

TFT SPECIFICATION

Part Number	USMP-T030-043043CAV-A0
Size	3"
Resolution	432 x 432
Brightness	850 cd/m²
Contrast	800:1
Viewing Angle	80/80/80/80
Operating Temp.	-30 ~ 85°C

FOR ADDITIONAL INFORMATION
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Issue Date	Approved by (customer use)	Checked by	Prepared by

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3. GENERAL SPECIFICATIONS

Composition: 3.0inch WVGA resolution display with a projected Capacitive Touch Panel (CTP)

Interface: RGB interface for LCM and I²C for CTP.

Parameter	Specifications	Unit
Screen Size	3.0 (Diameter)	inch
Display Format	432(H) x (R,G,B) x 432(V)	dot
LCD Active Area	74.3904(H) x 74.3904(V)	mm
Sensor Active Area	76.4(H) x 76.4(V)	
Pixel Pitch	0.1722(H) × 0.1722(V)	mm
Pixel Configuration	Stripe	
Outline Dimension	94(H) x94(V) x9.13(D)	mm
Surface treatment	AR + AF Coating	
Back-light	LED	
TFT-LCD Display mode	Normally Black	
Weight	TBD	g
View Angle direction(TFT)	All	
Our components and processes are compliant to RoHS standard		

4. LCD ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min.	Max.	Unit	Remark
Power supply voltage	VDD	0.3	4.6	V	
	VDDI	0.3	4.6	V	
Operating temperature	Top	-30	85	°C	
Storage temperature	Tst	-30	85	°C	

5. LCD ELECTRICAL CHARACTERISTICS

5.1 Typical operation conditions

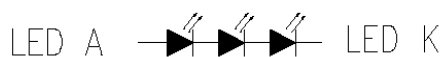
GND=0V, Ta=25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Power Supply voltage	VDD	2.5	-	3.3	V	
	VDDI	1.65	-	3.3	V	
"H" level logical input voltage	V _{IH}	0.7VDD	-	VDD	V	
"L" level logical input voltage	V _{IL}	-	-	0.3VDD	V	

5.2 Backlight Driving Consumption

Ta= 25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED voltage	V _L	-	-	19.8	V	
LED current	I _L	-	60	-	mA	
LED dice Life Time		-	50,000	-	hr	



V_F : 19.8V Max.
I_F : 60mA

6. LCD INPUT SIGNAL TIMING

6.1 AC Characteristics

Serial interface characteristic

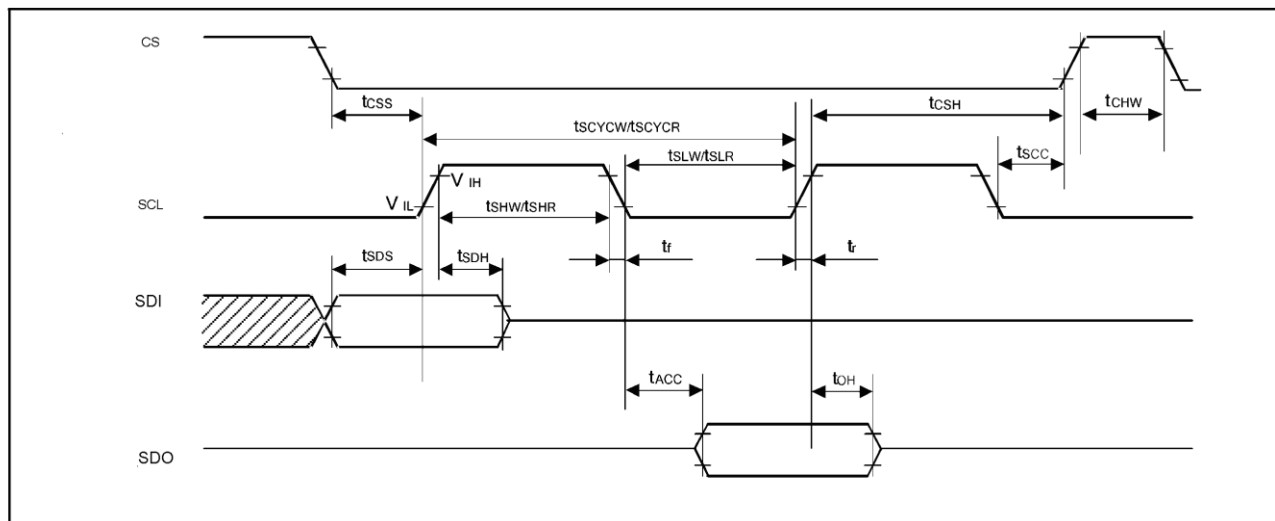


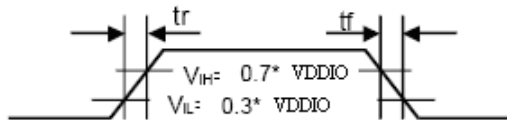
Figure 7.1-1 Serial Interface Characteristics

Parameter	Symbol	Conditions	MIN	TYP	MAX	Unit
Serial clock cycle (Write)	t_{SCYCW}		80			
SCL "H" pulse width (Write)	t_{SHW}	SCL	30		--	ns
SCL "L" pulse width (Write)	t_{SLW}	SCL	30		--	ns
Data setup time (Write)	t_{SDS}	SDI	10		--	ns
Data hold time (Write)	t_{SDH}	SDI	10		--	ns
Serial clock cycle (Read)	t_{SCYCR}		150			
SCL "H" pulse width (Read)	t_{SHR}	SCL	60		--	ns
SCL "L" pulse width (Read)	t_{SLR}	SCL	60		--	ns
Access time	t_{ACC}	SDO For maximum $C_L=30pF$ For maximum $C_L=8pF$	10		60	ns
Output disable time	t_{OH}	SDO For maximum $C_L=30pF$ For maximum $C_L=8pF$	15		100	ns
SCL to Chip select	t_{SCC}	CS	30		--	ns
CS "H" pulse width	t_{CHW}	CS	60		--	ns
CS -SCL time (write)	t_{CSS}	CS	30		--	ns
CS -SCL time (write)	t_{CSH}	CS	30		--	ns
CS -SCL time (Read)	t_{CSS}	CS	60		--	ns
CS -SCL time (Read)	t_{CSH}	CS	65		--	ns

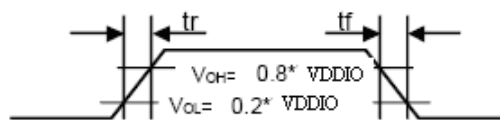
Note: The input signal rise time and fall time (t_r , t_f) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of VDDIO for Input signals.

Input Signal Slope



Output Signal Slope



6.2 RGB interface characteristic

Vertical Timings for RGB I/F

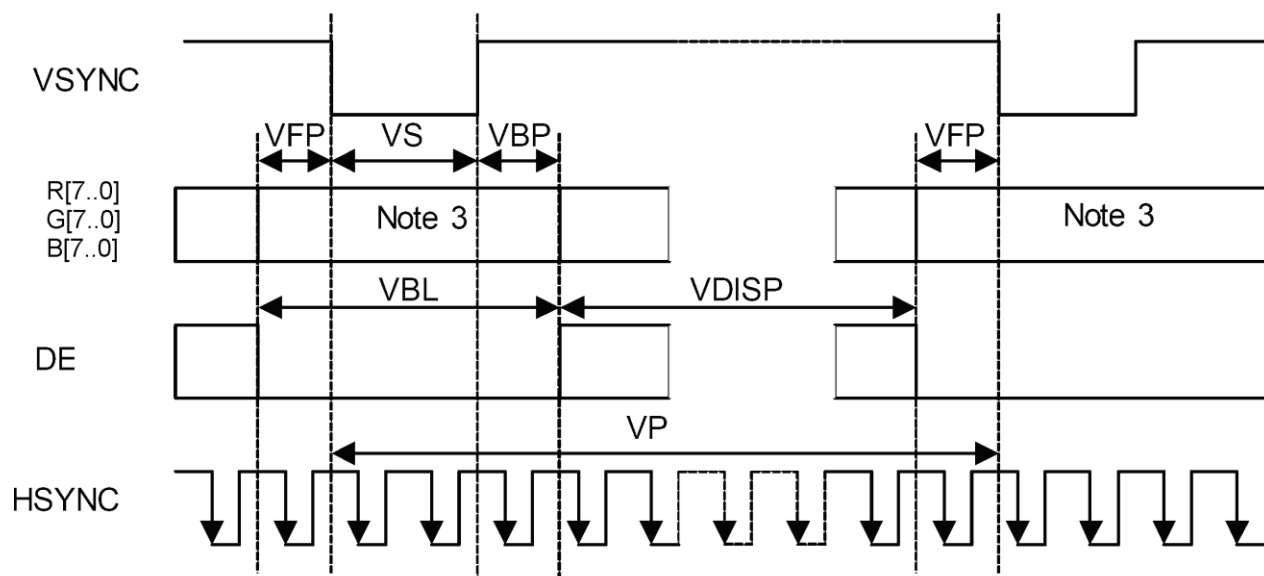


Figure7.1-2 Vertical Timings for RGB I/F

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Vertical cycle	VP	-	646	-	650	Line
Vertical low pulse width	VS	-	2	-	4	Line
Vertical front porch	VFP	-	2	-	4	Line
Vertical back porch	VBP	-	2	-	4	Line
Vertical data start point	-	VS+VBP	4	-	8	Line
Vertical blanking period	VBL	VS+VBP+VFP	6	-	10	Line
Vertical active area	-	VDISP	-	800	-	Line
Vertical Refresh rate	VRR	-	50	-	70	Hz

Note: (1) Signal rise and fall times are equal to or less than 20 ns.

(2) Input signals are measured by $0.30 \times VDDI$ for low state and $0.70 \times VDDI$ for high state.

(3) Data lines can be set to "High" or "Low" during blanking time – Don't care.

Horizontal Timings for RGB I/F

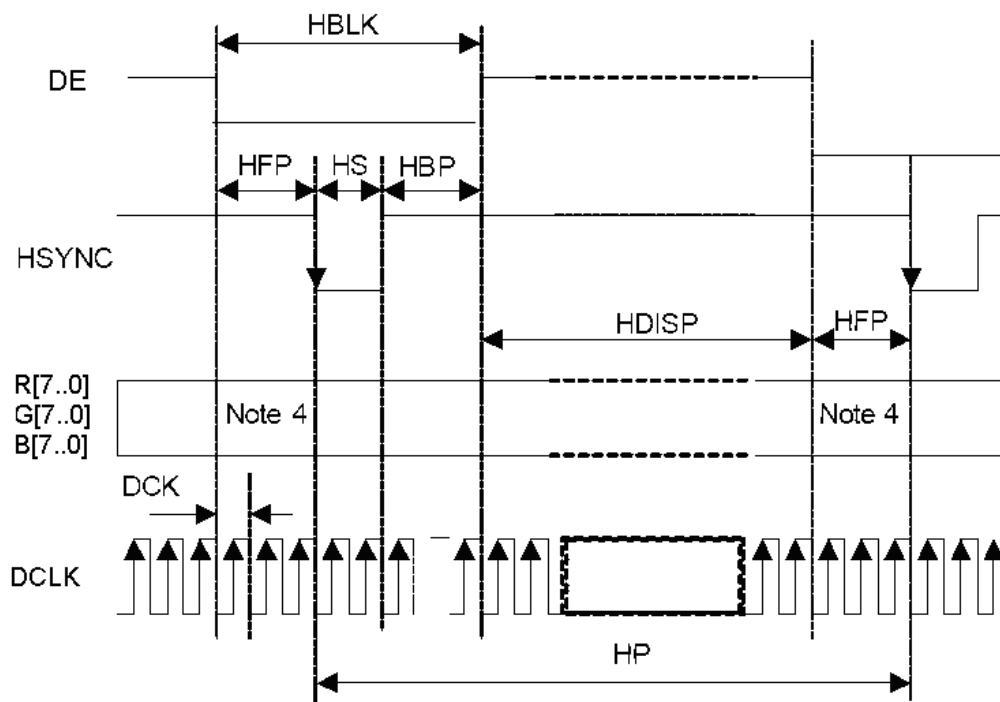


Figure 7.2-3 Horizontal Timing for RGB I/F

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
HSYNC cycle	HP	Note 3	504	-	568	DCLK
HSYNC low pulse width	HS	-	5	-	78	DCLK
Horizontal back porch	HBP	-	5	-	78	DCLK
Horizontal front porch	HFP	-	5	-	78	DCLK
Horizontal data start point	-	HS+HBP	19	-	83	DCLK
			700	-	-	ns
Horizontal blanking period	HBLK	HS+HBP+HFP	24	-	88	DCLK
Horizontal active area	HDISP	-	-	432	-	DCLK
Pixel clock frequency When RGB I/F is running	DCLK	VRR = Min. 50 Hz – Max. 70 Hz	16.3	-	25.8	MHz
			38.7	-	61	ns

- Note:** (1) Signal rise and fall times are equal to or less than 20 ns.
 (2) Input signals are measured by 0.30 x VDDI for low state and 0.70 x VDDI for high state.
 (3) HP is multiples of eight DCLK.
 (4) Data lines can be set to "High" or "Low" during blanking time – Don't care.
 (5) B3h Command (09h): DPL=1, the data is read on the falling edge of DCLK signal.

6.3 RGB interface General Timing

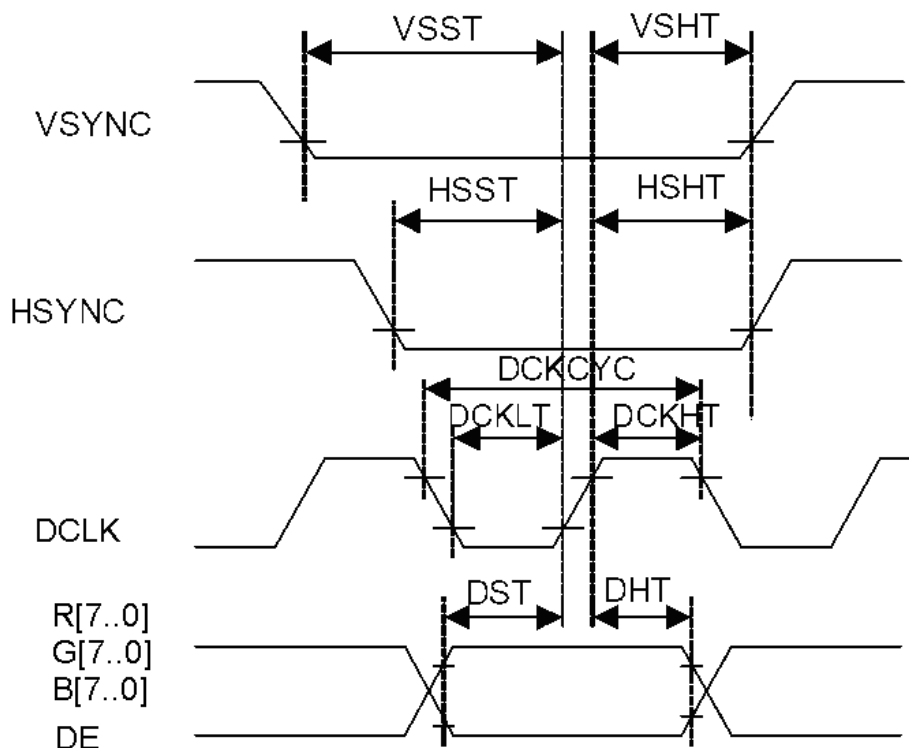


Figure 5.2.3.1 General Timings for RGB I/F

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Vertical sync. Setup time	VSST	-	5	-	-	ns
Vertical sync. Hold time	VSHT	-	5	-	-	ns
Horizontal sync. Setup time	HSST	-	5	-	-	ns
Horizontal sync. Hold time	HSHT	-	5	-	-	ns
Pixel clock cycle When RGB I/F is running	DCKCYC	VRR = Min. 50 Hz Max. 70 Hz	38.7 (Note1)	-	61 (Note 2)	ns
Pixel clock low time	DCKLT	-	5	-	-	ns
Pixel clock high time	DCKHT	-	5	-	-	ns
Data setup time DB[23:0]	DST	-	5	-	-	ns
Data Hold time DB[23:0]	DHT	-	5	-	-	ns

Note: (1) 25.8 MHz
 (2) 16.3 MHz

6.4 Reset Input Timing

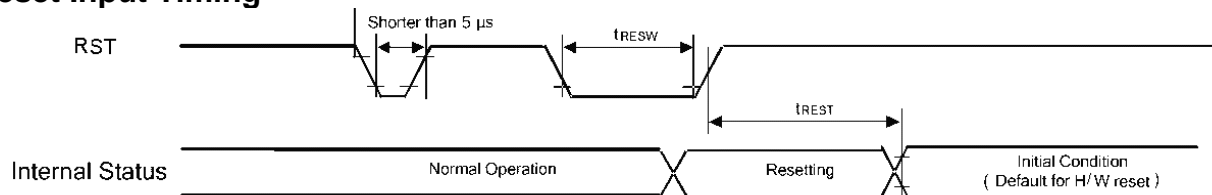


Figure 5.2.4.1 Write to Read and Read to Write Timing

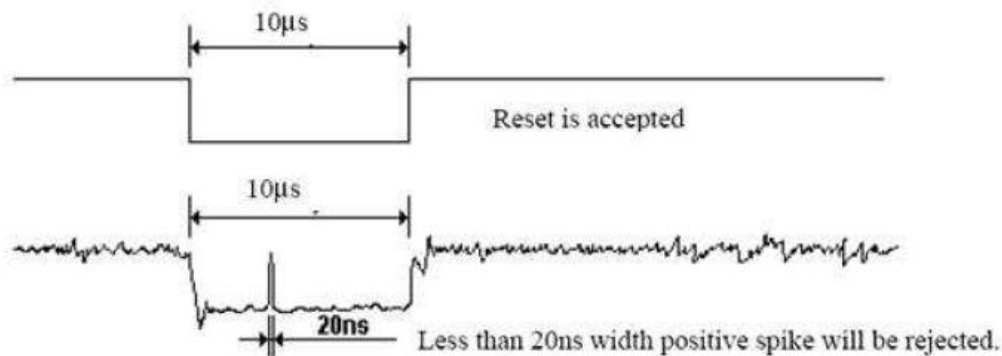
Symbol	Parameter	Related Pins	Min.	Typ.	Max.	Note	Unit
tRESW	Reset low pulse width	RST	10	-	-	-	μs
tREST	Reset complete time	-	-	-	5	When reset applied during STB mode	ms
		-	-	-	120	When reset applied during STB mode	ms

Note:

1. Spike due to an electrostatic discharge on RST line does not cause irregular system reset according to the table below.

NRESET Pulse	Action
Shorter than 5 μ	Reset Rejected
Longer than 10 μs	Reset
Between 5 μs and 10 μs	Reset Start

2. During the resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode) and then returns to Default condition for H/W reset.
3. During Reset Complete Time, ID2 value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (tREST) within 5ms after a rising edge of RST.
4. Spike Rejection also applies during a valid reset pulse as shown below:



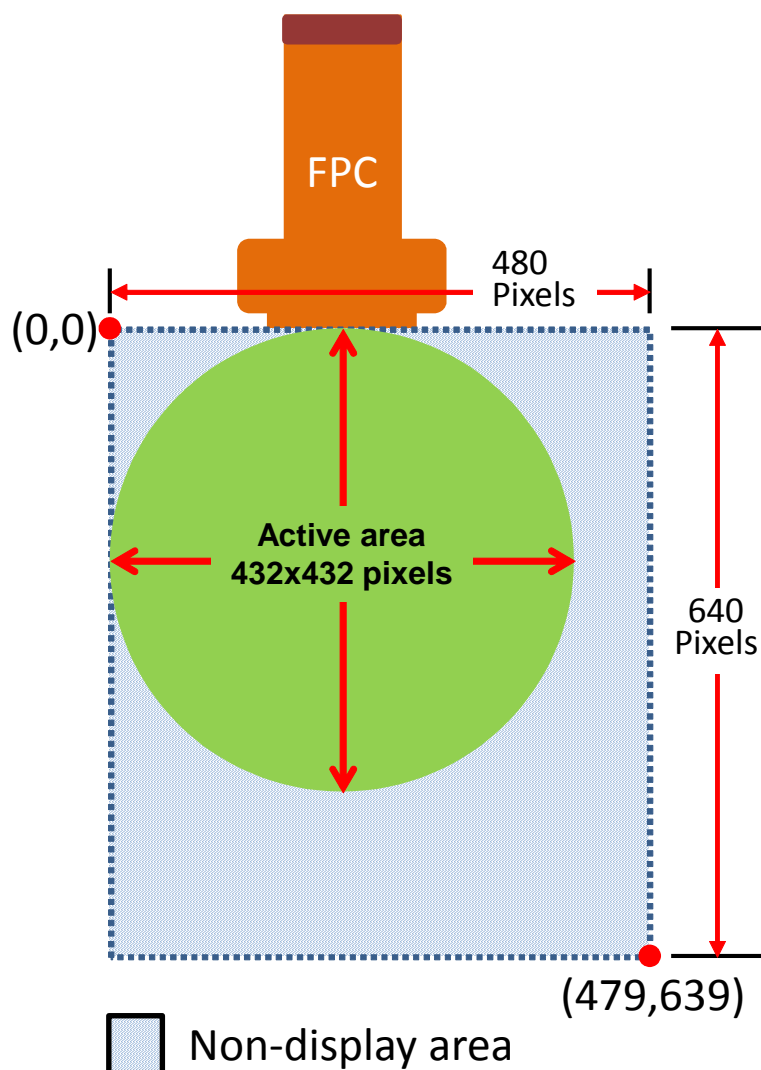
5. When Reset is applied during Sleep In Mode.
6. When Reset is applied during Sleep Out Mode.
7. It is necessary to wait 5msec after releasing RST before sending commands. Also Sleep Out command cannot be sent for 120msec.

7. LCD PIN CONNECTIONS

Pin No	Symbol	Description	Remark
1	VDDI	Power supply for interface system	
2	VDD	Power supply for analog system	
3	VDD		
4	GND	Ground	
5	/RESX	This signal will reset the device and must be applied to properly initialize the chip. Signal is active low.	
6	SDI	Serial data input signal.	
7	SDO	Serial data output signal.	
8	SCL	Serial data clock signal.	
9	CSX	Chip select input pin ("Low" enable).	
10	DCLK	Pixel clock signal.	
11	DE	Data enable signal.	
12	VSYNC	Vertical sync.	
13	HSYNC	Horizontal sync.	
14	GND	Ground	
15	DB0	RGB data bus.	
16	DB1		
17	DB2		
18	DB3		
19	DB4		
20	DB5		
21	DB6		
22	DB7		
23	GND	Ground	
24	DG0	RGB data bus.	
25	DG1		
26	DG2		
27	DG3		
28	DG4		
29	DG5		
30	DG6		
31	DG7		
32	GND	Ground	
33	DR0	RGB data bus.	
34	DR1		
35	DR2		
36	DR3		
37	DR4		
38	DR5	RGB data bus.	
39	DR6		
40	DR7		

41	GND	Ground	
42	LED+	POWER SUPPLY FOR LED+	
43	LED+		
44	LEDK	POWER SUPPLY FOR LED-	
45	LEDK		

Pixel mapping



SPI Initial Code

```
SPI_Start();
    SPI_3W_SET_CMD(0xB9);
    SPI_3W_SET_PAs(0xFF);
    SPI_3W_SET_PAs(0x83);
    SPI_3W_SET_PAs(0x63);
    SPI_Stop();
    DelayX1ms(1);

    SPI_Start();
    SPI_3W_SET_CMD(0x11);
    SPI_Stop();
    DelayX1ms(120);

    SPI_Start();
    SPI_3W_SET_CMD(0xB9);
    SPI_3W_SET_PAs(0xFF);
    SPI_3W_SET_PAs(0x83);
    SPI_3W_SET_PAs(0x63);
    SPI_Stop();
    DelayX1ms (1);

    SPI_Start();
    SPI_3W_SET_CMD(0xB1);
    SPI_3W_SET_PAs(0x78);//
    SPI_3W_SET_PAs(0x34);//
    SPI_3W_SET_PAs(0x07);//BT=7h
    SPI_3W_SET_PAs(0x33);//
    SPI_3W_SET_PAs(0x02);//
    SPI_3W_SET_PAs(0x13);//
    SPI_3W_SET_PAs(0x10);//
    SPI_3W_SET_PAs(0x10);//
    SPI_3W_SET_PAs(0x2C);//
    SPI_3W_SET_PAs(0x34);//
    SPI_3W_SET_PAs(0x22);//
    SPI_3W_SET_PAs(0x22);//
    SPI_Stop();
    DelayX1ms (1);

    SPI_Start();
    SPI_3W_SET_CMD(0x3A);
    SPI_3W_SET_PAs(0x70);
    SPI_Stop();

    SPI_Start();
    SPI_3W_SET_CMD(0xB3);
    SPI_3W_SET_PAs(0x01);
    SPI_Stop();
```

```
SPI_Start();  
SPI_3W_SET_CMD(0xB4);  
SPI_3W_SET_PAs(0x00);  
SPI_3W_SET_PAs(0x12);  
SPI_3W_SET_PAs(0x72);  
SPI_3W_SET_PAs(0x12);  
SPI_3W_SET_PAs(0x06);  
SPI_3W_SET_PAs(0x03);  
SPI_3W_SET_PAs(0x54);  
SPI_3W_SET_PAs(0x03);  
SPI_3W_SET_PAs(0x4E);  
SPI_Stop();
```

```
SPI_Start();  
SPI_3W_SET_CMD(0xB6);  
SPI_3W_SET_PAs(0x36);  
SPI_Stop();
```

```
SPI_Start();  
SPI_3W_SET_CMD(0xCC);  
SPI_3W_SET_PAs(0x07);  
SPI_Stop();  
DelayX1ms(1);
```

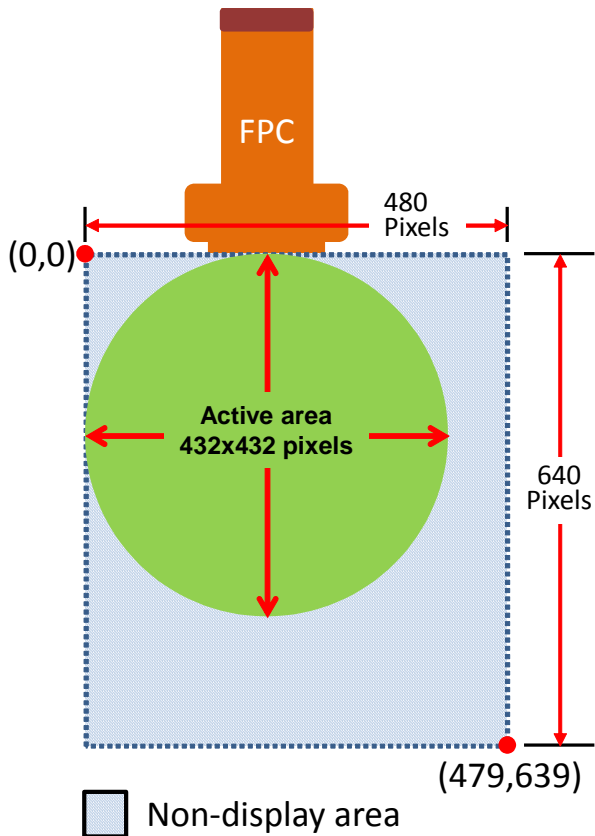
```
SPI_Start();  
SPI_3W_SET_CMD(0xE0); // For GP2.9" panel Gamma2.2  
SPI_3W_SET_PAs(0x00);  
SPI_3W_SET_PAs(0x00);  
SPI_3W_SET_PAs(0x00);  
SPI_3W_SET_PAs(0x1F);  
SPI_3W_SET_PAs(0x3E);  
SPI_3W_SET_PAs(0x3F);  
SPI_3W_SET_PAs(0x05);  
SPI_3W_SET_PAs(0x0B);  
SPI_3W_SET_PAs(0x0D);  
SPI_3W_SET_PAs(0xCF);  
SPI_3W_SET_PAs(0x10);  
SPI_3W_SET_PAs(0x90);  
SPI_3W_SET_PAs(0xD1);  
SPI_3W_SET_PAs(0x5C);  
SPI_3W_SET_PAs(0x1F);  
SPI_3W_SET_PAs(0x00);  
SPI_3W_SET_PAs(0x00);  
SPI_3W_SET_PAs(0x00);  
SPI_3W_SET_PAs(0x1F);  
SPI_3W_SET_PAs(0x3E);  
SPI_3W_SET_PAs(0x3F);  
SPI_3W_SET_PAs(0x05);  
SPI_3W_SET_PAs(0x0B);  
SPI_3W_SET_PAs(0x0D);
```

```
SPI_3W_SET_PAs(0xCF);  
SPI_3W_SET_PAs(0x10);  
SPI_3W_SET_PAs(0x90);  
SPI_3W_SET_PAs(0xD1);  
SPI_3W_SET_PAs(0x5C);  
SPI_3W_SET_PAs(0x1F);  
SPI_Stop();  
DelayX1ms(1);
```

```
SPI_Start();  
SPI_3W_SET_CMD(0x29);  
SPI_Stop();
```

8. CTP SPECIFICATIONS

8.1 GENERAL SPECIFICATIONS

Item	Specification	Unit
Type	Transparent type projected capacitive touch panel	
Input mode	Human's finger	
Multi touch	3	Point
Interface	I ² C	
Origin point	 <p>Diagram illustrating the CTP panel layout and origin point. The origin point (0,0) is located at the top-left corner of the active area. The active area is a green circle with a diameter of 432x432 pixels. The non-display area is a light blue rectangle with a width of 480 pixels and a height of 640 pixels. The origin point is marked with a red dot at (0,0) and the bottom-right corner is marked with a red dot at (479,639). An FPC connector is shown at the top center.</p>	

8.2 Electrical Characteristic

8.2.1 Absolute Maximum Rating

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

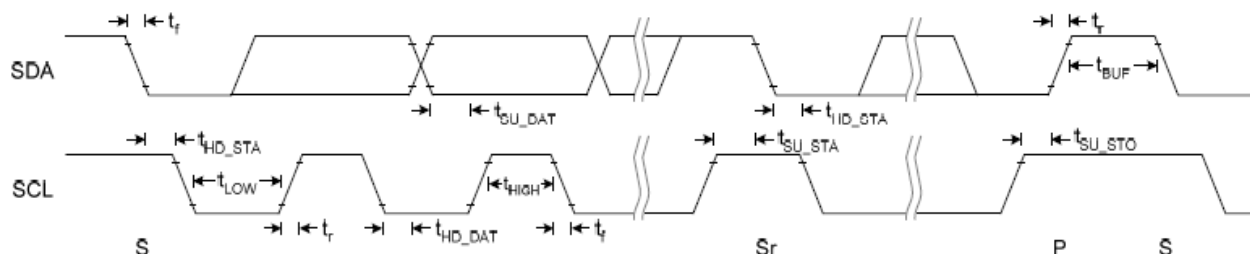
8.2.2 DC Characteristic

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	

8.2.3 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

8.3 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

8.4 I2C Host Interface Protocol

8.4.1 I2C Address

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

8.4.2 Register Read

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

I2C Start	I2C Header (W)	Start Reg. Addr. (a)	I2C Stop	I2C Start	I2C Header (R)	Value of Reg(a)	Value of Reg(a+1)	...	Value of Reg(a+n)	I2C Stop
-----------	----------------	----------------------	----------	-----------	----------------	-----------------	-------------------	-----	-------------------	----------

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.

I2C Start	I2C Header (R)	Value of Reg(a)	Value of Reg(a+1)	...	Value of Reg(a+n)	I2C Stop	I2C Start	I2C Header (R)	Value of Reg(a)	Value of Reg(a+1)	...	Value of Reg(a+n)	I2C Stop
-----------	----------------	-----------------	-------------------	-----	-------------------	----------	-----------	----------------	-----------------	-------------------	-----	-------------------	----------

Figure 2 - Repeated Register Read.

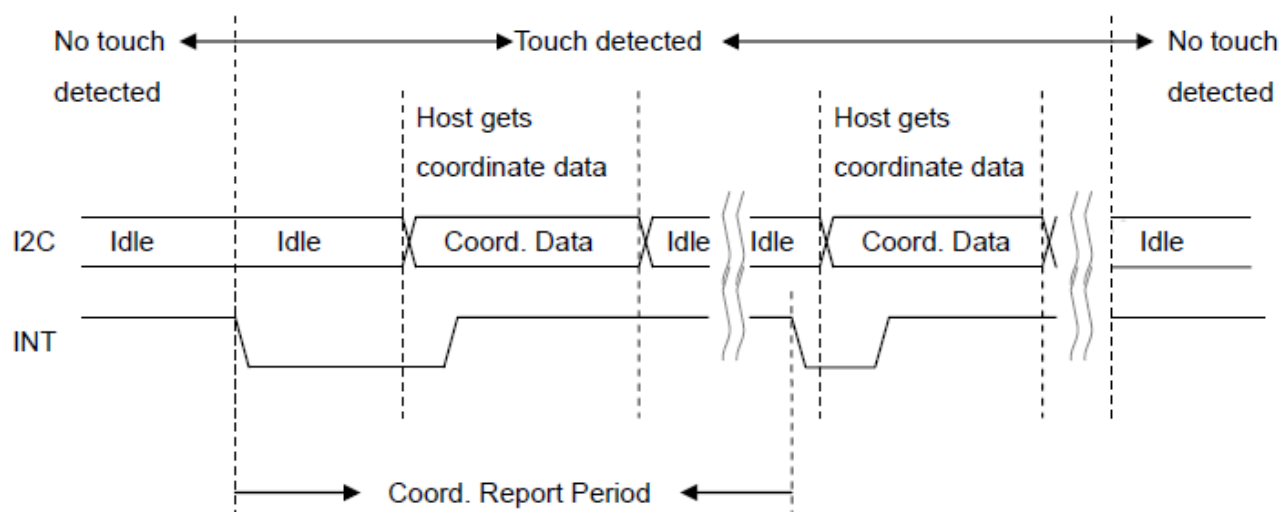
8.4.3 register write

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.

I2C Start	I2C Header (W)	Start Reg. Addr. (a)	Value to Reg(a)	Value to Reg(a+1)	...	Value to Reg(a+n)	I2C Stop
-----------	----------------	----------------------	-----------------	-------------------	-----	-------------------	----------

Figure 3 - Register Write Format.

8.4.4 I2C Electrical Waveform



8.5 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.

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	...	Reserved.							
0x16	XY1 Coord. (High Byte)	Valid 1 (RO)	X1_H (RO)			Reserved	Y1_H (RO)		
0x17	X1 Coord. (Low Byte)	X1_L (RO)							
0x18	Y1 Coord. (Low Byte)	Y1_L (RO)							
0x19	...	Reserved.							
0x1A ... 0x35							
0x36	XY9 Coord. (High Byte)	Valid 9 (RO)	X9_H (RO)			Reserved	Y9_H (RO)		
0x37	X9 Coord. (Low Byte)	X9_L (RO)							
0x38	Y9 Coord. (Low Byte)	Y9_L (RO)							
0x39	Reserved	Reserved.							
0x3A ... 0x3E	...	Reserved							
0x3F	Contact Count Max.	Max Number of Contacts Support (RO)							
0x40 ... 0xFE	...	Reserved							
0xFF	Page Reg.	Page Number (RW)							

8.5.1 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.

8.5.2 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	Reserved
...	
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	Reserved
...	
0xF	

8.5.3 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.	Reserved	Multi-Touch Disable (RW)	Proximity Enable (RW)	Reserved			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

8.5.4 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.

8.5.5 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.

8.5.6 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.

8.5.7 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.

8.5.8 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.

8.5.9 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

8.5.10 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

8.5.11 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

8.5.12 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.

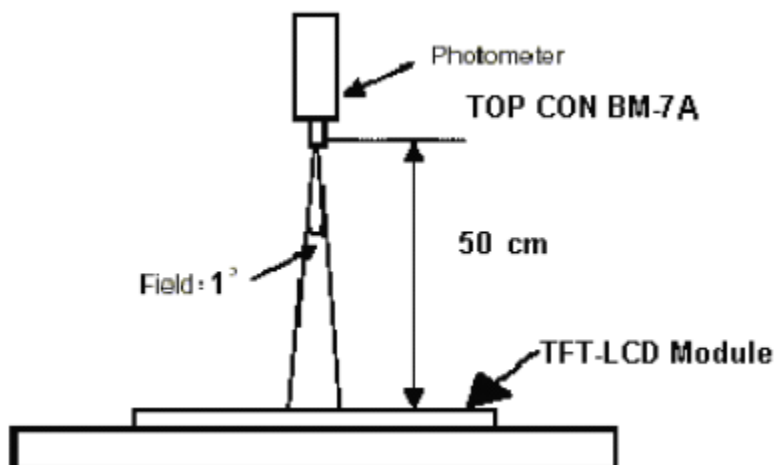
9. OPTICAL CHARACTERISTICS

Ta= 25°C

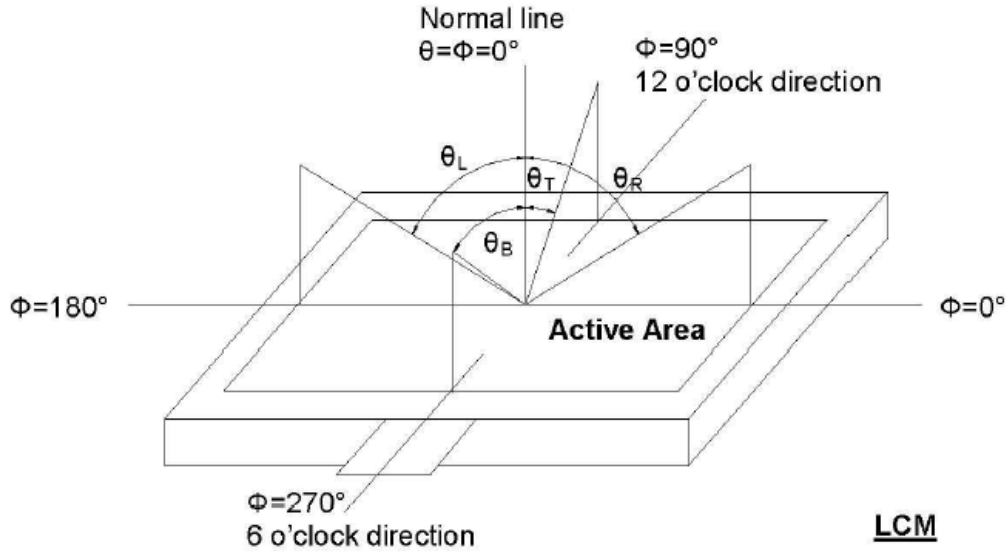
Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Viewing Angle		θ_L	Center CR \geq 10	70	80	-	deg	Note 1,2
		θ_R		70	80	-		
		θ_T		70	80	-		
		θ_B		70	80	-		
Contrast Ratio		CR	at optimized viewing angle	600	800	-		Note 1,4
Response time		Tr+Tf	Center $\theta_x=\theta_y=0^\circ$	-	25	-	ms	Note 1,6
Uniformity		B-uni	$\theta_x=\theta_y=0^\circ$	70	-	-	%	Note 1,5
Brightness		L	$\theta_x=\theta_y=0^\circ$	680	850	-	cd/m ²	Note 1,3
Chromaticity	W	x_W	Center $\theta_x=\theta_y=0^\circ$	Typ. -0.05	0.301	Typ. +0.05		Note 1,7
		y_W			0.338			
	R	x_R			0.561			
		y_R			0.316			
	G	x_G			0.303			
		y_G			0.527			
	B	x_B			0.143			
		y_B			0.169			

The following optical specifications shall be measured in a darkroom or equivalent state (ambient luminance ≤ 1 lux, and at room temperature). The operation temperature is 25°C \pm 2°C and LED Backlight Current IL=60mA. The measurement method is shown in Note1.

Note 1: The method of optical measurement:



Note 2: Definition of viewing angle range

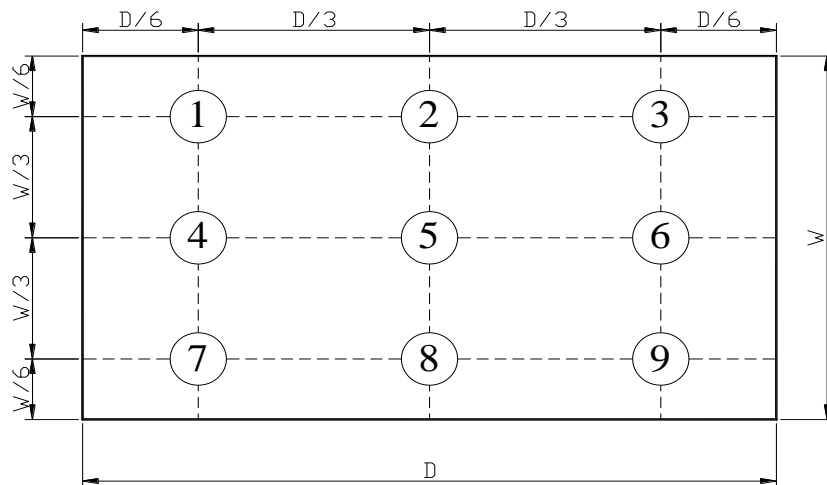


Note 3: Measured at the center area of the panel and at the viewing angle of the $\theta_x = \theta_y = 0^\circ$

Note 4: Definition of Contrast Ratio (CR):

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

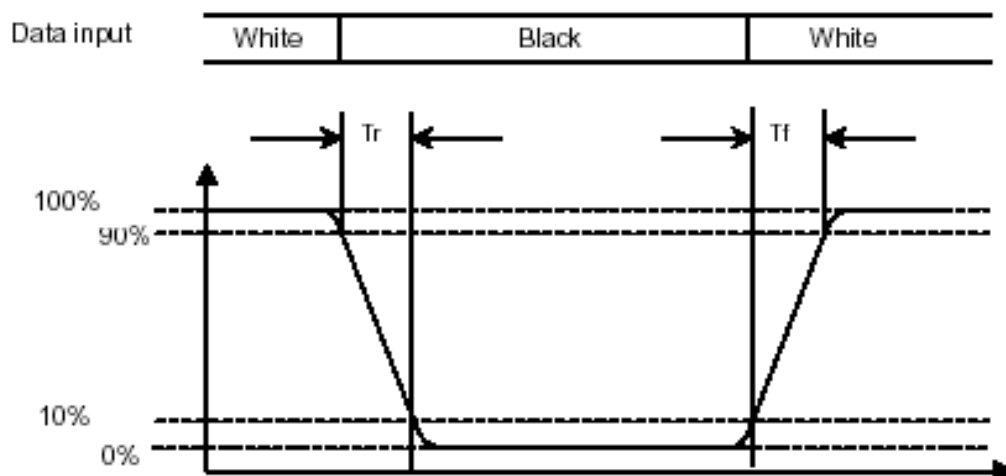
Note 5: Definition of Brightness Uniformity (B-uni):



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

Note 6: 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: The color coordinates (x_w, y_w), (x_R, y_R), (x_G, y_G), and (x_B, y_B) are obtained with all pixels in the viewing field at white, red, green, and blue states, respectively.

10. QUALITY ASSURANCE

10.1 Test Condition

10.1.1 Temperature and Humidity(Ambient Temperature)

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

Humidity : $65 \pm 5\%$

10.1.2 Operation

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

10.1.3 Container

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

10.1.4 Test Frequency

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

10.1.5 Test Method

Reliability Test Item & Level			Remark
No.	Test Item	Test Level	
1	High Temperature Storage Test	Ta=85°C,240hrs	IEC0068-2-2
2	Low Temperature Storage Test	Ta=-30°C,240hrs	IEC0068-2-1
3	High Temperature Operation Test	Ta=85°C,240hrs	IEC0068-2-2
4	Low Temperature Operation Test	Ta=-30°C,240hrs	IEC0068-2-1
5	High Temperature and High Humidity (No operation)	T=60°C,90%RH,240hrs	IEC0068-2-3
6	Thermal Cycling Test (No operation)	-30°C → +25°C → +85°C ,100 Cycles 30 min 5 min 30 min	IEC0068-2-14
7	Vibration test (Package)	Frequency:10~55HZ Amplitude:1.5mm Sweep time:11min Test period:6Cycles for each direction of X,Y,Z	IEC0068-2-6
8	Drop test (Package)	Height :60cm 1 conner,3edges,6surfaces	IEC0068-2-32
9	Electrostatic Discharge Test	Location: LCM/TP surface Condition:150pf 330Ω Contact +/- 4kV Air +/-8kV Criteria: Class C	IEC61000-4-2

11. APPEARANCE SPECIFICATION

11.1 Inspection condition

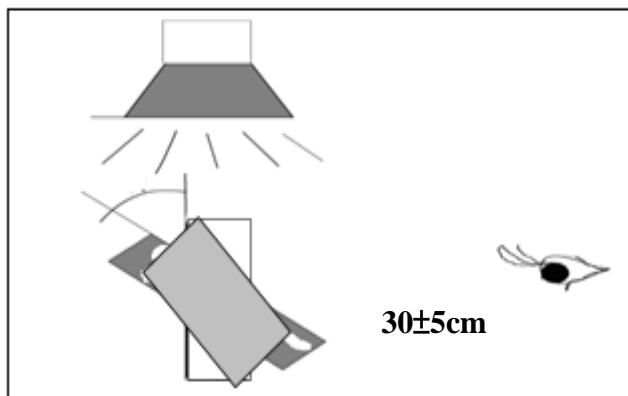
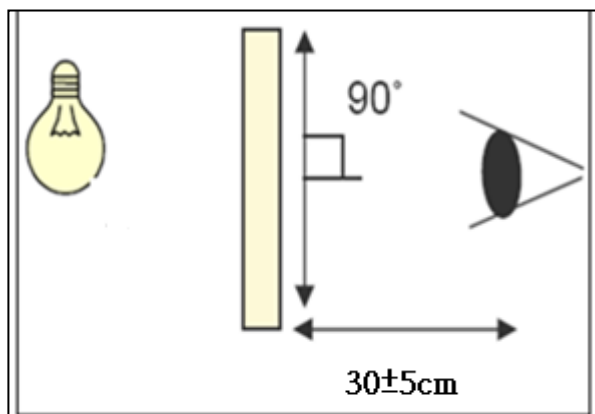
11.1.1 Inspection conditions

11.1.1.1 Inspection Distance : 30 ± 5 cm

11.1.1.2 View Angle :

(1) Inspection that light pervious to the product: $90 \pm 15^\circ$

(2) Inspection that light reflects on the product: $90 \pm 15^\circ$



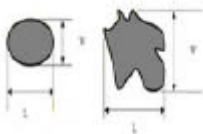
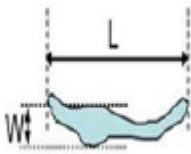
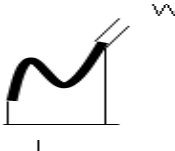
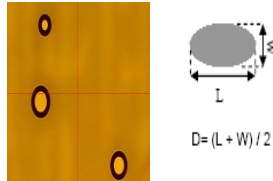
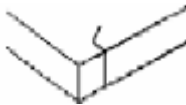
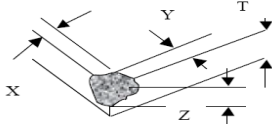
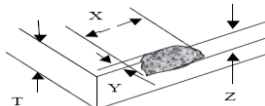
11.1.2 Environment conditions:

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

11.2 Inspection Parameters

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

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	0	4	
	Dark dot	4		
	Bright adjacent dots	0	0	
	Dark adjacent dots	2	2	
	Adjacent dots with a bright dot and a dark dot	0	0	

Foreign material in dot shape	SPEC (unit: mm)	Acceptable	 D= (L + W) / 2
	$D \leq 0.3$	Ignored	
	$0.3 < D \leq 0.5$, distance >5	$n \leq 5$	
	$D > 0.5$	0	
Foreign material in line shape	SPEC	Acceptable	 L : Long W : Width
	$W \leq 0.05$ 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.		
Scratch	SPEC	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= (L + W) / 2
	$D \leq 0.2$	Ignored	
	Non visible area	Ignored	
	$0.2 < D \leq 0.3$, distance >5	$n \leq 5$	
	$D > 0.3$	0	
Cover & Sensor Crack	Prohibited		
Cover angle missing	SPEC (unit: mm)	Acceptable	
	Side/Bottom	Ignored	
	It is prohibited if the defect appears on the front.		
Cover edge break	SPEC (unit: mm)	Acceptable	
	$X \leq 2.0$, $Y \leq 2.0$, $Z \leq 1/2T$	Ignored	
	$X > 2.0$, $Y > 2.0$, $Z > 1/2T$	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		

11.3 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: ISO 2859

Inspection level: Level II

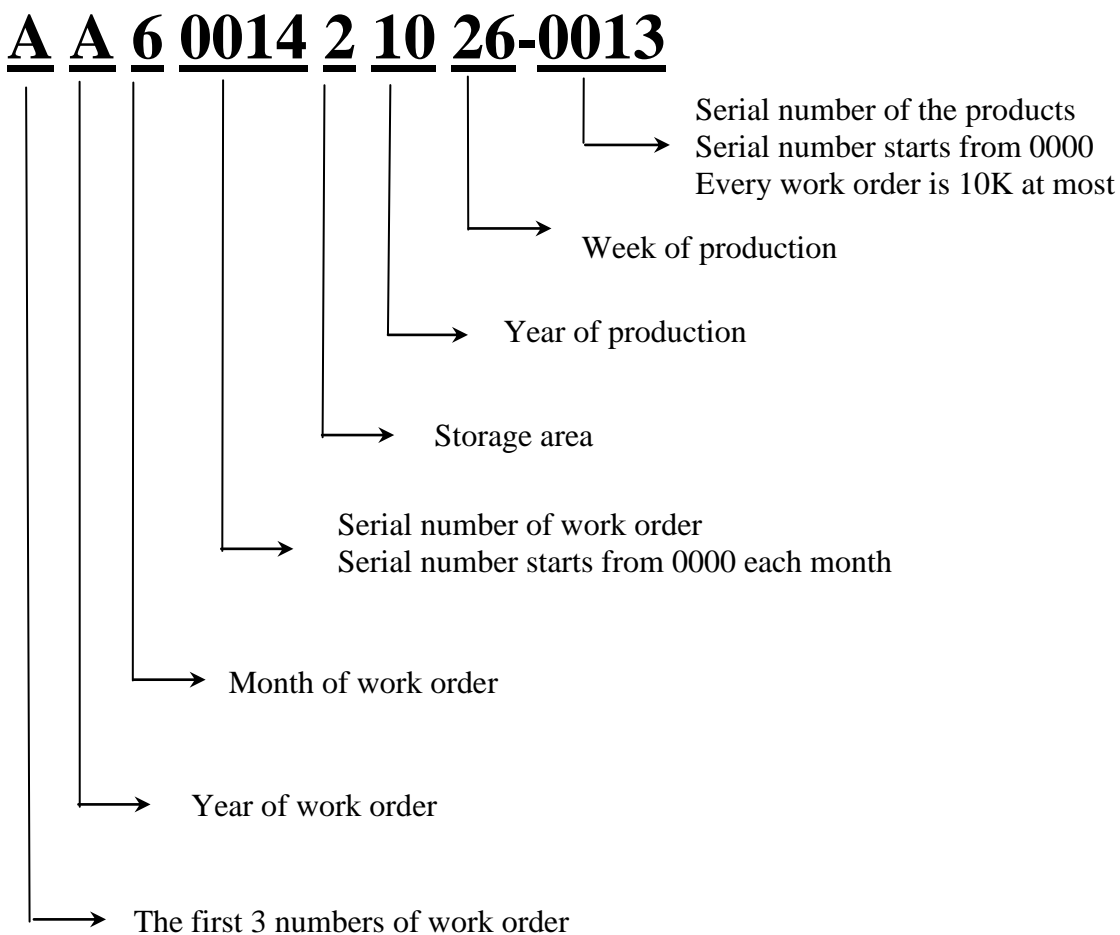
Class of defects	Definition		
	Major	AQL 0.65	It is a defect that is likely to result in failure or to reduce materially the usability of the product for the intended function.
	Minor	AQL 1.5	It is a defect that will not result in functioning problem with deviation classified.

12. PRODUCT LABEL DEFINE

Product Label style:

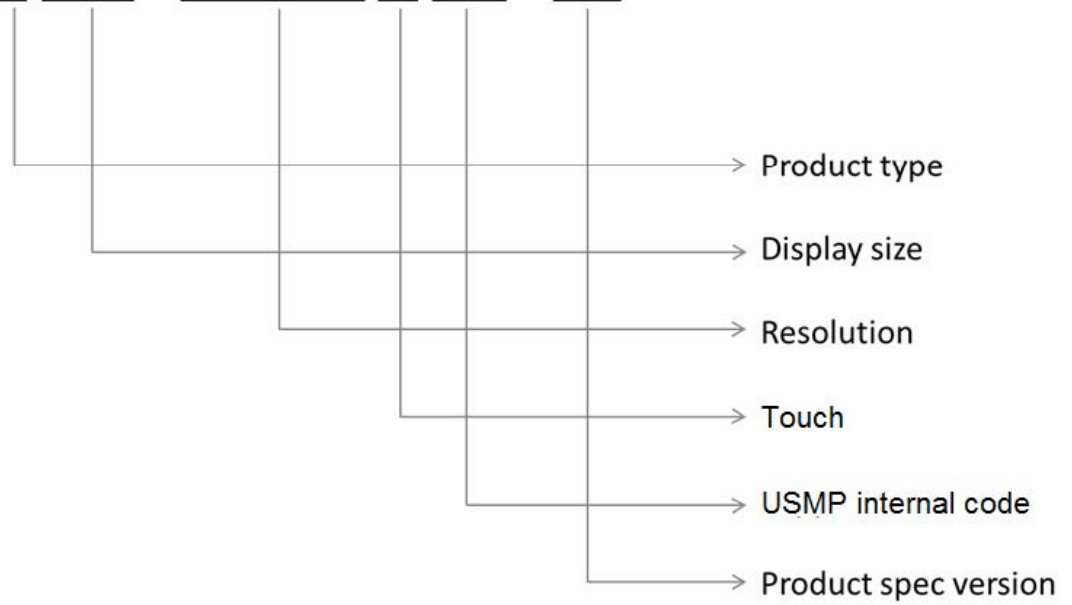


BarCode Define:



Product Name Define:

USMP - T 030 - 043043 C AV - A0



13. PRECAUTIONS IN USE LCM

1. ASSEMBLY PRECAUTIONS

- (1) You must mount a module using holes arranged in four corners or four sides.
- (2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
- (4) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (5) Do not open the case because inside circuits do not have sufficient strength.
- (6) Please do not take a LCD module to pieces and reconstruct it. Resolving and reconstructing modules may cause them not to work well.
- (7) Please do not touch metal frames with bare hands and soiled gloves. A color change of the metal frames can happen during a long preservation of soiled LCD modules.
- (8) Please pay attention to handling lead wire of backlight so that it is not tugged in connecting with inverter.

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 LCD module. They are adjusted to the most suitable value. If they are changed, it might happen LCD does not satisfy the characteristics specification
- (3) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (4) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (5) Module 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.
- (6) Please consider that LCD backlight takes longer time to become stable of radiation characteristics in low temperature than in room temperature.

3. ELECTROSTATIC DISCHARGE CONTROL

The operator should be grounded whenever he/she comes into contact with the module. Never touch any of the conductive parts such the copper leads on the PCB and the interface terminals with any parts of the human body.

- (2) The modules 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 LCDs 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 the LCDs in the environment of high humidity and high temperature such as 60°C 90%RH
- (3) Please do not leave the LCDs in the environment of low temperature; below -20°C.

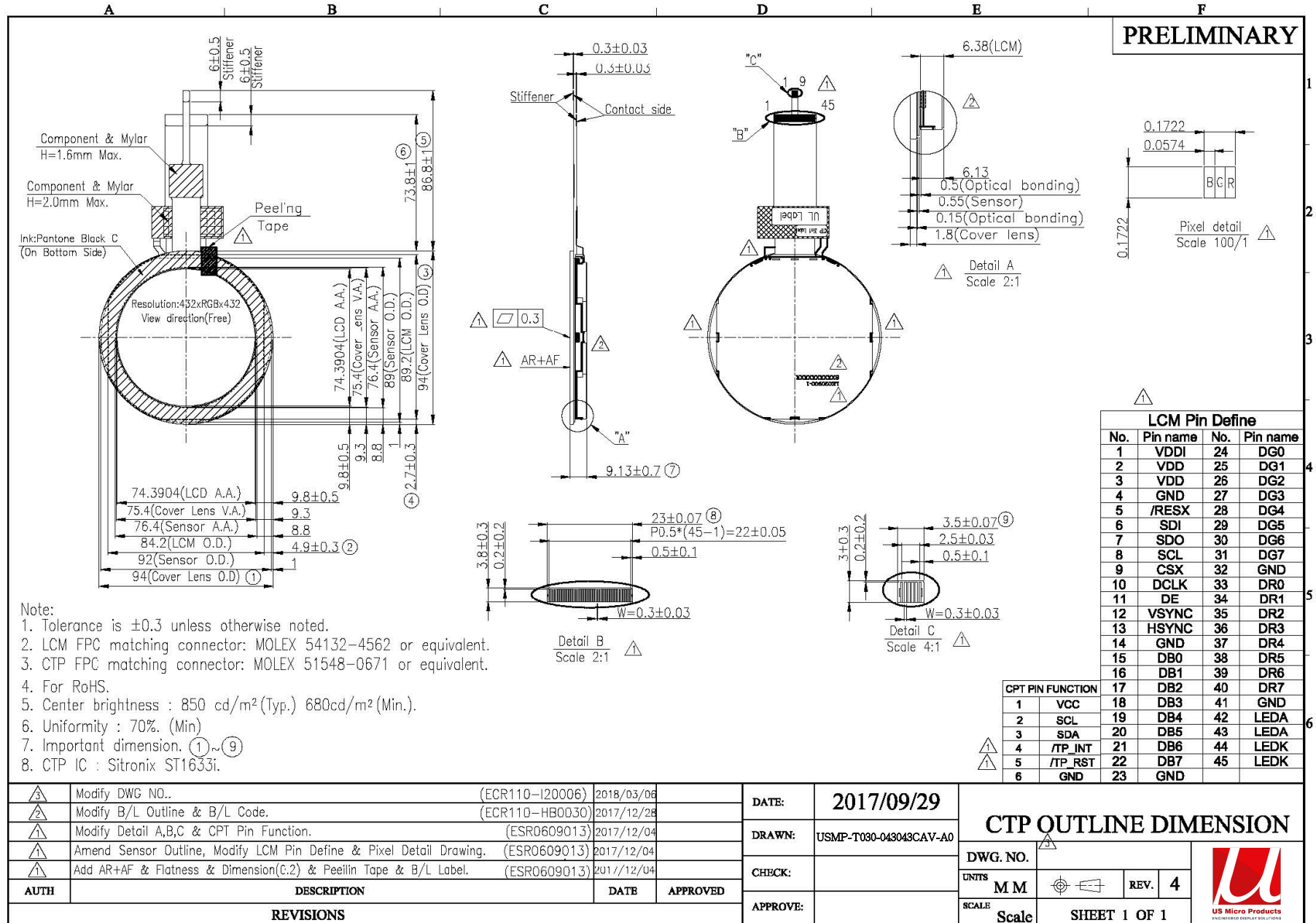
5. OTHERS

- (1) A strong incident light into LCD panel might cause display characteristics' changing inferior because of polarizer film, color filter, and other materials becoming inferior. Please do not expose LCD module direct sunlight and strong UV rays
- (2) Please pay attention to a panel side of LCD module not to contact with other materials in preserving it alone.
- (3) 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 LCDs 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.)
- (4) Waste
Liquid crystal module products shall not be arbitrarily discarded; the water and soil have a negative impact on the environment, the need to be handled by a qualified unit.

6. LIMITED WARRANTY

Unless otherwise agreed between USMP and customer, USMP will replace or repair any of its LCD and LCM which is found to be defective electrically and visually when inspected in accordance with USMP 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 USMP is limited to repair and/or replacement on the terms set forth above. USMP will not responsible for any subsequent or consequential events.

14. OUTLINE DRAWING



15. PACKAGE INFORMATION

TBD