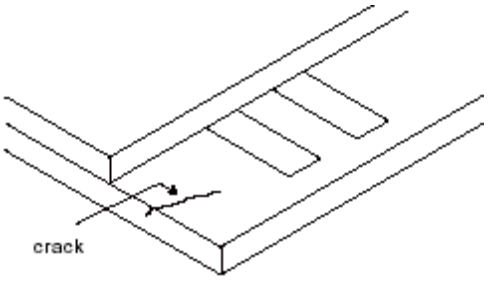
B:TP Glass defect



X(mm)	Y(mm)	Z(mm)
≤6.0	＜2.0	Disregard

(iii) Crack

Cracks tend to break are not allowed.



OUTGOING QUALITY STANDARD	PAGE 7 OF 8
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	MDS Product

4.4 Parts Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects	
4.4.1	Parts contraposition	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.		
4.4.2	SMT	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.		

OUTGOING QUALITY STANDARD	PAGE 8 OF 8
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	MDS Product

4.4.3 TP Defect

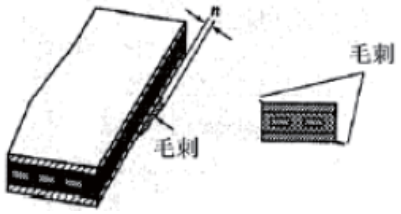
1、 Pattern font：

Pattern fonts are clear and symmetrical， pattern fonts filter lightly are allowed; The fort line is not allow to thinner or thicker than 1/3of normal size, and swing is not more than 0.1mm. the line is smooth and not broken.

2、The wing forward in the side of Visual Area：

The length of wing forward inside of the Visual Area: n≤0.2mm;

Not excess 3 point，and the distanceD≥20mm。



3、Film impression:With operation, must be invisibility.

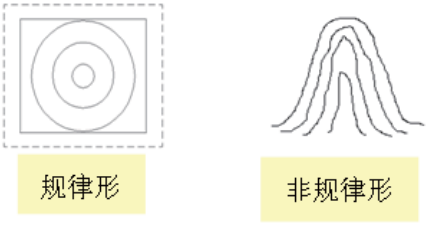
4、Touch panel knob：if writing function normally,it could be allowed.

5、 Newton ring

Without operation, the color circle of Regularity or Non-regularity from the normal or slope angle of view.

1、**Regularity：** The area of the newton ring is less than 1/3 area of the touch panel; and no character affected and line distorted after touch panel lightening. It's ok.

2、**Non-regularity** ： The area of the Newton ring is less than the 1/2 area of touch panel with lightening. And no character affected and line



■PRECAUTIONS FOR USING LCD MODULES

Handing Precautions

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

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

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

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

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

- Isopropyl alcohol
- Ethyl alcohol

Do not scrub hard to avoid damaging the display surface.

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

- Water
- Ketone
- Aromatic solvents

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

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

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

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

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

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

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

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

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

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

Handling precaution for LCM

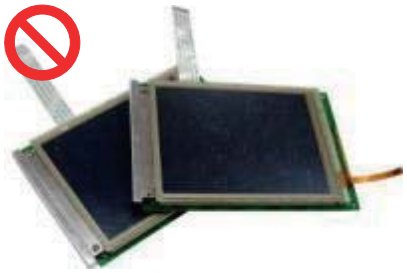
LCM is easy to be damaged. Please note below and be careful for handling.

Correct handling:

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

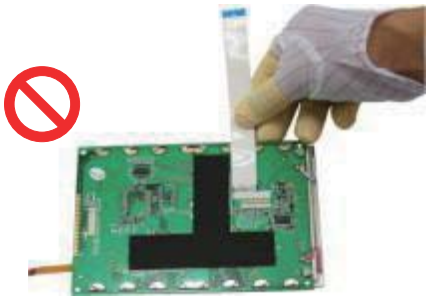
Incorrect handling:

Please don't touch IC directly.

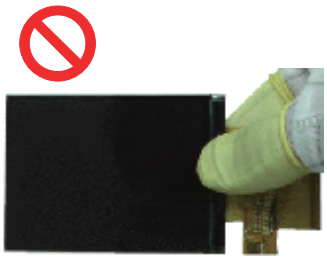


Please don't stack LCM.

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.

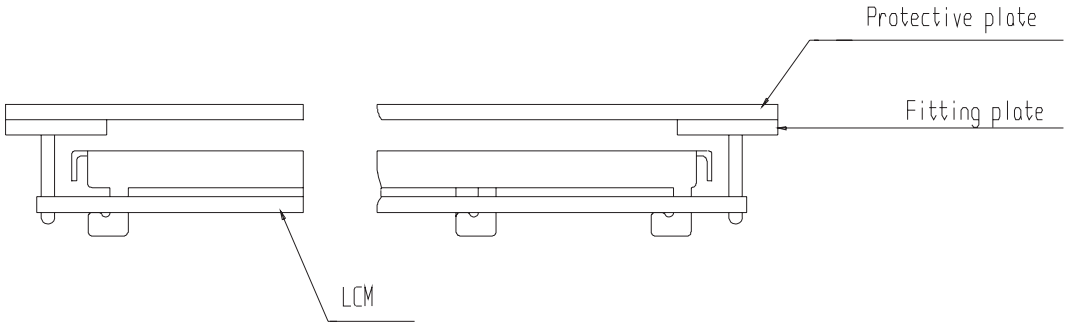
- Exposed area of the printed circuit board.
-Terminal electrode sections.

■ 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.

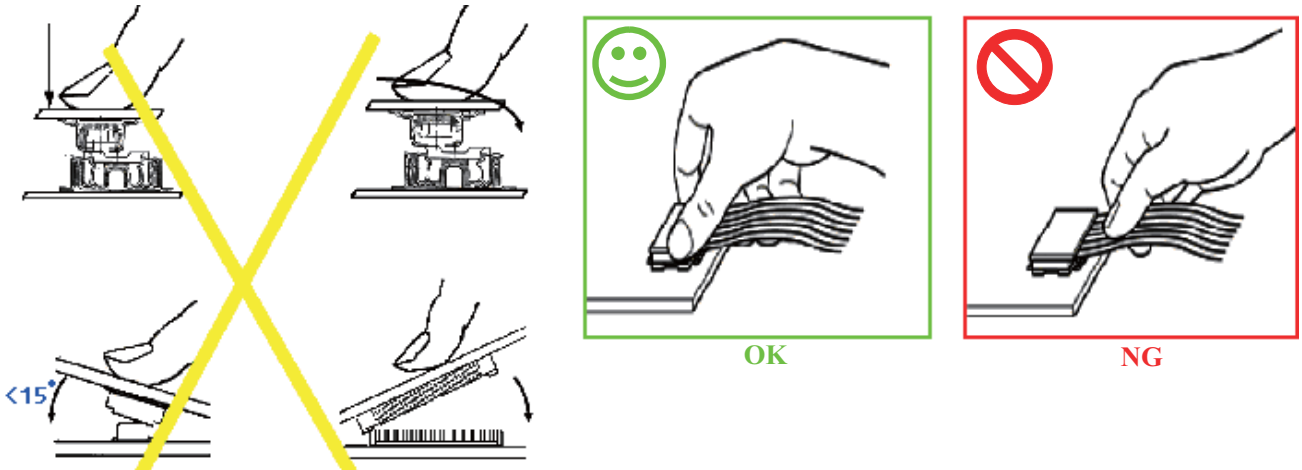
(1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



(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 ±0.1mm.

Precaution for assemble the module with BTB connector:

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



Precaution for soldering 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 : 4-8 mm/s.	300°C ~330°C. Time : 3-6S. Press: 0.8~1.2Mpa
ROHS product	340°C ~370°C. Time : 3-5S.	350°C ~370°C. Time : 4-8 mm/s.	330°C ~360°C. Time : 3-6S. Press: 0.8~1.2Mpa

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

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

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

Precautions for Operation

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

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

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

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

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

(6) Input 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.