

Display Elektronik GmbH

DATA SHEET

TFT MODULE

**DEM 320240N TMH-PW-N
(C-TOUCH)**

3,5“ TFT + PCT

Product Specification

Version: 2

10.10.2014

Revision History

VERSION	DATE	REVISED PAGE NO.	Note
0	10.10.2014		Preliminary
1	10.10.2014		First Issue
1.1.0	14.03.2015		Second issue
1.1.1	06.07.2015		Add size & Surface. Modify Module dimension (H=4.53mm) Modify LED Life Time , Reliability & Block Diagram
2	21.01.2016		Modify Static electricity test

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1. Summary
2. General Specification
3. Interface
4. Contour Drawing
5. Block Diagram
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10. Reliability
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1. Summary

This technical specification applies to 3.45' color TFT-LCD panel. The 3.45' color TFT-LCD panel is designed for camcorder, digital camera application and other electronic products which require high quality flat panel displays. This module follows RoHS.

2. General Specifications

- Size: 3.5 inch
- Dot Matrix: 320 x RGB x 240
- Module dimension: 76.90 x 63.90 x 4.53 mm
- Active area: 70.08 x 52.56 mm
- Dot pitch: 0.073 x 0.219 mm
- LCD type: TFT, Normally White, Transmissive
- View Direction: 12o'clock
- Gray Scale Inversion Direction: 6 o'clock
- Backlight Type: LED , Normally White
- With /Without TP: With CTP
- Surface TFT: Glare

*Color tone slight changed by temperature and driving voltage.

3. Interface

3.1. LCM PIN Definition

Pin	Symbol	Function	Remark
1	LED-	Power for LED backlight cathode	
2	LED-	Power for LED backlight cathode	
3	LED+	Power for LED backlight anode	
4	LED+	Power for LED backlight anode	
5	NC	No connect	
6	NC	No connect	
7	NC	No connect	
8	/RESET	Hardware reset	
9	CS	Chip select pin of serial interface	
10	SPCLK	Clock pin of serial interface	
11	SPDAT	Data input pin in serial mode	
12	B0	Data bus	
13	B1	Data bus	
14	B2	Data bus	
15	B3	Data bus	
16	B4	Data bus	
17	B5	Data bus	
18	B6	Data bus	
19	B7	Data bus	
20	G0	Data bus	
21	G1	Data bus	
22	G2	Data bus	
23	G3	Data bus	
24	G4	Data bus	
25	G5	Data bus	
26	G6	Data bus	
27	G7	Data bus	
28	R0	Data bus	
29	R1	Data bus	
30	R2	Data bus	
31	R3	Data bus	
32	R4	Data bus	
33	R5	Data bus	
34	R6	Data bus	
35	R7	Data bus	
36	HSYNC	Line synchronization signal	
37	VSYNC	Frame synchronization signal	
38	DCLK	Dot-clock signal and oscillator source	
39	NC	No connect	
40	NC	No connect	
41	VCC	Power Supply	

42	VCC	Power Supply	
43	NC	No connect	
44	NC	No connect	
45	NC	No connect	
46	NC	No connect	
47	NC	No connect	
48	NC	No connect	
49	NC	No connect	
50	NC	No connect	
51	NC	No connect	
52	DE	Display enable pin from controller. Internal pull high Connect to VDDIO or floating if not used	
53	DGND	System ground pin of the IC. Connect to system ground.	
54	AVSS	Grounding for analog circuit. Connect to system ground	

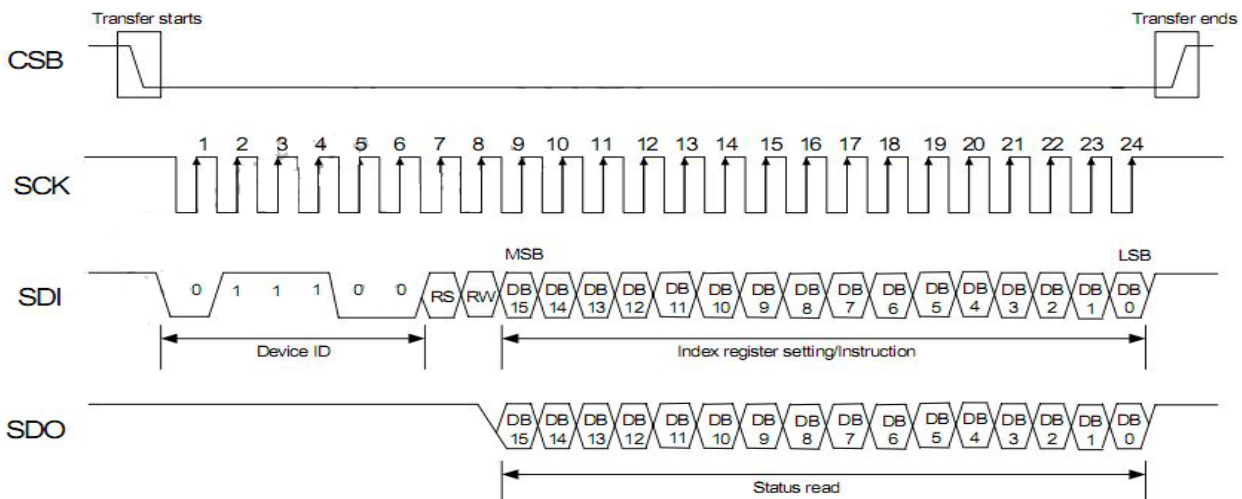
3.2. Serial Peripheral Interface(SPI)

The SPI is available through the chip select line (CSB), serial transfer clock line (SCK), serial data input (SDI), and serial data output (SDO).

The Driver IC recognizes the start of data transfer at the falling edge of CSB input to initiate the transfer of start byte. It recognizes the end of data transfer at the rising edge of CSB input. The Driver IC is selected when the 6-bit chip address in the start byte transferred from the transmission device and the 6-bit device identification code assigned to the Driver IC are compared and both 6-bit data correspond. The identification code must be 011100(Primary SPI Register) or 011101(Secondary SPI Register). Two different chip addresses must be assigned to the Driver IC because the seventh bit of the start byte is assigned to a register select bit (RS). When RS = 0, index register write or status read is executed. When the RS=1, instruction write. The eighth bit of the start byte is to specify read or write (R/W bit). The data are received when the R/W bit is 0, and are transmitted when the R/W bit is 1.

After receiving the start byte, the Driver IC starts to transmit or receive data by byte. The data transmission adopts a format by which the MSB is first transmitted (9th SCK started). All Driver IC instructions consist of 16 bits and they are executed internally after two bytes are transmitted with the MSB first (IB15 to 0---9th ~24th SCK).

Figure 6 SPI Interface Input Signal Timing



3.3. Recommend Register Setting

(Reference HX8238-D specification)

```
SPIByteWrite_reg(0x0001);  
SPIByteWrite_data(0x6300); //Line Inversion
```

```
SPIByteWrite_reg(0x0002);  
SPIByteWrite_data(0x0200);
```

```
SPIByteWrite_reg(0x0003);  
SPIByteWrite_data(0x8286);
```

```
SPIByteWrite_reg(0x0004);  
SPIByteWrite_data(0x04c7);
```

```
SPIByteWrite_reg(0x0005);  
SPIByteWrite_data(0xA800);
```

```
SPIByteWrite_reg(0x0008);  
SPIByteWrite_data(0x06ff);
```

```
SPIByteWrite_reg(0x000a);  
SPIByteWrite_data(0x4008);
```

```
SPIByteWrite_reg(0x000b);  
SPIByteWrite_data(0xd400);
```

```
SPIByteWrite_reg(0x000d);  
SPIByteWrite_data(0x3229);
```

```
SPIByteWrite_reg(0x000e);  
SPIByteWrite_data(0x1200);
```

```
SPIByteWrite_reg(0x000f);  
SPIByteWrite_data(0x0000);
```

```
SPIByteWrite_reg(0x0016);  
SPIByteWrite_data(0x9f80);
```

```
SPIByteWrite_reg(0x0017);  
SPIByteWrite_data(0x2212);
```

```
SPIByteWrite_reg(0x001e);  
SPIByteWrite_data(0x00fc);
```

```
SPIByteWrite_reg(0x0030);  
SPIByteWrite_data(0x0000);  
SPIByteWrite_reg(0x0031);
```


SPIByteWrite_data(0x0707);
 SPIByteWrite_reg(0x0032);
 SPIByteWrite_data(0x0206);

SPIByteWrite_reg(0x0033);
 SPIByteWrite_data(0x0001);

SPIByteWrite_reg(0x0034);
 SPIByteWrite_data(0x0105);
 SPIByteWrite_reg(0x0035);
 SPIByteWrite_data(0x0000);
 SPIByteWrite_reg(0x0036);
 SPIByteWrite_data(0x0707);

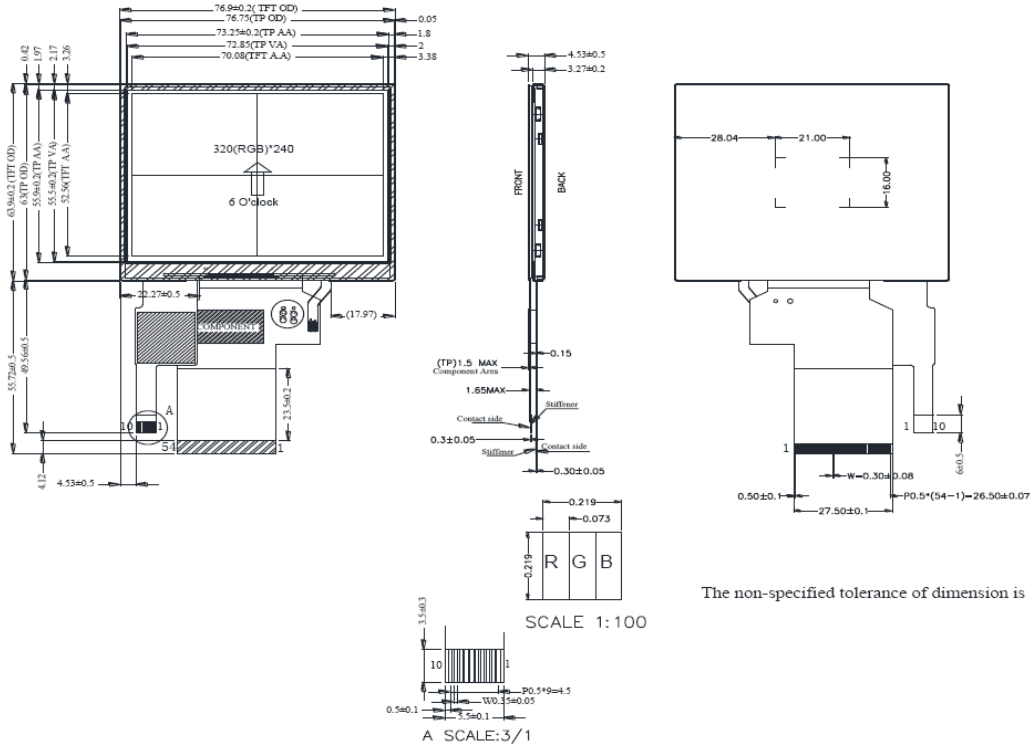
SPIByteWrite_reg(0x0037);
 SPIByteWrite_data(0x0100);

SPIByteWrite_reg(0x003a);
 SPIByteWrite_data(0x0502);
 SPIByteWrite_reg(0x003b);
 SPIByteWrite_data(0x0502);

3.4. CTP PIN Definition

Pin	Symbol	Function	Remark
1	VSS	System ground pin of the IC. Connect to system ground.	
2	VDDT	Power Supply : +3.3V	
3	SCL	I2C clock input	
4	NC	No connect	
5	SDA	I2C data input and output	
6	NC	No connect	
7	/RST	External Reset, Low is active	
8	/WAKE	External interrupt from the host	
9	/INT	External interrupt to the host	
10	VSS	System ground pin of the IC. Connect to system ground.	

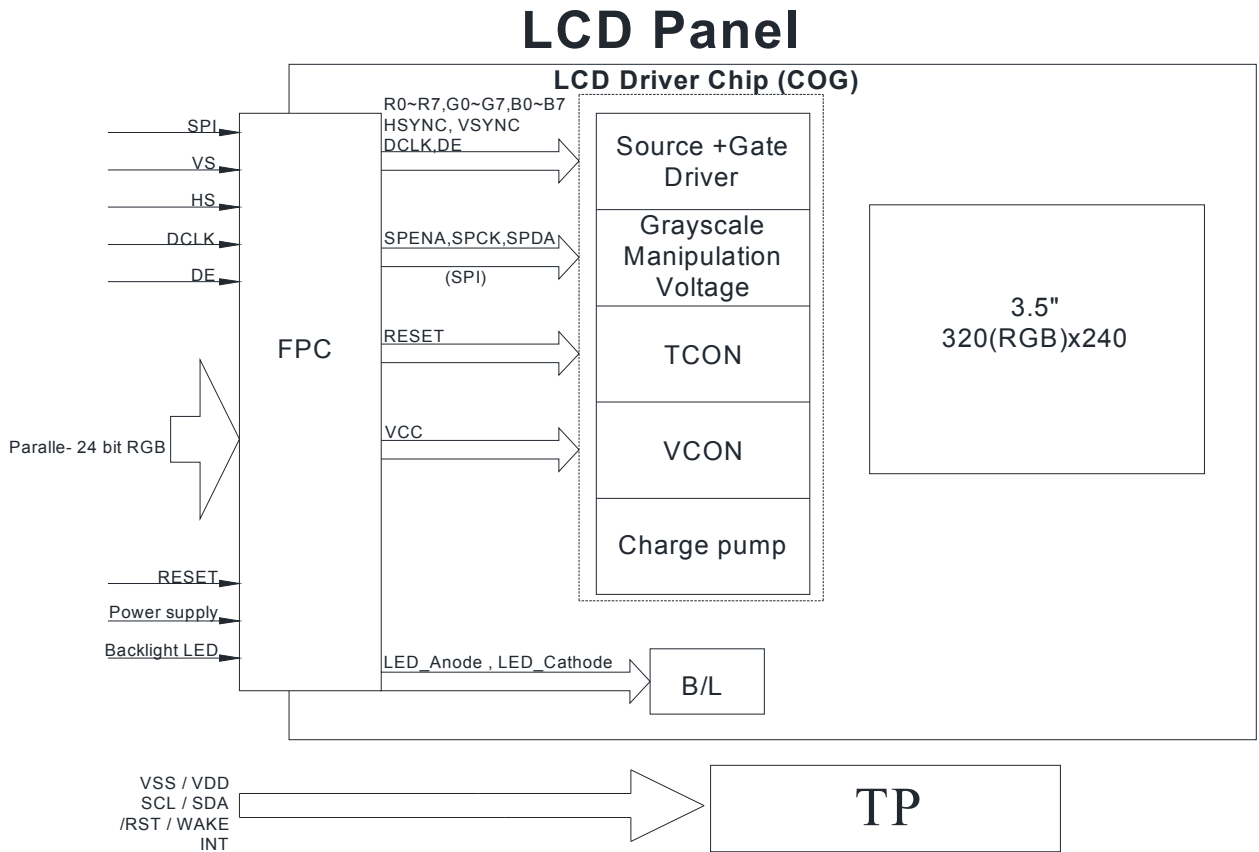
4. Contour Drawing



PIN NO.	SYMBOL	PIN NO.	SYMBOL
1	LED-	28	R0
2	LED-	29	R1
3	LED+	30	R2
4	LED+	31	R3
5	NC	32	R4
6	NC	33	R5
7	NC	34	R6
8	/RESET	35	R7
9	CS	36	HSYNC
10	SPCLK	37	VSYNC
11	SPDAT	38	DCLK
12	B0	39	NC
13	B1	40	NC
14	B2	41	VCC
15	B3	42	VCC
16	B4	43	NC
17	B5	44	NC
18	B6	45	NC
19	B7	46	NC
20	G0	47	NC
21	G1	48	NC
22	G2	49	NC
23	G3	50	NC
24	G4	51	NC
25	G5	52	DE
26	G6	53	DGND
27	G7	54	AVSS

PIN NO.	SYMBOL
1	VSS
2	VDDT
3	SCL
4	NC
5	SDA
6	NC
7	/RST
8	/WAKE
9	/INT
10	VSS

5. Block Diagram

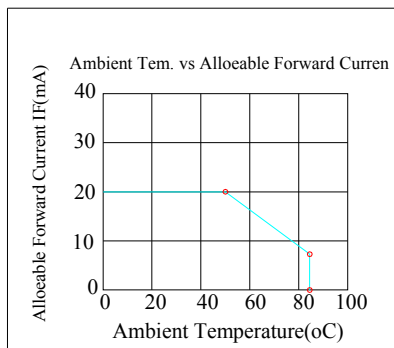


6. Absolute Maximum Ratings

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	TOP	-20	—	+70	°C
Storage Temperature	TST	-30	—	+80	°C

Note: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above

- 1. Temp. $\leq 60^{\circ}\text{C}$, 85% RH MAX. Temp. $> 60^{\circ}\text{C}$, Absolute humidity shall be less than 85% RH at 60°C



7. Electrical Characteristics

7.1. Operating conditions:

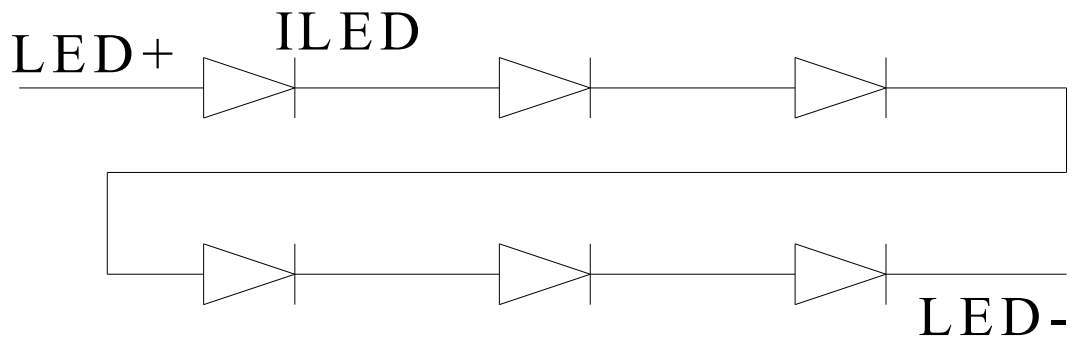
Item	Symbol	Condition	Min	Typ	Max	Unit	Remark
Supply Voltage For LCM	VCC	—	3.0	3.3	3.6	V	
Supply Current For LCM	ICC	—	—	4	10	mA	Note 1
Supply Voltage For Touch Logic	VDDT	—	2.8	-	3.3	V	

Note 1 : This value is test for VDD=3.3V , Ta=25°C only

7.2. LED driving conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED current		18	20	25	mA	
LED voltage	LED+	18.0	19.8	21	V	Note 1
LED Life Time		20,000	-	-	Hr	Note 2,3,4

Note 1 : There are 1 Groups LED



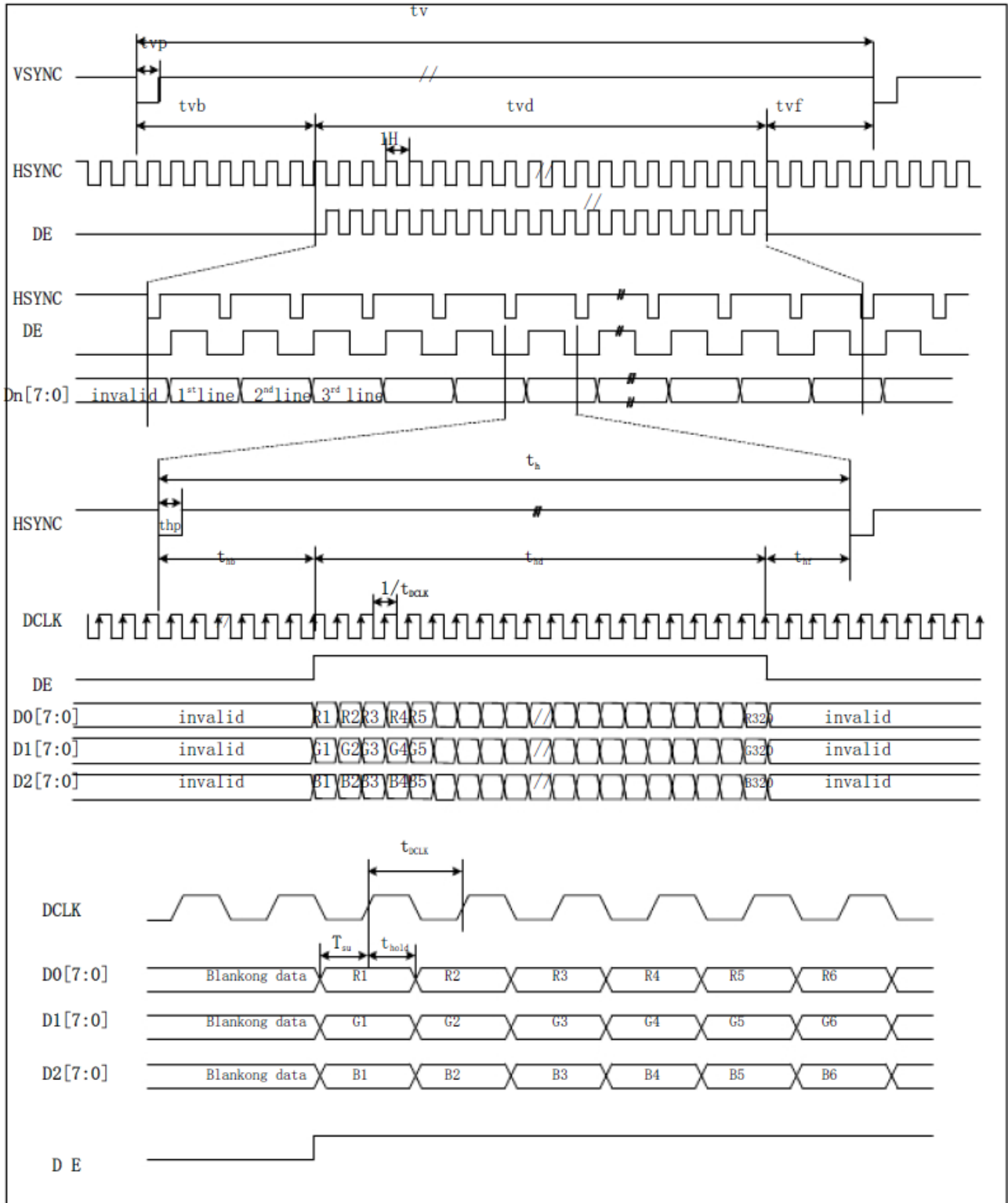
Note 2 : Ta = 25°C

Note 3 : Brightness to be decreased to 50% of the initial value

Note 4 : The single LED lamp case

8. Data input Characteristics

Parallel RGB Interface



Parallel RGB Input Signal Timing

Parameter	Symbol	Min.	Typ	Max.	Unit.	Note
DCLK Frequency	1/ tDCLK	—	6.5	10	MHz	
Horizontal Period	th	—	408	—	tDCLK	
Horizontal Display	thd	320	320	320	tDCLK	
Horizontal Back Porch	thb	—	68	—	tDCLK	
Horizontal Front Porch	thf	—	20	—	tDCLK	
Horizontal Pulse Width	thp	1	—	—	tDCLK	
Vertical Period	tv	—		—	th	
Vertical Display Period	tvd	240	240	240	th	
Vertical Back Porch	tvb	—	18	—	th	
Vertical Front Porch	tvf	—	4	—	th	
Vertical Pulse Width	tvp	1	—	—	th	
Data setup time	tsu	12	—	—	ns	
Data hold time	thold	12	—	—	ns	

9. Optical Characteristics

Item	Symbol	Condition.	Min	Typ.	Max.	Unit	Remark	
Response time	Tr+ Tf	$\theta=0^\circ$ 、 $\phi=0^\circ$	-	25	40	ms	Note 3,5	
Contrast ratio	CR	At optimized viewing angle	300	350	-	-	Note 4,5	
Color Chromaticity	White	Wx	$\theta=0^\circ$ 、 $\phi=0$	0.285	0.305	0.325	-	Note 2,6,7
		Wy		0.314	0.334	0.354	-	-
Viewing angle	Hor.	θ_R	CR \geq 10	60	70	-	Deg.	Note 1
		θ_L		60	70	-		
	Ver.	ϕ_T		40	50	-		
		ϕ_B		60	70	-		
Brightness	-	-	280	336	-	cd/m ²	Center of display	

Ta=25±2°C, IL=20mA

Note 1: Definition of viewing angle range

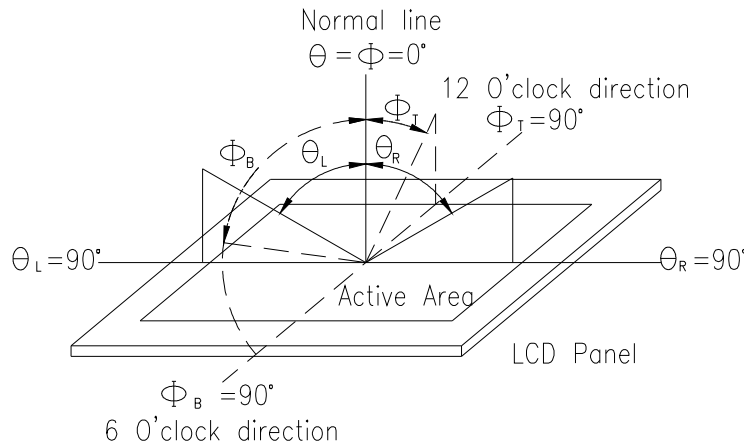


Fig. 10.1. Definition of viewing angle

Note 2: Test equipment setup:

After stabilizing and leaving the panel alone at a driven temperature for 10 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7orBM-5 luminance meter 1.0° field of view at a distance of 50cm and normal direction.

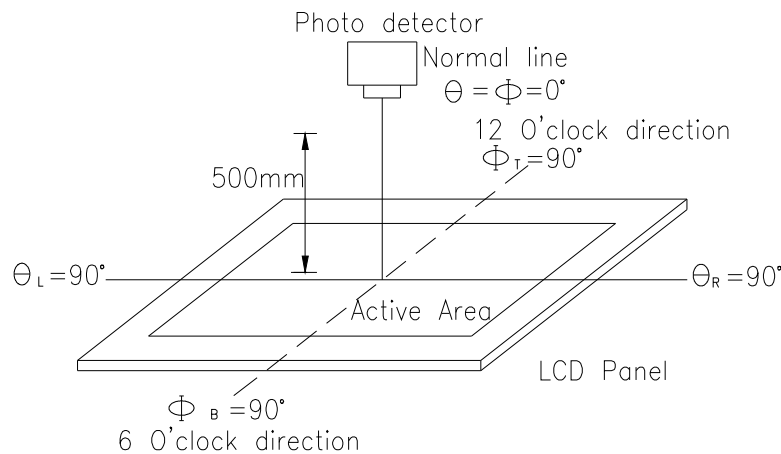
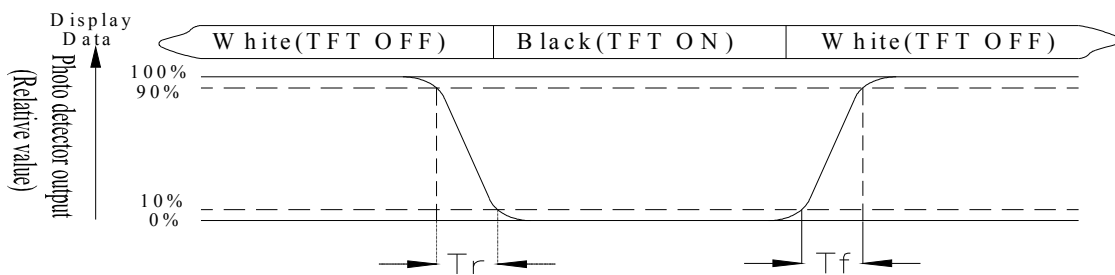


Fig. 10.2. Optical measurement system setup

Note 3: Definition of Response time:

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time, T_r , is the time between photo detector output intensity changed from 90% to 10%. And fall time, T_f , is the time between photo detector output intensity changed from 10% to 90%



Note 4: Definition of contrast ratio:

The contrast ratio is defined as the following expression.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Note 5: White $V_i = V_{i50} \pm 1.5V$

Black $V_i = V_{i50} \pm 2.0V$

“±” means that the analog input signal swings in phase with VCOM signal.

“±” means that the analog input signal swings out of phase with VCOM signal.

The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

Note 6: Definition of color chromaticity (CIE 1931)

Color coordinates measured at the center point of LCD

Note 7: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

10. Reliability

Content of Reliability Test (Wide temperature, -20°C~70°C)

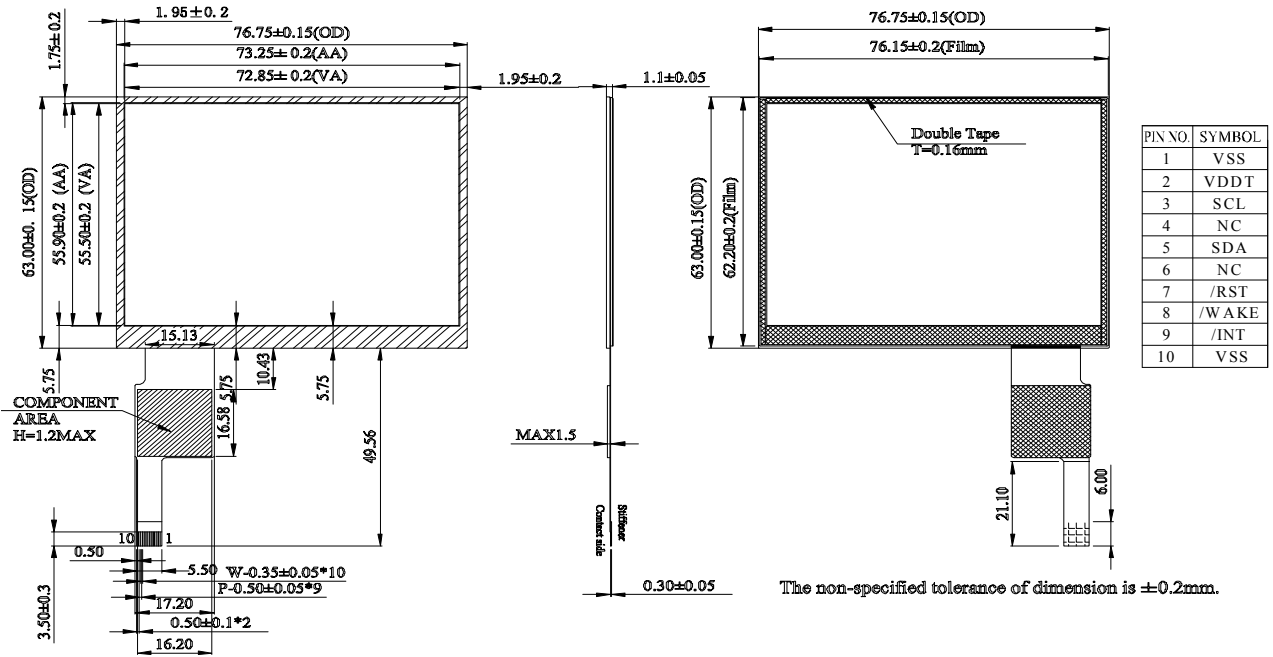
Environmental Test			
Test Item	Content of Test	Test Condition	Note
High Temperature storage	Endurance test applying the high storage temperature for a long time.	80°C 96hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C 96hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70°C 96hrs	—
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20°C 96hrs	1
High Temperature/ Humidity Operation	The module should be allowed to stand at 60□,85%RH max	60°C, 85%RH 96hrs	1,2
Thermal shock resistance	The sample should be allowed stand the following 10 cycles of operation <div style="text-align: center;"> <p style="margin: 0;">-20°C 25°C 60°C</p> <p style="margin: 0;">30min 5min 30min</p> <p style="margin: 0;">1 cycle</p> </div>	-20°C/60°C 10 cycles	—
Vibration test	Endurance test applying the vibration during transportation and using.	Total fixed amplitude : 15mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X,Y,Z for Each 15 minutes	3
Static electricity test	Endurance test applying the electric stress to the terminal.	VS=±600V(contact), ±800v(air), RS=330Ω CS=150pF 10 times	—

Note1: No dew condensation to be observed.

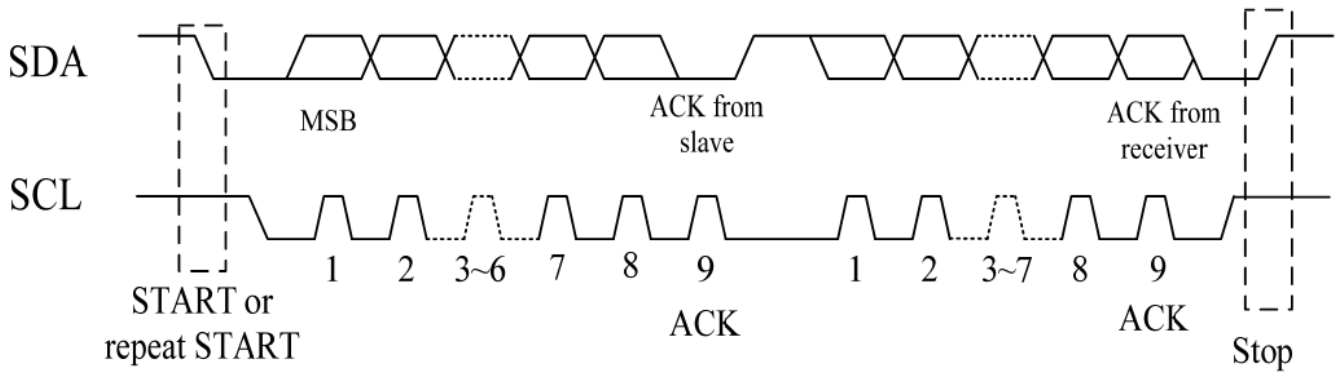
Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.

Note3: The packing have to including into the vibration testing.

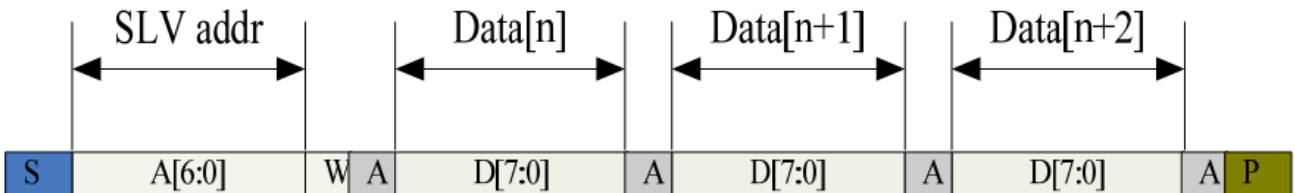
11.Touch Panel Information



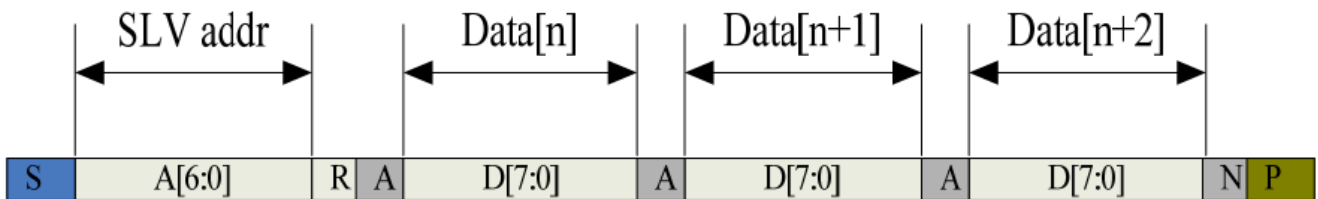
11.1. CTP I2C Timing:



I2C Serial Data Transfer Format



I2C master write, slave read



I2C master read, slave write

Mnemonics	Description
S	12C Start or 12C Restart
A[6:0]	Slave address A[6:4]:3'b011 A[3:0]:data bits are identical to those of 12CCON[7:4]register
W	1'b0:Write
R	1'b1:Read
A(N)	ACK(NACK)
P	STOP :the indication of the end of a packet(if this bit is missing, S will indicate the end of the current packet and beginning of the next packet)

Lists the meanings of the mnemonics used in the above figures

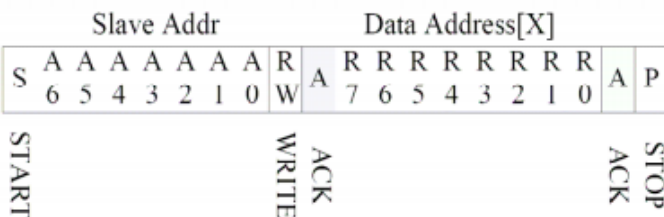
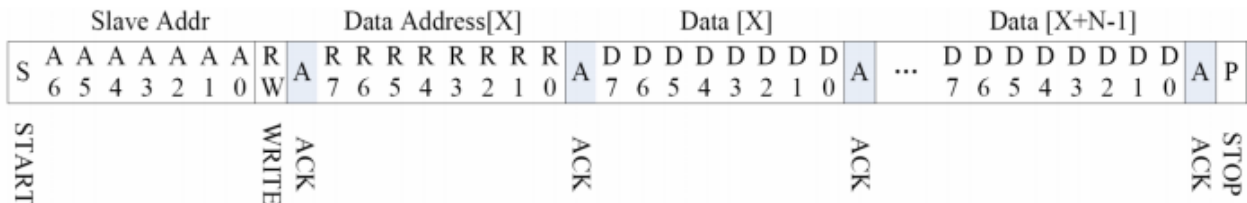
Parameter	Unit	Min	Max
SCL frequency	KHz	0	400
Bus free time between a STOP and START condition	us	4.7	\
Hold time (repeated) START condition	us	4.0	\
Data setup time	ns	250	\
Setup time for a repeated START condition	us	4.7	\
Setup time for STOP condition	us	4.0	\

Interface Timing Characteristics

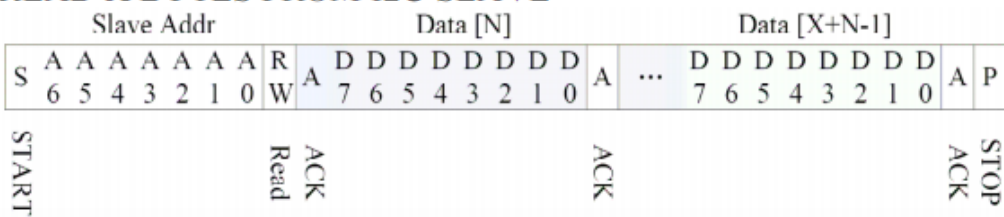
AS FOR STANDARD CTPM, HOST NEED TO USE BOTH INTERRUPT CONTROL SIGNAL AND SERIAL DATA INTERFACE TO GET THE TOUCH DATA.

HERE IS THE TIMING TO GET TOUCH DATA.

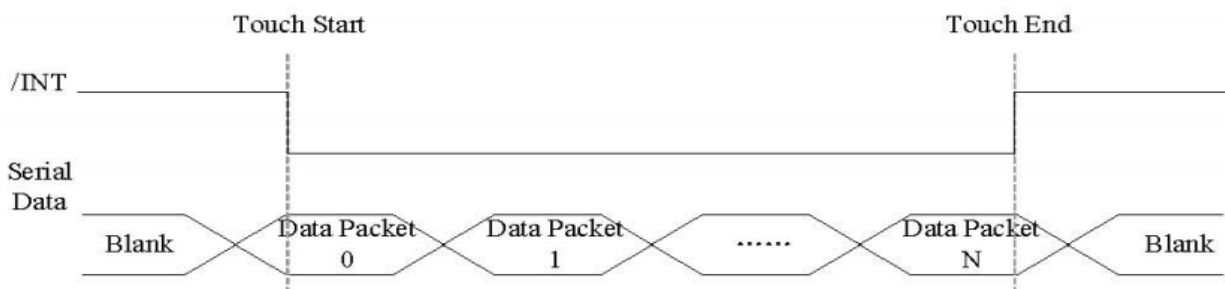
12.2. WRITE BYTES TO I2C SLAVE



READ X BYTES FROM I2C SLAVE



AS FOR STANDARD CTPM, HOST NEED TO USE BOTH INTERRUPT CONTROL SIGNAL AND SERIAL DATA INTERFACE TO GET THE TOUCH DATA, HERE IS THE TIMING TO GET TOUCH DATA.



Address: 0x38

TOUCH DATA READ PROTOCOL

NAME	VALUE	DESCRIPTION
START CH	0X00	START COMMAND FOR CTPM TOUCH DATA PACKET,HOST MUST SEND CTPM A START CH COMMAND BEFORE READ TOUCH DATA
1st READ BYTE~ LAST READ BYTE		TOUCH DATA PACKET SENT BY CTPM,EACH BYTE HAS 8-BIT DATA ,A TOUCH DATA PACKET CONSISTS OF N BYTE

A DATA PACKET STARTS WITH A HEADER AND ENDS WITH CRC CODE,AS FOR 5 POINTS DATA PACKET,THE LENGTH OF THE PACKET IS ALWAYS 26 BYTES IN SPIE OF ACTUAL TOUCH POINTS.

Address	Name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Host Access
00h	Devide__Mode		Device Model[2:0]							RW
01h	Gest__ID	Gesture ID[7:0]								R
02h	TD__Status					Number of touch points[3:0]				R
03h	Touch1__XH	1 st Event Flag				1 st Touch X Position[11:8]				R
04h	Touch1__XL	1 st Touch X Position[7:0]								R
05h	Touch1__YH	1 st Touch ID[3:0]				1 st Touch Y Position[11:8]				R
06h	Touch1__YL	1 st Touch Y Position[7:0]								R
09h	Touch2__XH	2 nd Event Flag				2 nd Touch X Position[11:8]				R
0Ah	Touch2__XL	2 nd Touch X Position[7:0]								R

0Bh	Touch2__YH	2nd Touch ID[3:0]		2ndTouch Y Position[11:8]	R
0Ch	Touch2__YL	2nd Touch Y Position[7:0]			R
0Fh	Touch3__XH	3rdEvent Flag		3rdTouch X Position[11:8]	R
10h	Touch3__XL	3rd Touch X Position[7:0]			R
11h	Touch3__YH	3rdTouch ID[3:0]		3rdTouch Y Position[11:8]	R
12h	Touch3__YL	3rd Touch Y Position[7:0]			R
15h	Touch4__XH	4thEvent Flag		4thTouch X Position[11:8]	R
16h	Touch4__XL	4th Touch X Position[7:0]			R
17h	Touch4__YH	4thTouch ID[3:0]		4thTouch Y Position[11:8]	R
18h	Touch4__YL	4th Touch Y Position[7:0]			R
1Bh	Touch5__XH	5thEvent Flag		5thTouch X Position[11:8]	R
1Ch	Touch5__XL	5th Touch X Position[7:0]			R
1Dh	Touch5__YH	5thTouch ID[3:0]		5thTouch Y Position[11:8]	R
1Eh	Touch5__YL	5th Touch Y Position[7:0]			R