



DATA IMAGE CORPORATION

CTP Module Specification Preliminary

ITEM NO.: SCF0500633GGU02

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Customer Companies	R&D Dept.	Q.C. Dept.	Eng. Dept.	Prod. Dept.
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	2	23/JUN/15'		31

2. RECORD OF REVISION

Rev	Date	Item	Page	Comment	Source
1	15/MAY/15'			Initial preliminary	ESR0402015
2	23/JUN/15'	6	5	Modify LCD BLOCK DIAGRAM	11S-F60016
		10.1	12	Update General Specifications,Add FW	
		12	23	Update QUALITY ASSURANCE	

3. GENERAL SPECIFICATIONS

Composition: 5.0inch WVGA resolution display with a projected Capacitive Touch Panel (CTP)

Interface: RGB interface for LCM and I²C for CTP.

Parameter	Specifications	Unit
Screen Size	5.0(diagonal)	inch
Display Format	800 X RGB X 480	dots
Outline Dimension	142 (W) x 94 (H) x 6.05 (D)	mm
LCD Active Area	108 (W) x 64.8 (H)	mm
Sensor Active Area	108.8 (W) x 65.6 (H)	mm
Pixel Pitch	0.135 (W) x 0.135(H)	mm
Pixel Configuration	Stripe	
Weight	TBD	g
View Angle direction (Gray inversion)	6 o'clock	
LCD Part Number	FG0500E0DSSWBG01	

4. LCD ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	MIN.	MAX.	Unit	Remark
Power voltage	DV _{DD}	-0.3	5.0	V	
	AV _{DD}	-0.5	13.5	V	
	V _{GH}	-0.3	42.0	V	
	V _{GL}	-20.0	0.3	V	
Operating temperature	T _{OP}	-20	70	°C	
Storage temperature	T _{ST}	-30	80	°C	

Note : 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.

5. LCD ELECTRICAL CHARACTERISTICS

5.1 Typical operation conditions

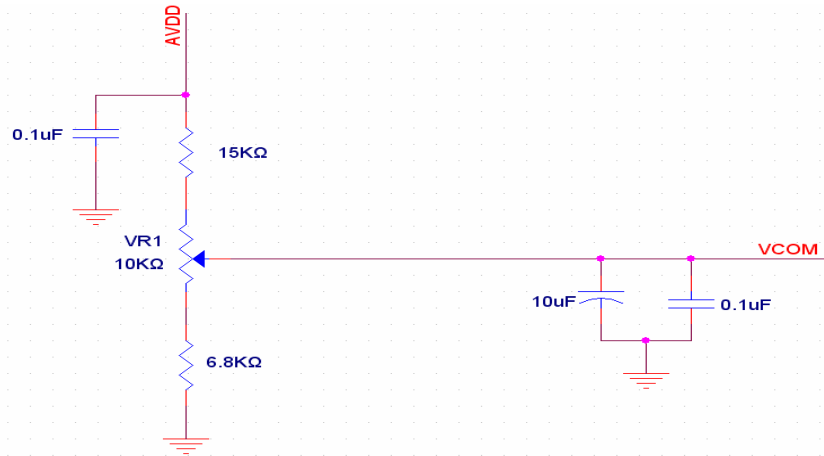
Parameter	Symbol	MIN.	Typ.	MAX.	Unit	Remark
Power voltage	DV _{DD}	+3.0	+3.3	+3.6	V	Note 2
	AV _{DD}	10.2	10.4	10.6	V	
	V _{GH}	15.3	16.0	16.7	V	
	V _{GL}	-6.7	-6.0	-5.3	V	
Current for Driver	IDV _{DD}	-	4.2	10	mA	DV _{DD} =3.3V
	I _{AV} DD	-	19	50	mA	AV _{DD} =10.4V
Input signal voltage	V _{COM}	3.09	4.09	5.09	V	Note 4
"H" level logical input voltage	V _{IH}	0.7 DV _{DD}	--	DV _{DD}	V	Note 3
"L" level logical input voltage	V _{IL}	0	--	0.3 DV _{DD}	V	Note 3

Note 1: Be sure to apply DV_{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: DCLK,HS,VS,RESET,U/D, L/R,DE,R0~R7,G0~G7,B0~B7,MODE

Note 4: Typical V_{COM} is only a reference value. It must be optimized according to each LCM. Please use VR and base on below application circuit.



5.2 Backlight Unit

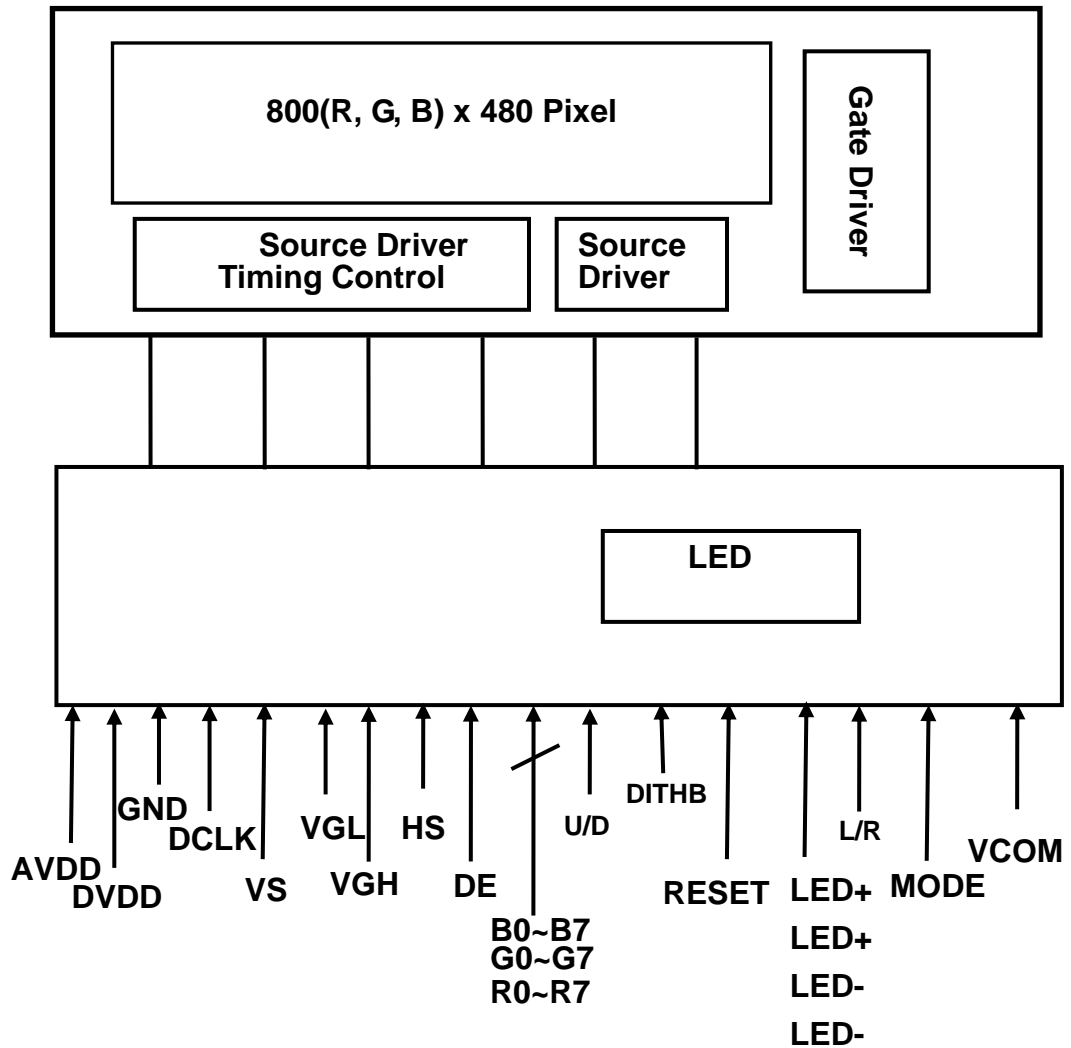
Ta=25°C

Parameter	Symbol	Min	Typ.	Max.	Unit	Remark
LED voltage	VF	19.6	21.7	23.8	V	Note(1)
LED current	IL	36	40	44	mA	
Operating LED Life Time		20,000	--	--	Hour	Note(2)

Note 1: The LED Supply Voltage is defined by the number of LED at Ta=25°C and, $I_L = 40\text{mA}$.

Note 2: The "LED life time" is defined as the module brightness decrease to 50% original brightness at Ta=25°C and $I_L = 40\text{mA}$. The LED lifetime could be decreased if operating I_L is larger than 40 mA

6. LCD BLOCK DIAGRAM



7. LCD PIN CONNECTIONS

Pin No.	Symbol	I/O	Function
1	VLED+	P	Power for LED backlight (Anode)
2	VLED+	P	Power for LED backlight (Anode)
3	VLED-	P	Power for LED backlight (Cathode)
4	VLED-	P	Power for LED backlight (Cathode)
5	GND	P	Power ground
6	VCOM	P	Common voltage
7	DVDD	P	Power for Digital Circuit
8	MODE	I	DE/SYNC mode select
9	DE	I	Data Input Enable
10	VS	I	Vertical Sync Input
11	HS	I	Horizontal Sync Input
12	B7	I	Blue data(MSB)
13	B6	I	Blue data
14	B5	I	Blue data
15	B4	I	Blue data
16	B3	I	Blue data
17	B2	I	Blue data
18	B1	I	Blue data
19	B0	I	Blue data(LSB)
20	G7	I	Green data(MSB)
21	G6	I	Green data
22	G5	I	Green data
23	G4	I	Green data
24	G3	I	Green data
25	G2	I	Green data
26	G1	I	Green data
27	G0	I	Green data(LSB)
28	R7	I	Red data(MSB)
29	R6	I	Red data
30	R5	I	Red data
31	R4	I	Red data
32	R3	I	Red data
33	R2	I	Red data
34	R1	I	Red data
35	R0	I	Red data(LSB)
36	GND	P	Power Ground
37	DCLK	I	Sample clock
38	GND	P	Power Ground
39	L/R	I	Left / right selection
40	U/D	I	Up/down selection
41	VGH	P	Gate ON Voltage
42	VGL	P	Gate OFF Voltage
43	AVDD	P	Power for Analog Circuit
44	RESET	I	Global reset pin.
45	NC	-	No connection
46	VCOM	P	Common Voltage
47	DITHB	I	Dithering function

48	GND	P	Power Ground
49	NC	-	No connection
50	NC	-	No connection

I/O:I: input, O: output, P: Power

Note 1: DE/SYNC mode select. Normally pull high. When select DE mode, MODE="1", VS and HS must pull high. When select SYNC mode, MODE="0", DE must be grounded.

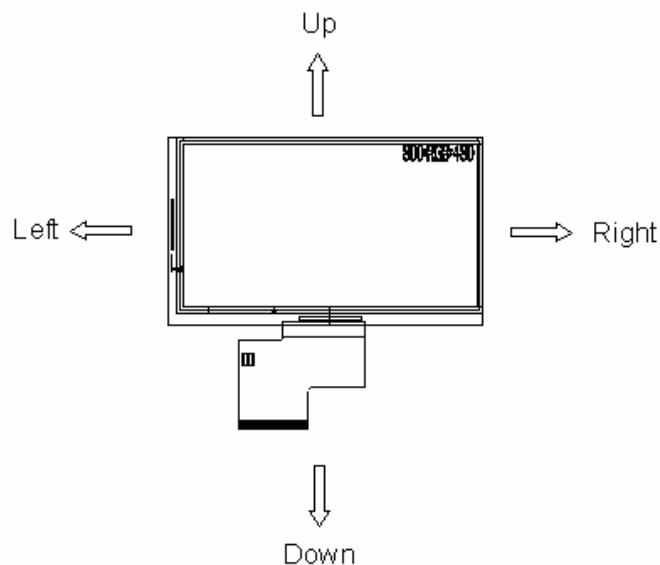
Note 2: Data shall be latched at the falling edge of DCLK.

Note 3: Selection of scanning mode

Setting of scan control input		Scanning direction
U/D	L/R	
DVDD	DVDD	Up to down, left to right
GND	GND	Down to up, right to left
DVDD	GND	Up to down, right to left
GND	DVDD	Down to up, left to right

Note 4: Definition of scanning direction.

Refer to the figure as below:



Note 5: Dithering function enable control, normally pull high.

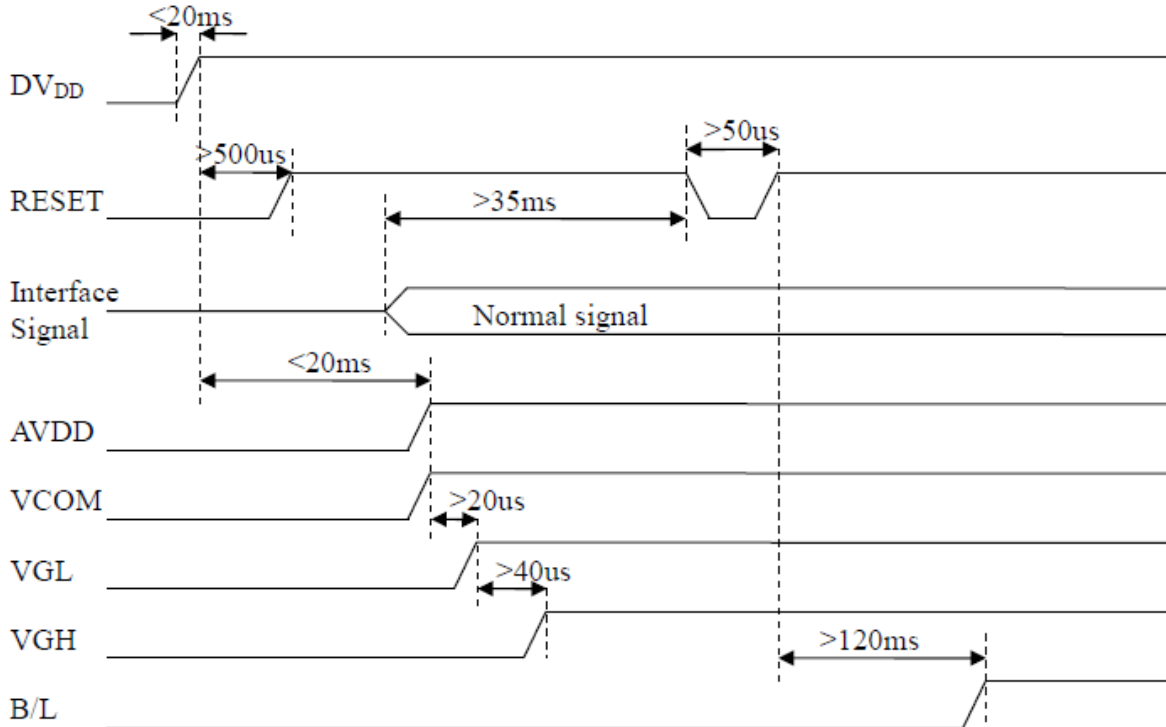
When DITHB="1",Disable internal dithering function,

When DITHB="0",Enable internal dithering function.

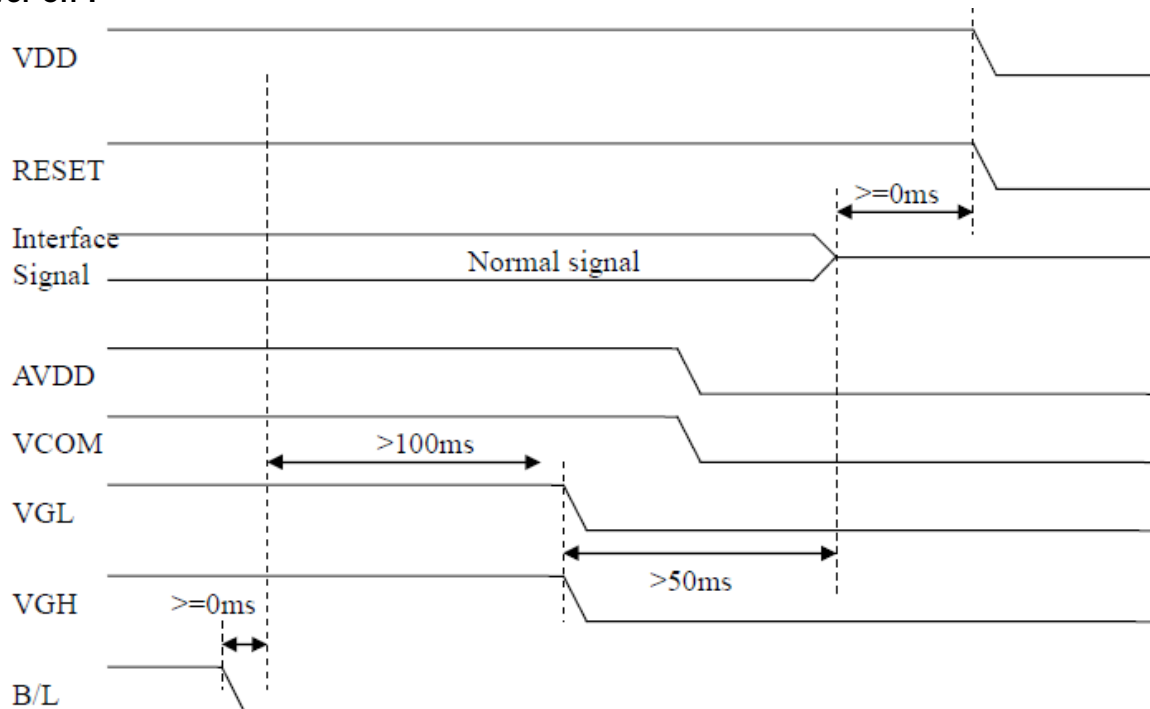
8. LCD POWER SEQUENCE

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.

Power on :



Power off :

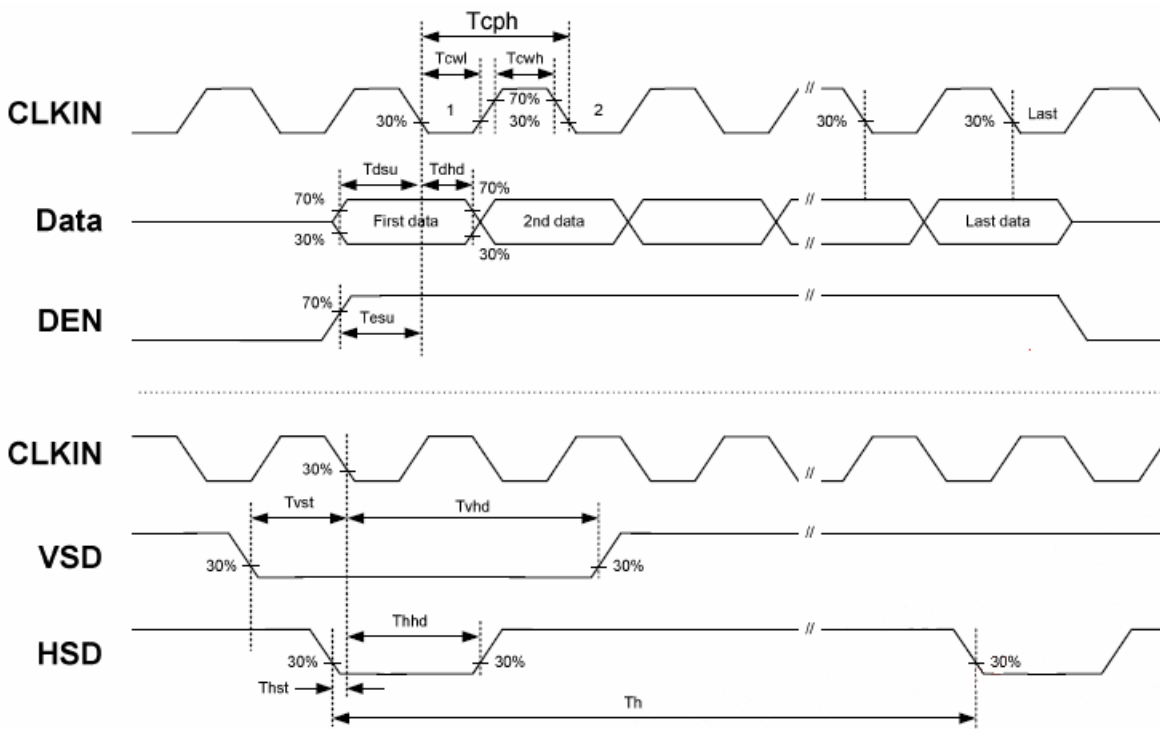


9. LCD INTERFACE SPECIFICATIONS

9.1 AC Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
HS setup time	T_{hst}	8	-	-	ns	
HS hold time	T_{hhd}	8	-	-	ns	
VS setup time	T_{vst}	8	-	-	ns	
VS hold time	T_{vhd}	8	-	-	ns	
Data setup time	T_{dsu}	8	-	-	ns	
Data hole time	T_{dhd}	8	-	-	ns	
DE setup time	T_{esu}	8	-	-	ns	
DE hole time	T_{ehd}	8	-	-	ns	
DV _{DD} Power On Slew rate	T_{POR}	-	-	20	ms	From 0 to 90% DV _{DD}
RESET pulse width	T_{Rst}	1	-	-	ms	
DCLK cycle time	T_{coh}	20	-	-	ns	
DCLK pulse duty	T_{cwh}	40	50	60	%	

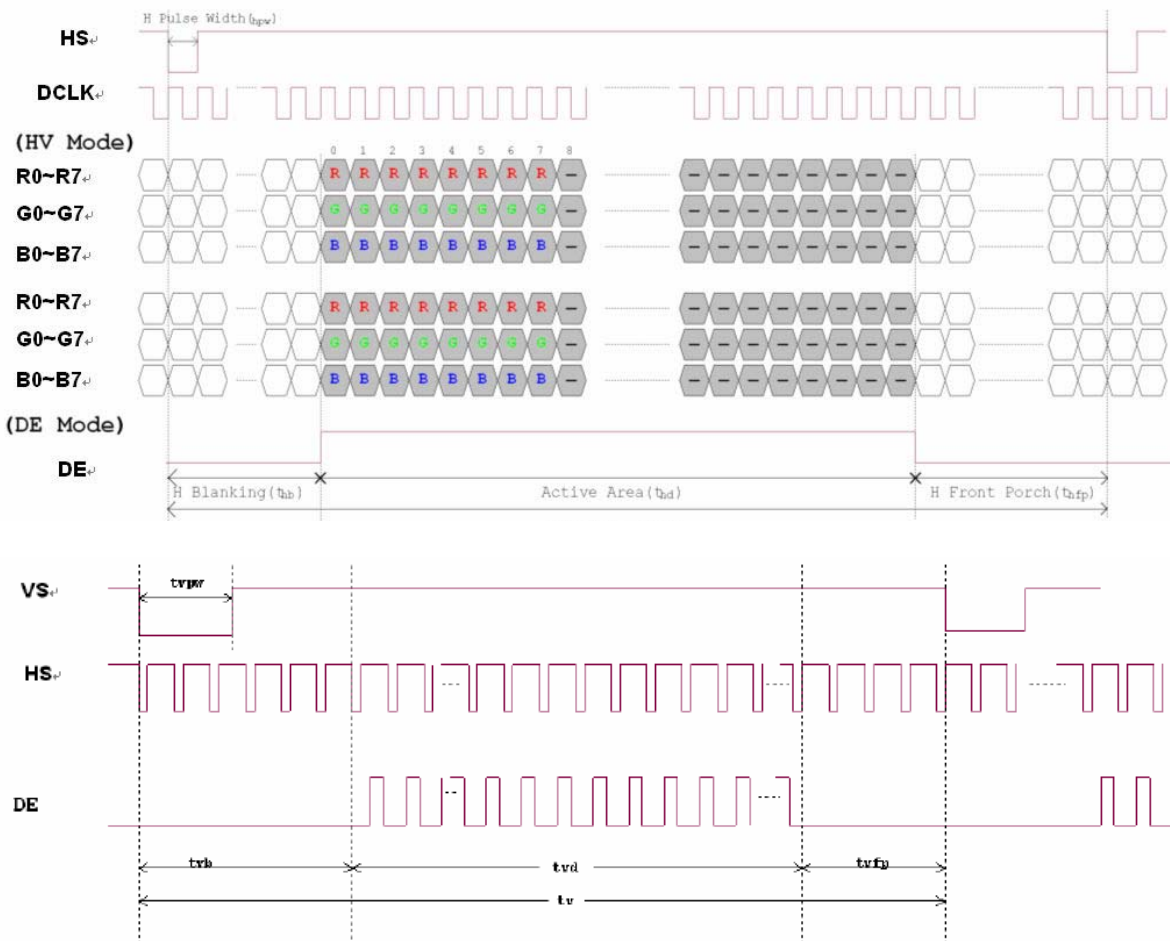
9.2 Input Clock and Data Timing Diagram



9.3 Timing

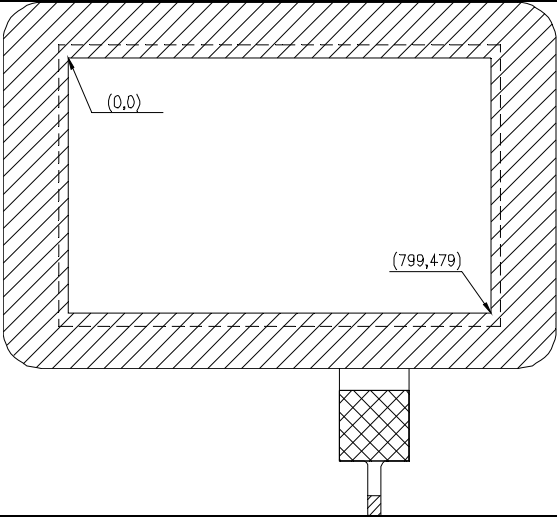
Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Horizontal Display Area	thd	-	800	-	DCLK	
DCLK Frequency	fclk	26.4	33.3	46.8	MHz	
One Horizontal Line	th	862	1056	1200	DCLK	
HS pulse width	thpw	1	-	40	DCLK	
HS Blanking	thb	46	46	46	DCLK	
HS Front Porch	thfp	16	210	354	DCLK	

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Vertical Display Area	tvd	-	480	-	TH	
VS period time	tv	510	525	650	TH	
VS pulse width	tvpw	1	-	20	TH	
VS Blanking	tvb	23	23	23	TH	
VS Front Porch	tvfp	7	22	147	TH	



10. CTP SPECIFICATIONS

10.1 GENERAL SPECIFICATIONS

Item	Specification	Unit
Type	Transparent type projected capacitive touch panel	
Input mode	Human's finger	
Multi touch	5	Point
Interface	I ² C	
Report rate	100	Hz
Origin point		
FW : FW4736_20150408.dump. Ver : 01		

10.2 Electrical Characteristic

10.2.1 Absolute Maximum Rating

Parameter	Symbol	Spec.			Unit
Supply voltage	VCC	-0.3	-	6	V

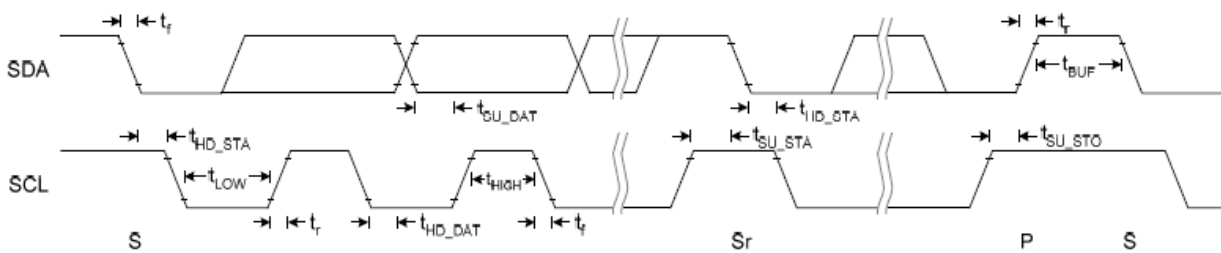
10.2.2 DC Characteristic

Symbol	Description	Min	Typ	Max	Unit	Notes
VCC	Supply voltage	2.7	3.3	3.6	V	
ICC	Supply current		14		mA	VCC=3.3V
VIH	Input High Voltage	0.85*VCC		3.6	V	
VIL	Input Low Voltage	0		0.15*VCC	V	

10.2.3 CTP PIN FUNCTION

Pin No.	Symbol	Function
1	VCC	Power for CTP
2	SCL	CTP I ² C Clock
3	SDA	CTP I ² C Data
4	/TP_INT	CTP interrupt pin, active low.
5	/TP_RST	CTP reset input pin, active low.
6	GND	Ground

10.3 AC electrical characteristics



I2C Fast mode timing

Conditions :VDD=3.3V GND=0V TA=25°C

Symbol	Parameter	Rating			Unit
		Min.	Typ.	Max.	
f_{SCL}	SCL clock frequency	0	-	400	kHz
t_{LOW}	Low period of the SCL clock	1.3	-	-	us
t_{HIGH}	High period of the SCL clock	0.6	-	-	us
t_f	Signal falling time	-	-	300	ns
t_r	Signal rising time	-	-	300	ns
t_{SU_STA}	Set up time for a repeated START condition	0.6	-	-	us
t_{HD_STA}	Hold time (repeated) START condition. After this period, the first clock pulse is generated	0.6	-	-	us
t_{SU_DAT}	Data set up time	100	-	-	ns
t_{HD_DAT}	Data hold time	0	-	0.9	us
t_{SU_STO}	Set up time for STOP condition	0.6	-	-	us
t_{BUF}	Bus free time between a STOP and START condition	1.3	-	-	us
C_b	Capacitive load for each bus line	-	-	400	pF

10.4 I2C Host Interface Protocol

10.4.1 I2C Address

I2C address is to 0x55 (7-bits address)

10.4.2 Register Read

For reading register value from I2C device, host has to tell I2C device the Start Register Address before reading corresponding register value.

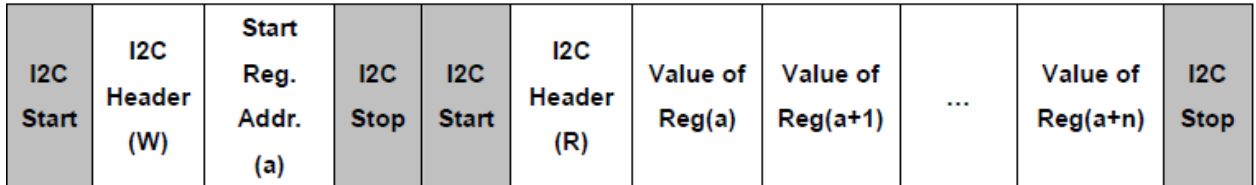


Figure 1 - Register Read Format.

Touch IC I2C host interface protocol supports Repeated Register Read. That is, once the Start Register Address has been set by host, consequent I2C Read(R) transactions will directly read register values starting from the Start Register Address without setting address first, as shown in Figure 2.

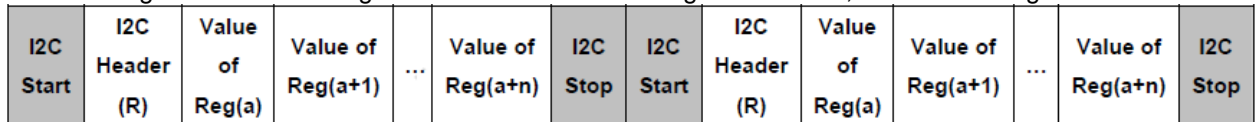


Figure 2 - Repeated Register Read.

10.4.3 register write

For writing register to I2C device, host has to tell I2C device the Start Register Address in each I2C Register Write transaction. Register values to the I2C device will be written to the address starting from the Start Register Address described in Register Write I2C transaction as shown in Figure 3.

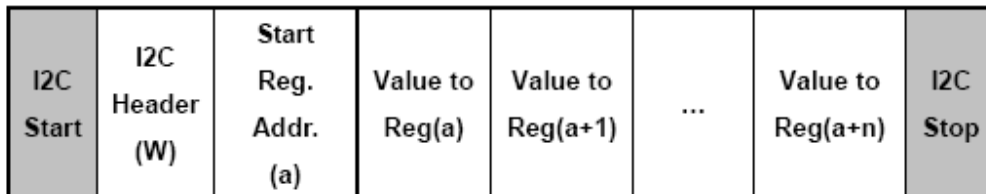
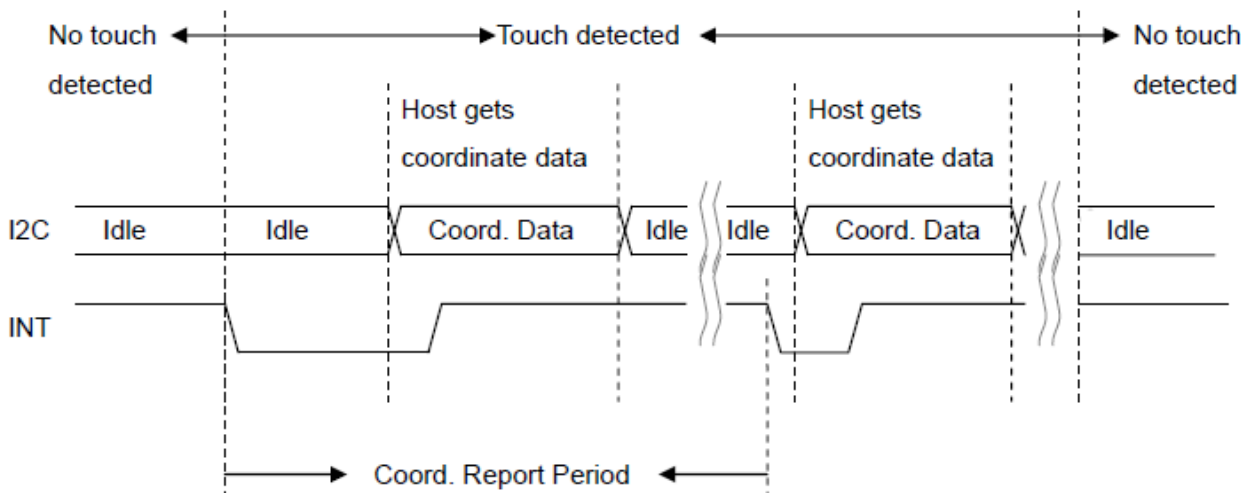


Figure 3 - Register Write Format.

10.4.4 I2C Electrical Waveform



10.5 Report Page Registers

Touch IC provides a register set for host to configure device attributes and retrieve information about fingers and raw data through device host interface. Host interface registers are listed below.

Host Interface Registers (Report Page)									
Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x00	Firmware Version	Version (RO)							
0x01	Status Reg.	Error Code (RO)				Device Status (RO)			
0x02	Device Control Reg.	Reserv ed	Multi-Touch Disable (RW)	Proximi ty Enable (RW)	Reserv ed	Reserved		Power Down (RW)	Reset (RW)
0x03	Timeout to Idle Reg.	Timeout to Idle (sec.) (RW)							
0x04	XY Resolution (High Byte)	Reserv ed	X_Res_H (RO)			Reserv ed	Y_Res_H (RO)		
0x05	X Resolution (Low Byte)	X_Res_L (RO)							
0x06	Y Resolution (Low Byte)	Y_Res_L (RO)							
0x07	Sensing Counter (High Byte)	Sensing_Counter_H (RO)							
0x08	Sensing Counter (Low Byte)	Sensing_Counter_L (RO)							
0x09 ... 0x0B	...	Reserved							
0x0C	Firmware Revision 3	FW_Rev_3 (RO)							
0x0D	Firmware Revision 2	FW_Rev_2 (RO)							
0x0E	Firmware Revision 1	FW_Rev_1 (RO)							
0x0F	Firmware Revision 0	FW_Rev_0 (RO)							
0x10	Advanced Touch Info.	Reserv ed	Proximi ty Flag (RO)	Reserved					
0x11	Keys Reg.	Keys (RO)							
0x12	XY0 Coord. (High Byte)	Valid 0 (RO)	X0_H (RO)			Reserv ed	Y0_H (RO)		
0x13	X0 Coord. (Low Byte)	X0_L (RO)							

Host Interface Registers (Report Page)									
Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x14	Y0 Coord. (Low Byte)	Y0_L (RO)							
0x15	...	<i>Reserved.</i>							
0x16	XY1 Coord. (High Byte)	Valid 1 (RO)	X1_H (RO)			<i>Reserved</i>	Y1_H (RO)		
0x17	X1 Coord. (Low Byte)	X1_L (RO)							
0x18	Y1 Coord. (Low Byte)	Y1_L (RO)							
0x19	...	<i>Reserved.</i>							
0x1A ... 0x35							
0x36	XY9 Coord. (High Byte)	Valid 9 (RO)	X9_H (RO)			<i>Reserved</i>	Y9_H (RO)		
0x37	X9 Coord. (Low Byte)	X9_L (RO)							
0x38	Y9 Coord. (Low Byte)	Y9_L (RO)							
0x39	Reserved	<i>Reserved.</i>							
0x3A ... 0x3E	...	<i>Reserved</i>							
0x3F	Contact Count Max.	Max Number of Contacts Support (RO)							
0x40 ... 0xFE	...	<i>Reserved</i>							
0xFF	Page Reg.	Page Number (RW)							

10.5.1 Firmware Version Register

Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x01	Status Reg.	Error Code (RO)				Device Status (RO)			

Firmware Version Register provides version information about current firmware. Host application can support version control in firmware upgrade function by reading Firmware Version Register and comparing with the version of new firmware binary.

10.5.2 Status Register

Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x01	Status Reg.	Error Code (RO)				Device Status (RO)			

Status Register shows current status of the device to host, including Device Status and Error Code. Init status represents that the device is in Init state and not ready for host access. Host has to wait for the device to change into Normal state before accessing registers other than Status Register. If Device Status shows Error, the Error Code field in the Status Register gives reason of the error.

Device Status	
0x0	Normal
0x1	Init
0x2	Error
0x3	Auto Tuning
0x4	Idle
0x5	Power Down
0x6	Boot ROM
0x7	Waiting to execute Sub-AP
0x8	<i>Reserved</i>
...	
0xF	

Error Code	
0x0	No Error
0x1	Invalid Address
0x2	Invalid Value
0x3	Invalid Platform
0x4	Dev Not Found
0x5	Stack Overflow
0x6	Invalid Firmware Parameter Table
0x7	Invalid Secondary Touch Firmware

Error Code	
0x8	<i>Reserved</i>
...	
0xF	

10.5.3 Device Control Register

Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x02	Device Control Reg.	<i>Reserved</i>	Multi-Touch Disable (RW)	Proximity Enable (RW)	<i>Reserved</i>			Power Down (RW)	Reset (RW)

Device Control Register provides device control bits for host to reset the device or power down the device. "Multi-Touch Disable" control bit is used to configure touch detector as single touch or multi-touch detector. The default setting of this control bit is cleared to 0 and touch device can report multiple touch positions.

Set "Multi-Touch Disable" control bit to 1 makes the touch device to report only one touch position

The "Multi-Touch Disable" control bit is useless in triangle projects.

For ST1x56/ST1x64/ST1x64A/ST1x72 series touch IC:

When host sets Power Down bit, touch sensor controller will enter power down mode. Host can pull I2C INT pin to low to wake up the controller.

For ST1x32/ST1x28/ST1x30/ST1x34/ST1x36 series touch IC :

When host sets Power Down bit, touch sensor controller will enter power down mode. Host can clear Power Down bit to wake up the controller.

The "Proximity Enable" control bit is only for some triangle projects.

Host sets "Proximity Enable" bit to 1 to enable proximity function and clear it to disable. The proximity information is shown in "Proximity Flag" of "Advanced Touch Information" register.

Please always write 0 into reserved bits

10.5.4 Timeout to Idle Register

Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x03	Timeout to Idle Reg.	Timeout to Idle (sec.) (RW)							

Timeout to Idle Register provides timeout control to enter Idle Mode for host. The touch controller will enter Idle Mode after the number of seconds specified in Timeout to Idle Register if there is no touch detected in this period. Set this field to 0xFF will disable Idle Mode. Set this field to 0 will entering Idle Mode immediately. Idle state will be updated to Device Status field of Status Register, 0x01, after entering Idle Mode automatically. The default value of Timeout to Idle Register is set to 0x08 for 8 seconds to Idle Mode.

10.5.5 XY Resolution Registers

Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x04	XY Resolution (High Byte)	Reserved	X_Res_H (RO)			Reserved	Y_Res_H (RO)		
0x05	X Resolution (Low Byte)	X_Res_L (RO)							
0x06	Y Resolution (Low Byte)	Y_Res_L (RO)							

XY Resolution Registers represents resolution of X and Y coordinates of the touch screen.

10.5.6 Sensing Counter Registers

Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x07	Sensing Counter (High Byte)	Sensing_Counter_H (RO)							
0x08	Sensing Counter (Low Byte)	Sensing_Counter_L (RO)							

Sensing Counter Registers provide a frame-based scan counter for host to verify current scan rate. This counter will be increased by one each time when a frame data is produced by the controller scanning system.

10.5.7 Firmware Revision Registers

Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x0C	Firmware Revision 3	FW_Rev_3 (RO)							
0x0D	Firmware Revision 2	FW_Rev_2 (RO)							
0x0E	Firmware Revision 1	FW_Rev_1 (RO)							
0x0F	Firmware Revision 0	FW_Rev_0 (RO)							

Firmware Revision Registers provide revision information about current firmware.

10.5.8 Advanced Touch Information Register

Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x10	Advanced Touch Info.	Reserved	Proximity Flag (RO)	Reserved					

Advanced Touch Information field provides some advanced touch information, like proximity, for host. Touch controller sets proximity flag to 1 to notify host that the human body is very close to proximity sensor. The "Proximity Flag" is only for some triangle projects.

If proximity flags are changed, the touch controller will set INT pin to GND to notify host.

The timing of touch controller to update latest information into "Advanced Touch Information Register", "Keys Register" and "XY Coordinate Registers" is when host reads register data via I2C interface with specified 0x10, 0x11 or 0x12 start register address.

10.5.9 Keys Register

Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x11	Keys	Keys (RO)							

Key field represents which key is pressed or released. Each bit in the Key field represents the pressed or released state of one key. If the bit is set, it means that the corresponding key is pressed. Otherwise, the key is released

10.5.10 XY Coordinate Registers

Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x12	XY0 Coord. (High Byte)	Valid 0 (RO)	X0_H (RO)			Reserved	Y0_H (RO)		
0x13	X0 Coord. (Low Byte)	X0_L (RO)							
0x14	Y0 Coord. (Low Byte)	Y0_L (RO)							
0x15	...	Reserved.							

XY Coordinate Registers represent the XY coordinates for each touch point ID. Valid bit field tells that this point ID is valid and the XY information represents a real touch point on touch sensor

10.5.11 Maximum Number of Contacts Support Register

Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x3F	Contact Count Max.	Max Number of Contacts Support (RO)							

It's a read-only feature for getting the total number of contacts that the touch sensor controller supports

10.5.12 Page Register

Reg. Addr.	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0xFF	Page Reg.	Page Number (RW)							

For ST1x56/ST1x64/ST1x64A/ST1x72 series touch IC:

The auto tune program is build-in into ST1x56/ST1x64/ST1x64A/ST1x72. Page Register provides changing page of Host Interface Register. Default page is Report Page

Page Number	Description
0x00	Report Page
0x01	Auto Tune Page

For ST1x32/ST1x28/ST1x30/ST1x34/ST1x36 series touch IC:

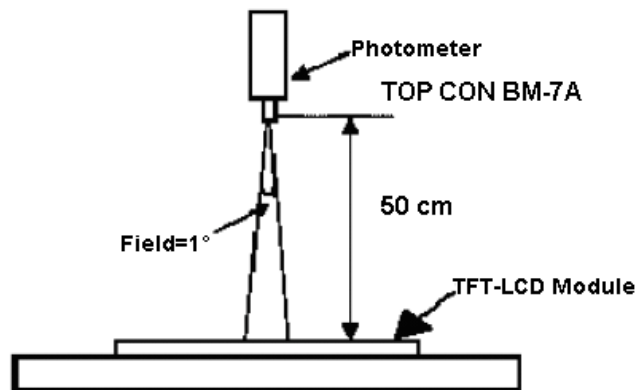
Page Register is a read only register. It can not change page by writing specified page number into this register.

11. OPTICAL CHARACTERISTICS

Parameter		Symbol	Condition	MIN.	TYP.	MAX.	Unit	Remarks
Viewing Angle	Horizontal	θ_{x+}	Center CR \geq 10	60	70	--	deg	Note 1,4
		θ_{x-}		60	70	--		
	Vertical	θ_{y+}		40	50	--		
		θ_{y-}		60	70	--		
Contrast Ratio		CR	at optimized viewing angle	320	400			Note 1,3
Response time	Rise	Tr	Center	-	10	20	ms	Note 1,6
	Fall	Tf	$\theta_x=\theta_y=0^\circ$	-	15	30	ms	
Uniformity		B-uni	$\theta_x=\theta_y=0^\circ$	70	75	--	%	Note1,5
Center Brightness		L	$\theta_x=\theta_y=0^\circ$	240	300	--	cd/m ²	Note 1,2
Chromaticity		x_w	Center	0.26	0.31	0.36		Note 1,7
		y_w	$\theta_x=\theta_y=0^\circ$	0.28	0.33	0.38		

The following optical specifications shall be measured in a darkroom or equivalent state (ambient luminance \leq 1 lux, and at room temperature). The operation temperature is 25°C \pm 2°C. The LED current IF=40mA. The measurement method is shown in Note1.

Note1: The method of optical measurement:

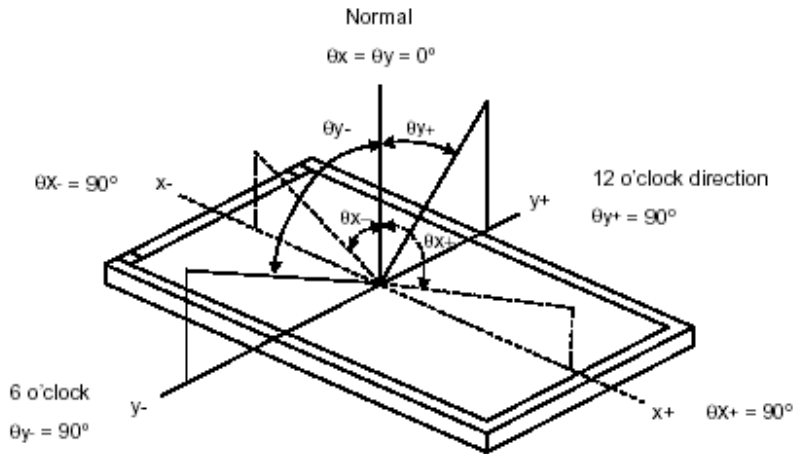


Note2: Measured at the center area of the panel and at the viewing angle of the $\theta_x = \theta_y = 0^\circ$

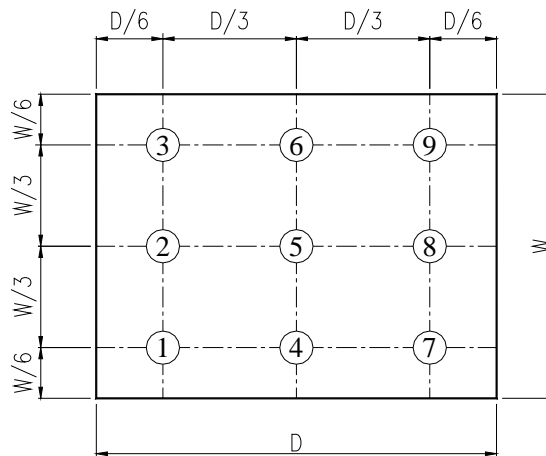
Note3: Definition of Contrast Ratio (CR):

$$CR = \frac{\text{Luminance with all pixels in white state}}{\text{Luminance with all pixels in Black state}}$$

Note4: Definition of Viewing Angle



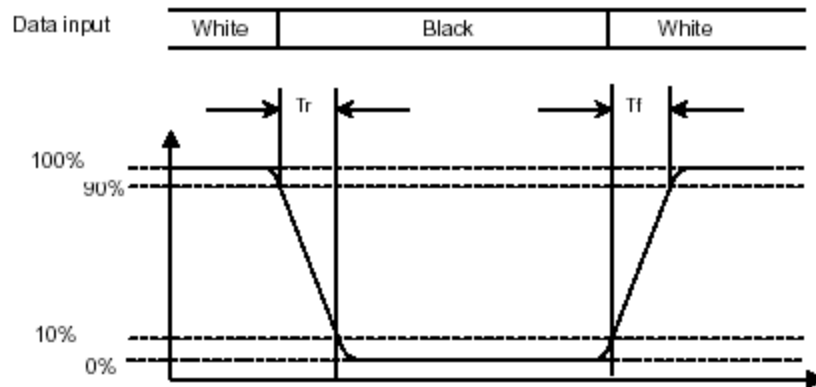
Note 5: Definition of Brightness Uniformity (B-uni):



$$B\text{-uni} = \frac{\text{Minimum luminance of 9 points}}{\text{Maximum luminance of 9 points}} \quad (\text{Note 5}).$$

Note6: Definition of Response Time:

The Response Time is set initially by defining the "Rising Time (T_r)" and the "Falling Time (T_f)" respectively. T_r and T_f are defined as following figure.



Note 7: Definition of Chromaticity:

The color coordinate (x_w, y_w) is obtained with all pixels in the viewing field at white state.

12. QUALITY ASSURANCE

12.1 Test Condition

12.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : $20 \pm 5^{\circ}\text{C}$
 Humidity : $65 \pm 5\%$

12.1.2 Operation

Unless specified otherwise, test will be conducted under function state.

12.1.3 Container

Unless specified otherwise, vibration test will be conducted to the product itself without putting it in a container.

12.1.4 Test Frequency

In case of related to deterioration such as shock test. It will be conducted only once.

12.1.5 Test Method

No.	Reliability Test Item & Level	Test Level	Remark
1	High Temperature Storage Test	T=80°C,240hrs	IEC68-2-2
2	Low Temperature Storage Test	T=-30°C,240hrs	IEC68-2-1
3	High Temperature Operation Test	T=70°C,240hrs	IEC68-2-2
4	Low Temperature Operation Test	T=-20°C,240hrs	IEC68-2-1
5	Thermal cycling storage test (no Operation)	-30°C ----25°C -----80°C ,200Cycle 30min 5min 30min	IEC68-2-14
6	Shock test	100G,6ms,Direction:±X±Y±Z Cycle:3times	IEC68-2-27
7	High temperature and high humidity operation test	T=60°C,90% RH,240hrs	IEC68-2-3
8	Drop test(with carton)	Height :60cm 1 conner,3edges,6surfaces	IEC68-2-32
9	vibration test(with carton)	Frequency:10~55HZ Amplitude:1.5mm Sweep time:11min Test period:6Cycles for each direction of X,Y,Z	IEC68-2-6
10	ESD test	State: operating Location: LCM/TP surface Condition:150pf 330Ω Contact +/- 4kV Air +/-8kV Criteria: Class C	IEC-61000-4-2

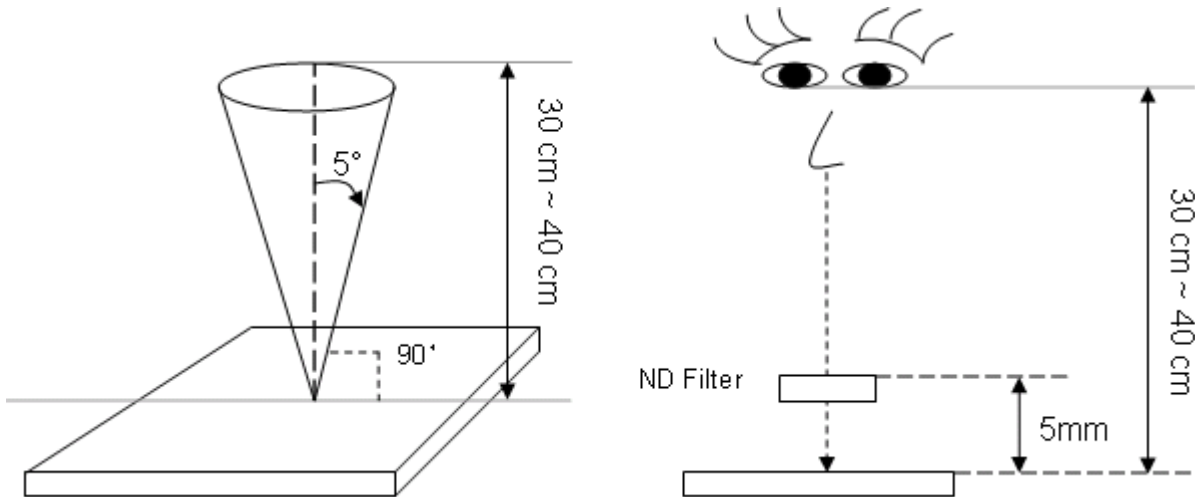
12.2 Inspection condition

12.2.1 Inspection conditions

12.2.1.1 Inspection Distance : 35 ± 5 cm

12.2.1.2 View Angle :

- (1) Inspection that light pervious to the product: $\pm 5^\circ$
- (2) Inspection that light reflects on the product: $\pm 45^\circ$

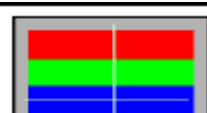


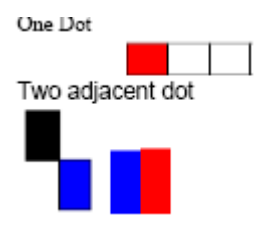
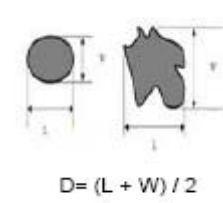
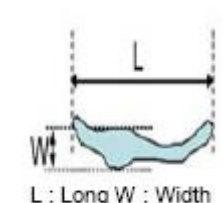
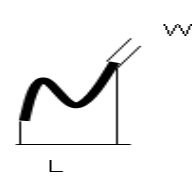
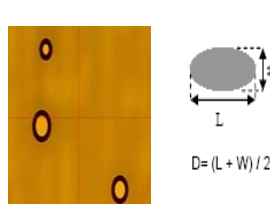
12.2.2 Environment conditions :

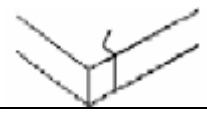
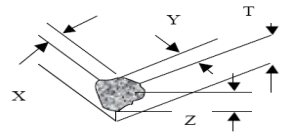
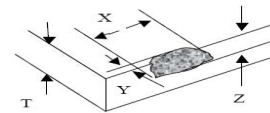
Ambient Temperature :	$25 \pm 5^\circ\text{C}$
Ambient Humidity :	30~75%RH
Ambient Illumination	600~800 lux

12.3 Inspection Parameters

Appearance inspection standard (D: diameter, L: length; W: width, Z: height, T: glass thickness, n: number)

Inspection item	Inspection standard	Description
No image	Prohibited	
Image abnormal	Prohibited	
Bright line	Prohibited	
Mura	It is acceptable that the defect can not be seen with 2% ND filter.	

Dot	Item	Acceptable Visible area	Total	
	Bright dot	2		
Dark dot	4			
Bright adjacent dots	1	1		
Dark adjacent dots	2	2		
Adjacent dots with a bright dot and a dark dot	1	1		
Foreign material in dot shape	SPEC (unit: mm)	Acceptable		
	$D \leq 0.3$	Ignored		
	$0.3 < D \leq 0.5$, distance > 5	$n \leq 5$		
	$D > 0.5$	0		
Inspection item	Inspection standard		Description	
Foreign material in line shape	SPEC (unit: mm)	Acceptable		
	$W \leq 0.05$ and $L \leq 7$	Ignored		
	$0.05 < W \leq 0.1$, $L \leq 7$, distance > 5	$n \leq 5$		
	$W > 0.1$ or $L > 7$	0		
Contamination	It is acceptable if the dirt can be wiped.			
Inspection item	Inspection standard		Description	
Scratch	SPEC (unit: mm)	Acceptable		
	$W \leq 0.05$ and $L \leq 7$	Ignored		
	$0.05 < W \leq 0.08$, $L \leq 7$, distance > 5	$n \leq 5$		
	$0.08 < W \leq 0.1$, $L \leq 7$, distance > 5	$n \leq 3$		
	$W > 0.1$ or $L > 7$	0		
Bubble	SPEC (unit: mm)	Acceptable		
	$D \leq 0.2$	Ignored		
	Non visible area	Ignored		
	$0.2 < D \leq 0.3$, distance > 5	$n \leq 5$		
	$D > 0.3$	0		

Insufficient glue	SPEC (unit: mm)	Acceptable	
	Non visible area	Ignored	
	Visible area	0	
Cover & Sensor Crack	Prohibited		
Sensor angle missing & edge break	SPEC (unit: mm)	Acceptable	
	Damage circuit or effect function	0	
Cover/Sensor angle missing	SPEC (unit: mm)	Acceptable	
	$X \leq 3.0, Y \leq 3.0, Z \leq T$	Ignored	
	$X > 3.0, Y > 3.0, Z > T$	0	
Cover/Sensor edge break	SPEC (unit: mm)	Acceptable	
	$X \leq 3.0, Y \leq 3.0, Z \leq T$	Ignored	
	$X > 3.0, Y > 3.0, Z > T$	0	
Inspection item	SPEC		Description
Ink	SPEC (unit: mm)	Acceptable	
	word unclear, inverted, mistake, break line	0	
Bubble under protection film	SPEC (unit: mm)	Acceptable	
	NA		
Function	Prohibited		

12.4 Sampling Condition

Unless otherwise agree in written, the sampling inspection shall be applied to the incoming inspection of customer.

Lot size: Quantity of shipment lot per model.

Sampling type: normal inspection, single sampling

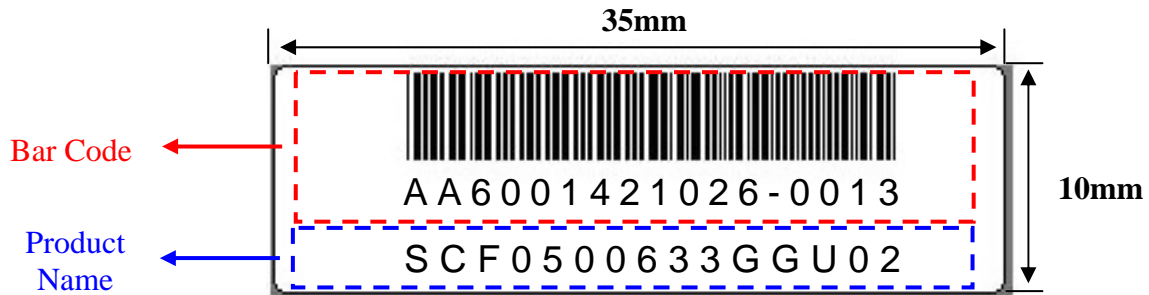
Sampling table: MIL-STD-105E

Inspection level: Level II

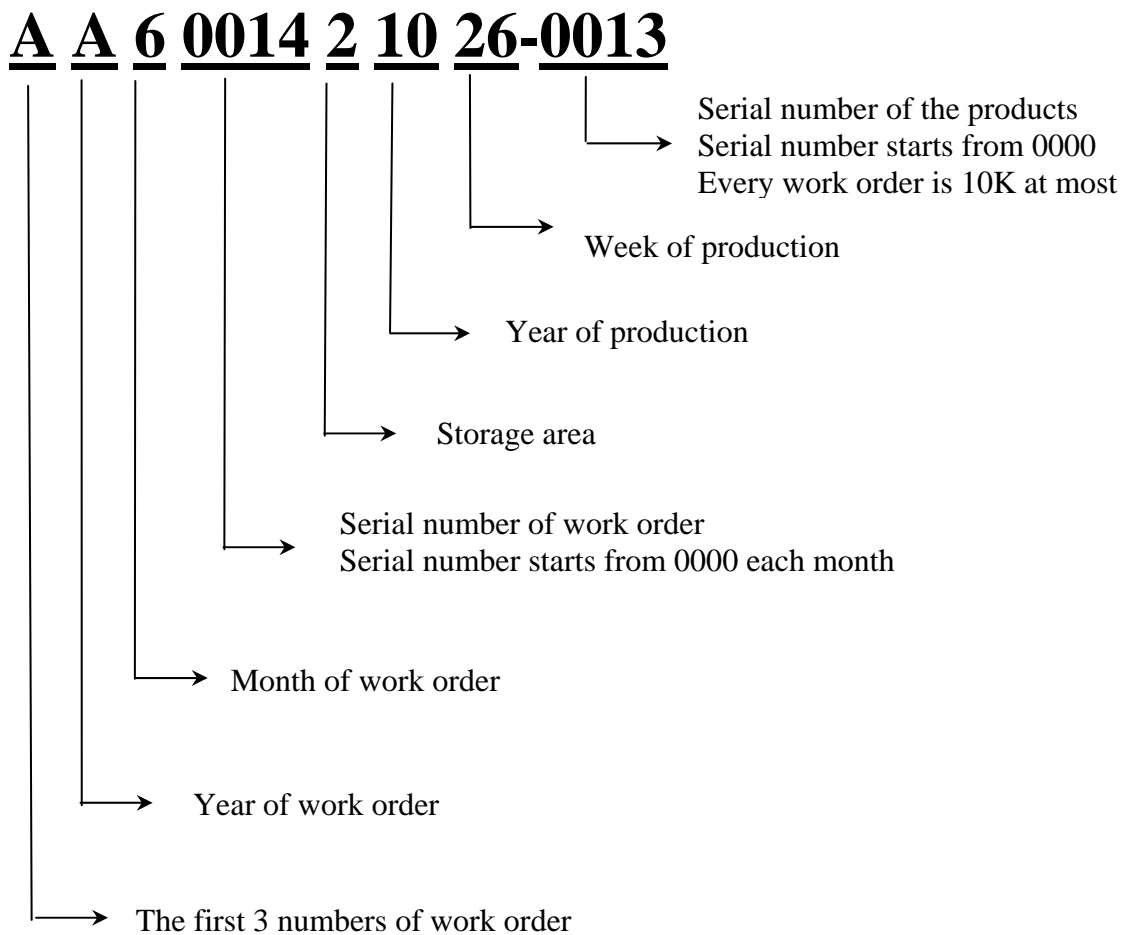
Class of defects	Definition		
	Major	AQL 0.65	It is a defect that is likely to result in failure or to reduce materially the usability of the product for the intended function.
Minor	AQL 1.5	It is a defect that will not result in functioning problem with deviation classified.	

13. PRODUCT LABEL DEFINE

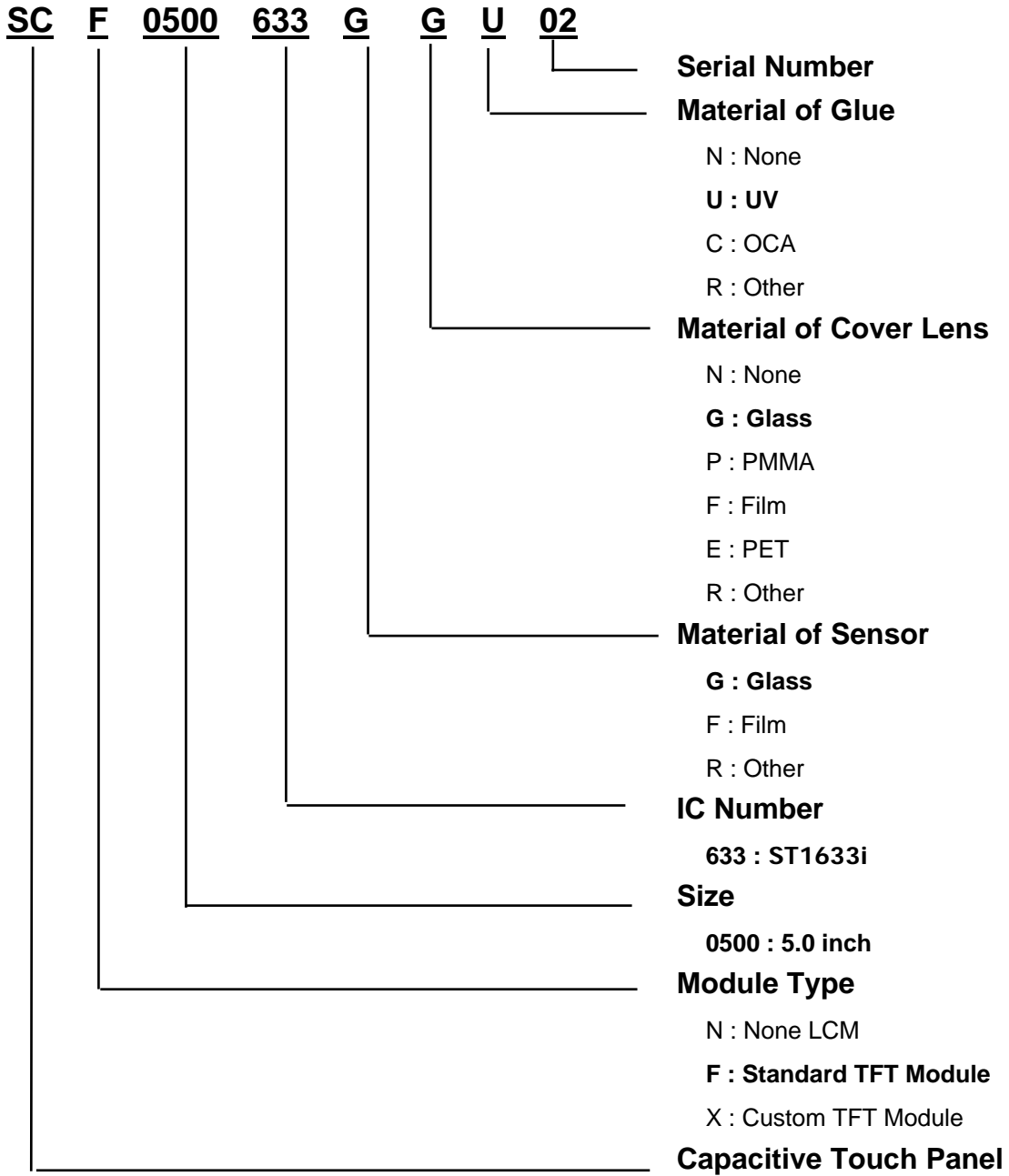
Product Label style:



BarCode Define:



Product Name Define:



14. PRECAUTIONS IN USE LCM

1. ASSEMBLY PRECAUTIONS

- (1) Since Touch Panel is consist of glass, please be careful your hands to be injured during handing. You must wear gloves during handing.
- (2) Do not touch, push or rub the exposed touch panel, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
- (3) Do not stack the touch panels together. Do not put heavy objects on touch panel.
- (4) Please do not take a CTP to pieces and reconstruct it. Resolving and reconstructing modules may cause them not to work well.
- (5) Please excessive force or strain to the panel or tail is prohibited, Do not lift touch panel by cable(FPC).
- (6) Use clean sacks or glove to prevent fingerprints and/or stains left on the panel. Extra attention and carefulness should be taken while handling the glass edge.
- (7) Please pay attention for the matters stated below at mounting design of touch panel enclosure.

Enclosure support to fix touch panel must be out of active area.(do not design enclosure presses the active area to protect from miss put)

2. OPERATING PRECAUTIONS

- (1) Please be sure to turn off the power supply before connecting and disconnecting signal input cable.
- (2) Please do not change variable resistance settings in CTP. They are adjusted to the most suitable value. If they are changed, it might happen CTP does not satisfy the characteristics specification
- (3) Be careful for condensation at sudden temperature change. Condensation makes damage to sensor or electrical contacted parts.
- (4) CTP has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (5) Touch the panel with your finger or stylus only to assure normal operation. Any sharp edged or hard objects are prohibited.
- (6) Operate the panel in a steady environment. Abrupt variation on temperature and humidity may cause malfunction of the panel.

3. ELECTROSTATIC DISCHARGE CONTROL

- (1) The operator should be grounded whenever he/she comes into contact with the CTP. Never touch any of the conductive parts such the copper leads on the FPC and the interface terminals with any parts of the human body.

- (2) The CTP should be kept in antistatic bags or other containers resistant to static for storage.
- (3) Only properly grounded soldering irons should be used.
- (4) If an electric screwdriver is used, it should be well grounded and shielded from commutator sparks.
- (5) The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended
- (6) Since dry air is inductive to statics, a relative humidity of 50-60% is recommended.

4. STORAGE PRECAUTIONS

- (1) When you store touch panel for a long time, it is recommended to keep the temperature between 0°C-40°C without the exposure of sunlight and to keep the humidity less than 90%RH.
- (2) Please do not leave touch panel in the environment of high humidity and high temperature such as 60°C 90%RH
- (3) Please do not leave touch panel in the environment of low temperature; below -20°C.

5. OTHERS

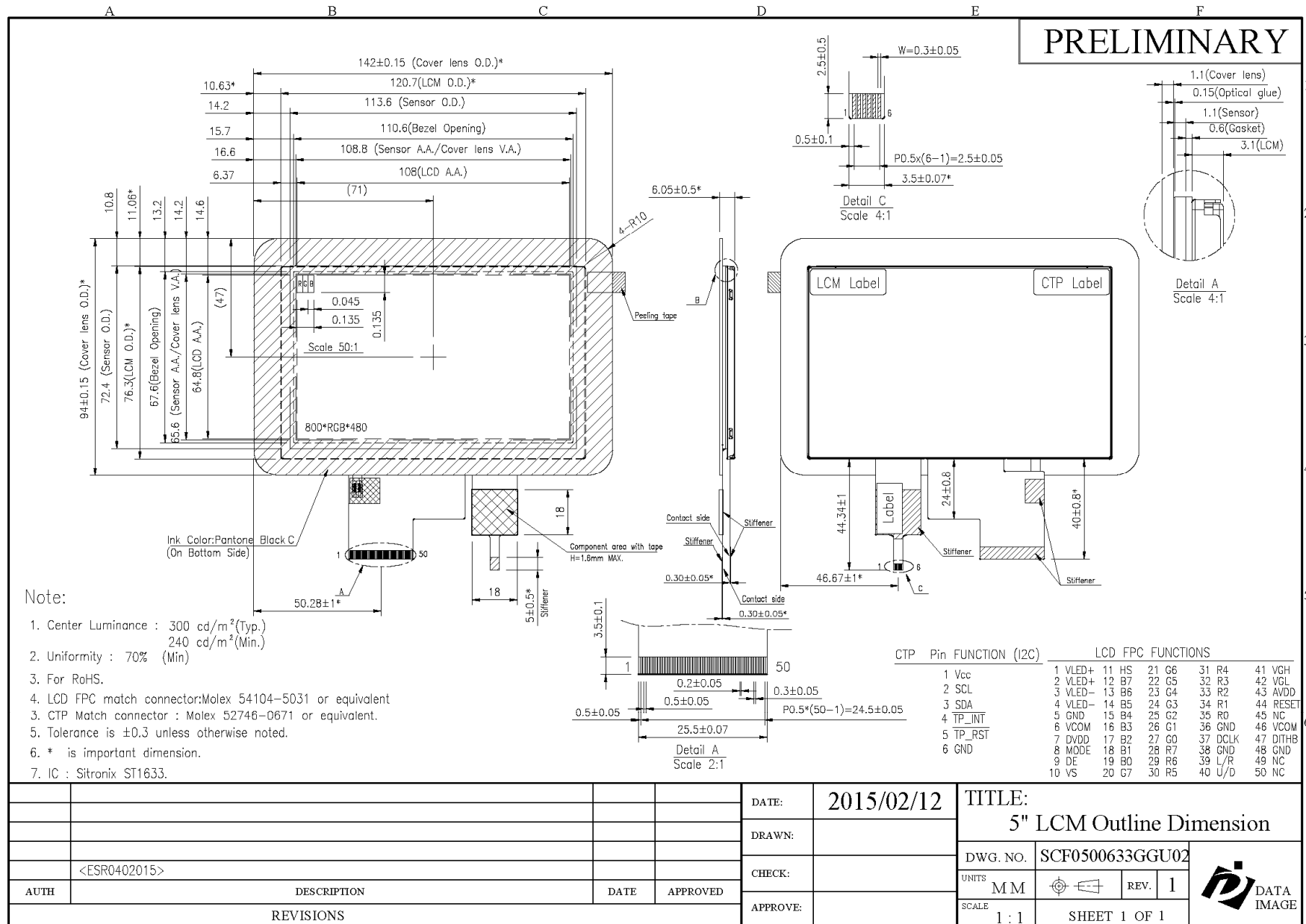
For the packaging box, please pay attention to the followings:

- a. Please do not pile them up more than 5 boxes. (They are not designed so.) And please do not turn over.
- b. Please handle packaging box with care not to give them sudden shock and vibrations. And also please do not throw them up.
- c. Packing box and inner case for CTP are made of cardboard. So please pay attention not to get them wet. (Such like keeping them in high humidity or wet place can occur getting them wet.)

6. LIMITED WARRANTY

Unless otherwise agreed between DATA IMAGE and customer, DATA IMAGE will replace or repair any of its CTP which is found to be defective electrically and visually when inspected in accordance with DATA IMAGE acceptance standards, for a period on one year from date of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of DATA IMAGE is limited to repair and/or replacement on the terms set forth above. DATA IMAGE will not responsible for any subsequent or consequential events.

Confidential Document
15. OUTLINE DRAWING



16. PACKAGE INFORMATION

TBD