DATA IMAGE CORPORATION

CTP Module Specification

PRELIMINARY

ITEM NO.: SCF0700C48GGU21

Table of Contents

Customer Companies	R&D Dept.	Q.C. Dept.	Eng. Dept.	Prod. Dept.
	ALEX	JOE	GARY	KEN
Approved by	Version:	Issued Date:	Sheet Code:	Total Pages:
	1	07/FEB/13’		34

2. RECORD OF REVISION

Rev	Date	Item	Page	Comment
1	07/FEB/13’			Initial preliminary

3. GENERAL SPECIFICATIONS

Composition: 7 inch WVGA resolution display with a projected capacitive Touch Panel (CTP).
Interface: RGB interface for panel and I^2C for the CTP.

Parameter		Specifications	Unit
Screen Size		7.0 (diagonal)	inch
Surface Treatment		Glare	
Display Format		800(H) x (R,G,B) x 480(V)	dots
Outline Dimension		179.7 (W) x 107.6 (H) x 7.75(D)	mm
LCD Active Area		152.4(W) x 91.44 (H)	mm
Sensor Active Area		154.6(W) x 92.4 (H)	mm
Dot Pitch		0.0635(W) x 0.1905 (H)	mm
Pixel Configuration		Stripe	
Weight		TBD	g
View Angle direction		6 o'clock	
Temperature Range	Operation	-20~70	℃
	Storage	-30~80	℃

4. LCD ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	MIN.	MAX.	Unit	Remark
Power supply voltage		Vcc	-0.3	6.0	V	Ta=25℃
Logic input voltage		VI	-0.3	V_{CC}+0.3	V	
Humidity	Operation	20%~90% relative humidity				Ta<=60℃
	Non Operation	5%~90% relative humidity				Ta<=60℃

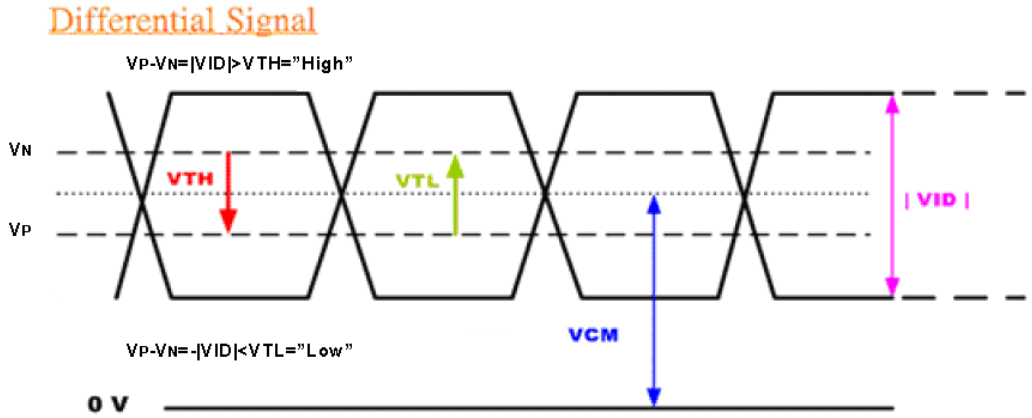
5. LCD ELECTRICAL CHARACTERISTICS

fH=30KHz, fV=60Hz, fCLK=33.3MHz,Ta=25°C

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Remark
Power Supply voltage for LCD	V_{CC}	+3.0	+3.3	+3.6	V	
Power Supply Current for LCD	I_{CC}		150	200	mA	V_{CC} =3.3V
Power Supply voltage for LED	V_{DD}	3	3.3	5.5	V	
Power Supply Current for LED	I_{DD}		650	850	mA	V_{DD} =3.3V
Power Supply Current for LED	I_{DD}		400	550	mA	V_{DD} =5.0V
Ripple voltage	V_{RF}	-	-	100	mV_{P-P}	
ADJ frequency		19K	20K	21K	Hz	
ADJ input voltage	VIH	3.0	-	3.3	V	
	VIL	0	-	0.3	V	
Differential Input High Threshold	VTH	-	-	100	[mV]	VCM=1.2V Note 1
Differential input Low Threshold	VTL	-100	-	-	[mV]	
LED dice life time			20000		Hr	Note 2

Note 1: LVDS Signal Waveform.

Note 1: LVDS Signal Waveform.



Note 2: The "LED dice life time" is defined as the brightness decrease to 50% original brightness that the ambient temperature is 18℃~28℃ and LED dice current=20mA.

6. LCD INPUT SIGNAL CHARACTERISTICS

6.1 AC Characteristic

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Data setup time	T_{dsu}	6	-	-	ns
Data hold time	T_{dhd}	6	-	-	ns
DE setup time	T_{esu}	6	-	-	ns

6.2 Resolution：800x480

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
DCLK frequency	F_{CPH}	25	33.26	40	MHz
DCLK period	T_{CPH}	-	30.06	-	ns
DCLK pulse duty	T_{CWH}	40	50	60	%
DE period	$T_{DEH}+T_{DEL}$	1000	1056	1200	T_{CPH}
DE pulse width	T_{DEH}	-	800	-	T_{CPH}
DE frame blanking	T_{DEB}	10	45	110	$T_{DEH}+T_{DEL}$
DE frame width	T_{DE}	-	480	-	$T_{DEH}+T_{DEL}$

6.3 Timing Controller Timing Chart

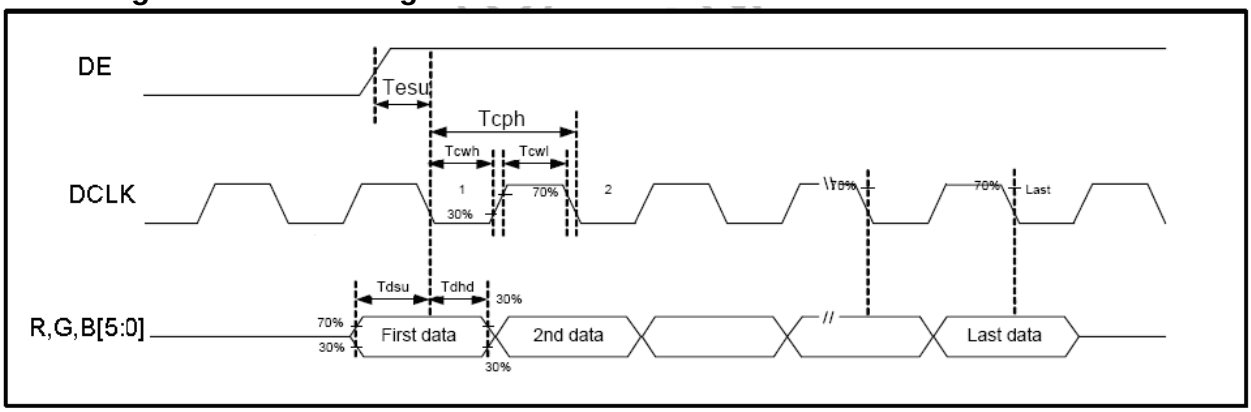
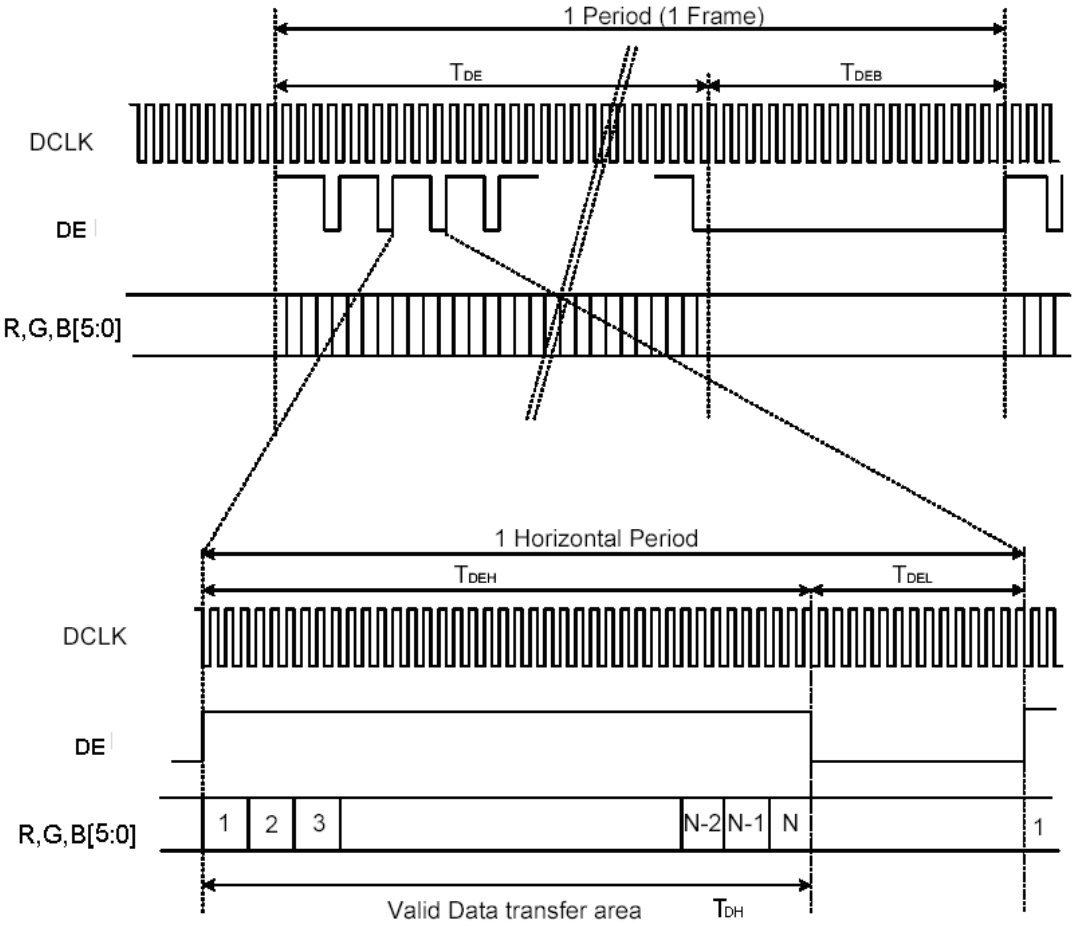
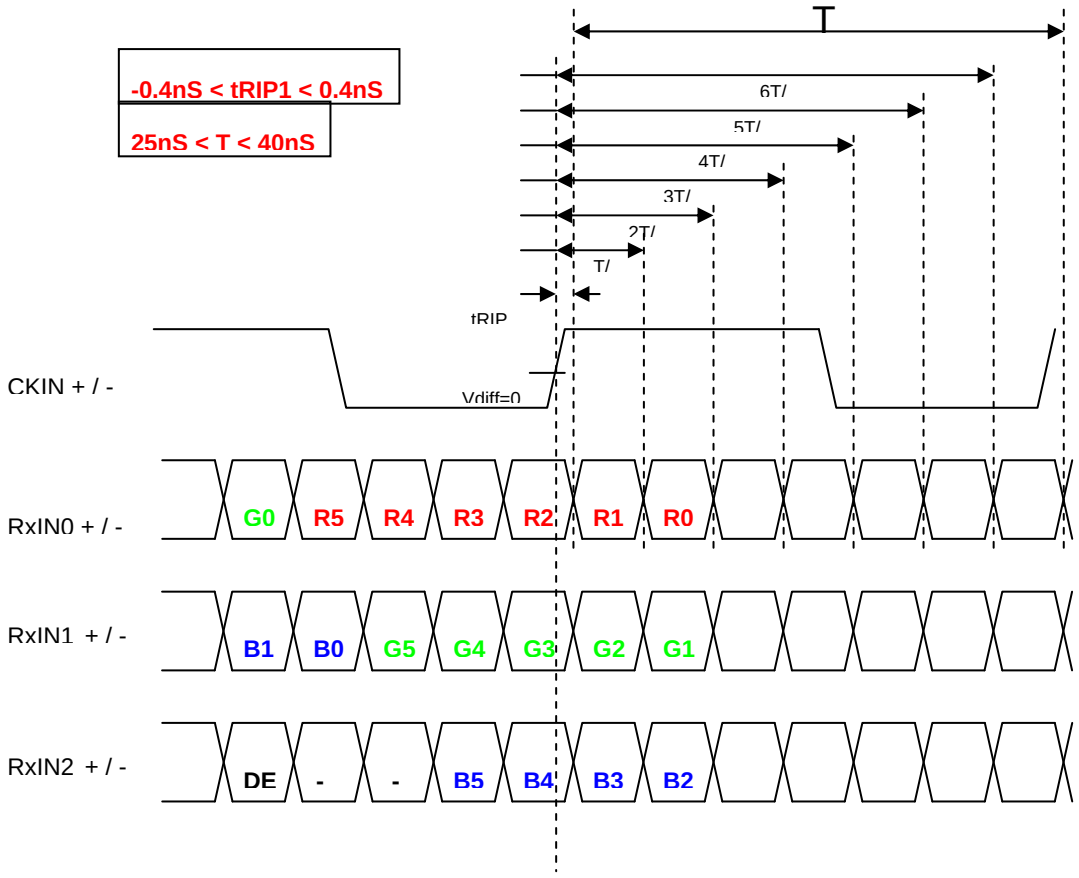


Figure 1 Clock and Data input waveforms.



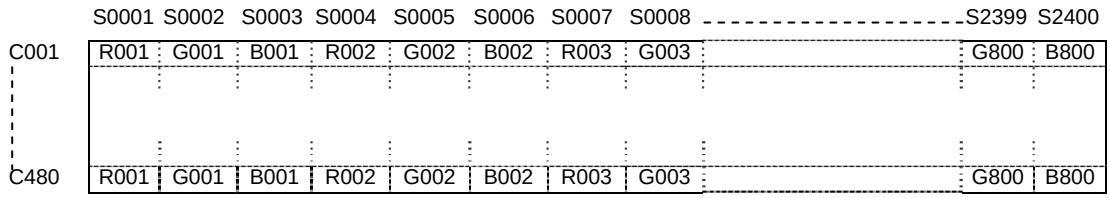
6.4 LVDS Timing Chart



6.5 Color Data Input Assignment

Color		Data Signal																	
		Red						Green						Blue					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale of Red	Red(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	Green(0)/ Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Gray Scale of Blue	Blue(0)/ Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue (61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue (62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue (63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Correspondence between Data and Display Position

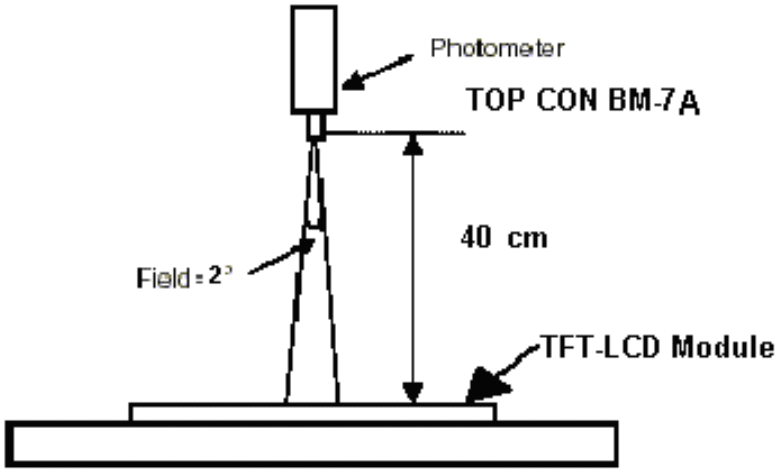


7. OPTICAL CHARACTERISTIC

Parameter		Symbol	Condition	MIN.	TYP.	MAX.	Unit	Remarks
Viewing Angle	Horizontal	θ_x+	Center CR≥10	65	70	--	deg	Note 1,4
		θ_x-		65	70	--		
	Vertical	θ_Y+		55	60	--		
		θ_Y-		55	60	--		
Contrast Ratio		CR	at optimized viewing angle	250	400	--		Note 1,3
Response time	Rise	Tr	Center θx=θy =0°	-	5	10	ms	Note 1,6
	Fall	Tf		-	11	16	ms	
Uniformity		B-uni	θx=θy =0°	70	80	--	%	Note1,5
Brightness		L	θx=θy =0°	210	270	--	cd/㎡	Note 1,2
Chromaticity		x_W	Center θx=θy =0°	0.26	0.31	0.36		Note 1,7
		y_W		0.28	0.33	0.38		
		x_R		0.52	0.57	0.62		
		y_R		0.31	0.36	0.41		
		x_G		0.30	0.35	0.40		
		y_G		0.53	0.58	0.63		
		x_B		0.10	0.15	0.20		
		y_B		0.09	0.14	0.19		
Image sticking		tis	2 hours			2	Sec	Note 8

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±2°C. The measurement method is shown in Note1.

Note1: The method of optical measurement:

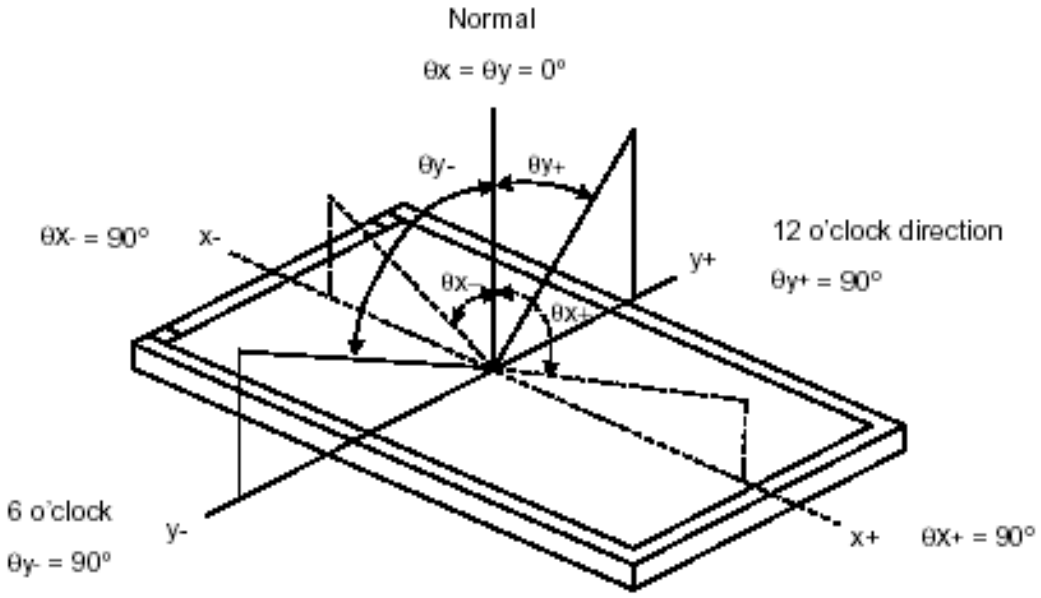


Note2: Measured at the center area of the panel and at the viewing angle of the θx=θy =0°

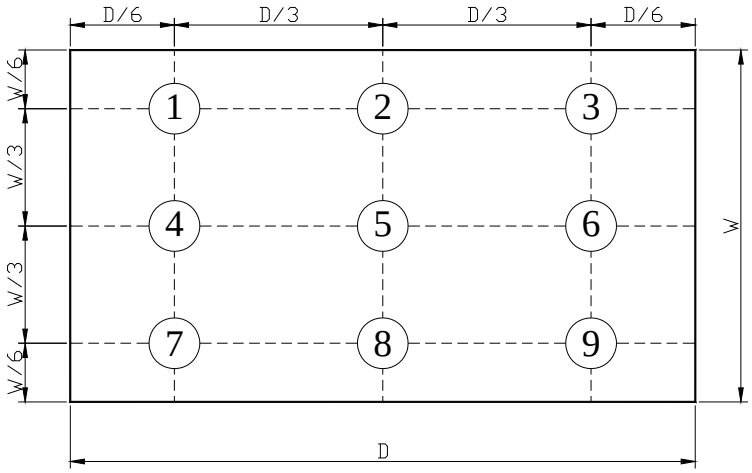
Note3: Definition of Contrast Ratio (CR):

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

Note4: Definition of Viewing Angle



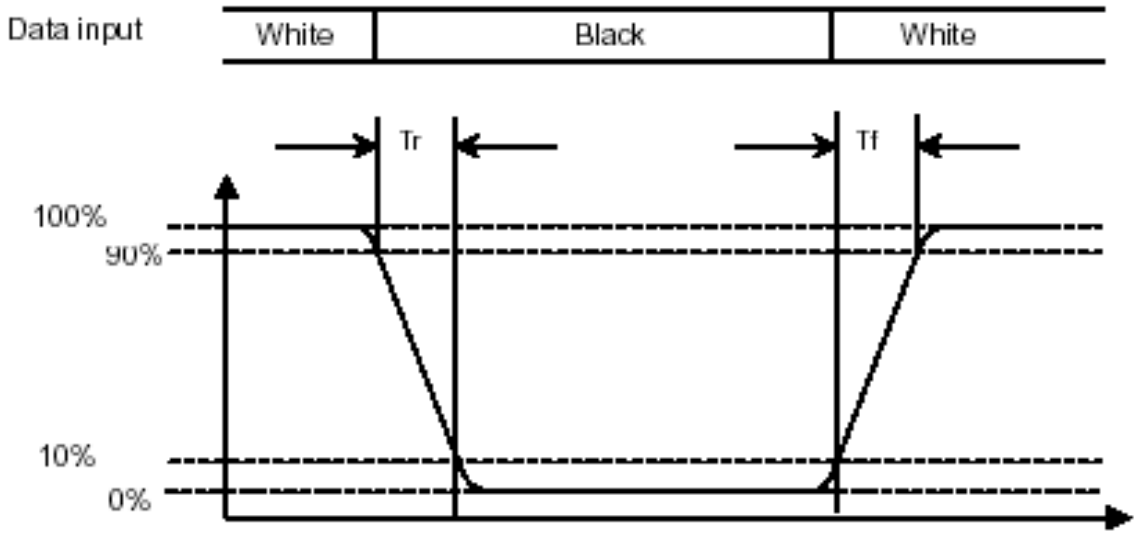
Note 5: Definition of Brightness Uniformity (B-uni):



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

Note6: Definition of Response Time:

The Response Time is set initially by defining the “Rising Time (Tr)” and the “Falling Time (Tf)” respectively. Tr and Tf are defined as following figure.



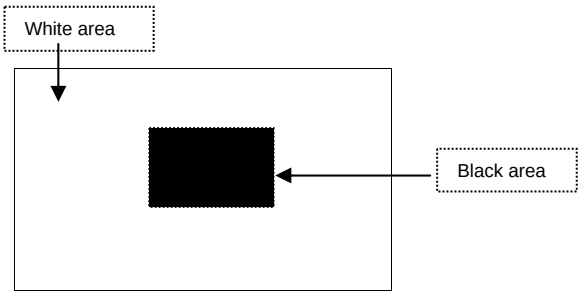
Note 7: Definition of Chromaticity:

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.

Note 8: Definition of Image sticking (tis):

Continuously display the test pattern shown in the figure below for 2 hours. Then display a completely white screen. The previous image shall not persist more than 2 sec at 25 °C

Image sticking pattern



8. LCD PIN CONNECTIONS

Pin No	Symbol	Function	Remark
1	VCC	power supply for Digital Circuit	
2	VCC	power supply for Digital Circuit	
3	GND	Ground	
4	GND	Ground	
5	RxIN0-	Differential Data Input ,CH0(Negative)	
6	RxIN0+	Differential Data Input ,CH0(Positive)	
7	GND	Ground	
8	RxIN1-	Differential Data Input ,CH1(Negative)	
9	RxIN1+	Differential Data Input ,CH1(Positive)	
10	GND	Ground	
11	RxIN2-	Differential Data Input ,CH2(Negative)	
12	RxIN2+	Differential Data Input ,CH2(Positive)	
13	GND	Ground	
14	CKIN-	Differential Clock Input (Negative)	
15	CKIN+	Differential Clock Input (Positive)	
16	GND	Ground	
17	VDD	Power Supply for LED Driver Circuit	
18	VDD	Power Supply for LED Driver Circuit	
19	GND	Ground	
20	ADJ	Brightness control for LED B/L	

Remarks：

1) ADJ is brightness control Pin. The larger of the pulse duty is, the higher of the brightness.
2) ADJ signal is 0~3.3V.Operation frequency is 20KHz
3) GND PIN must be grounding, can not be floating.

Remarks:

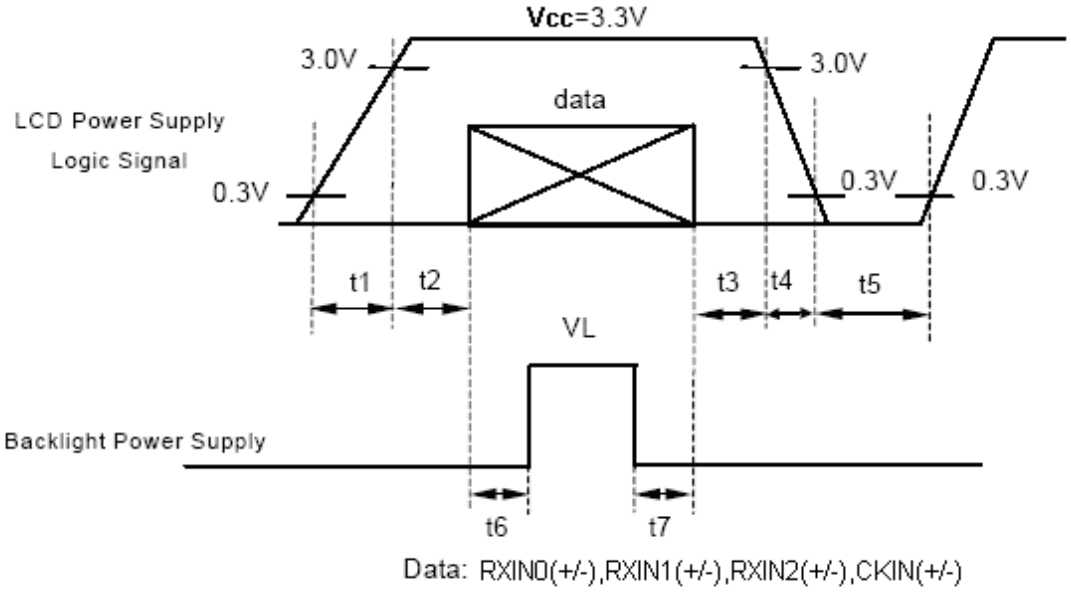
Power Signal sequence:

t1 ≤10ms ; 1 sec≤ t5

50ms≤ t2 ; 200ms ≤t6

0<t3 ≤50ms ; 200ms≤ t7

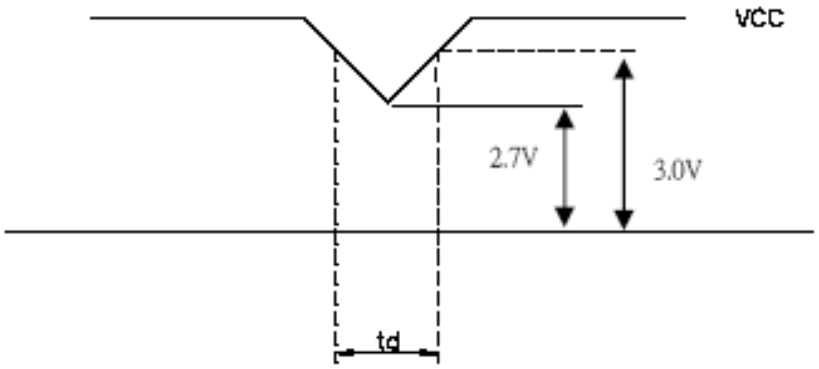
0<t4 ≤10ms



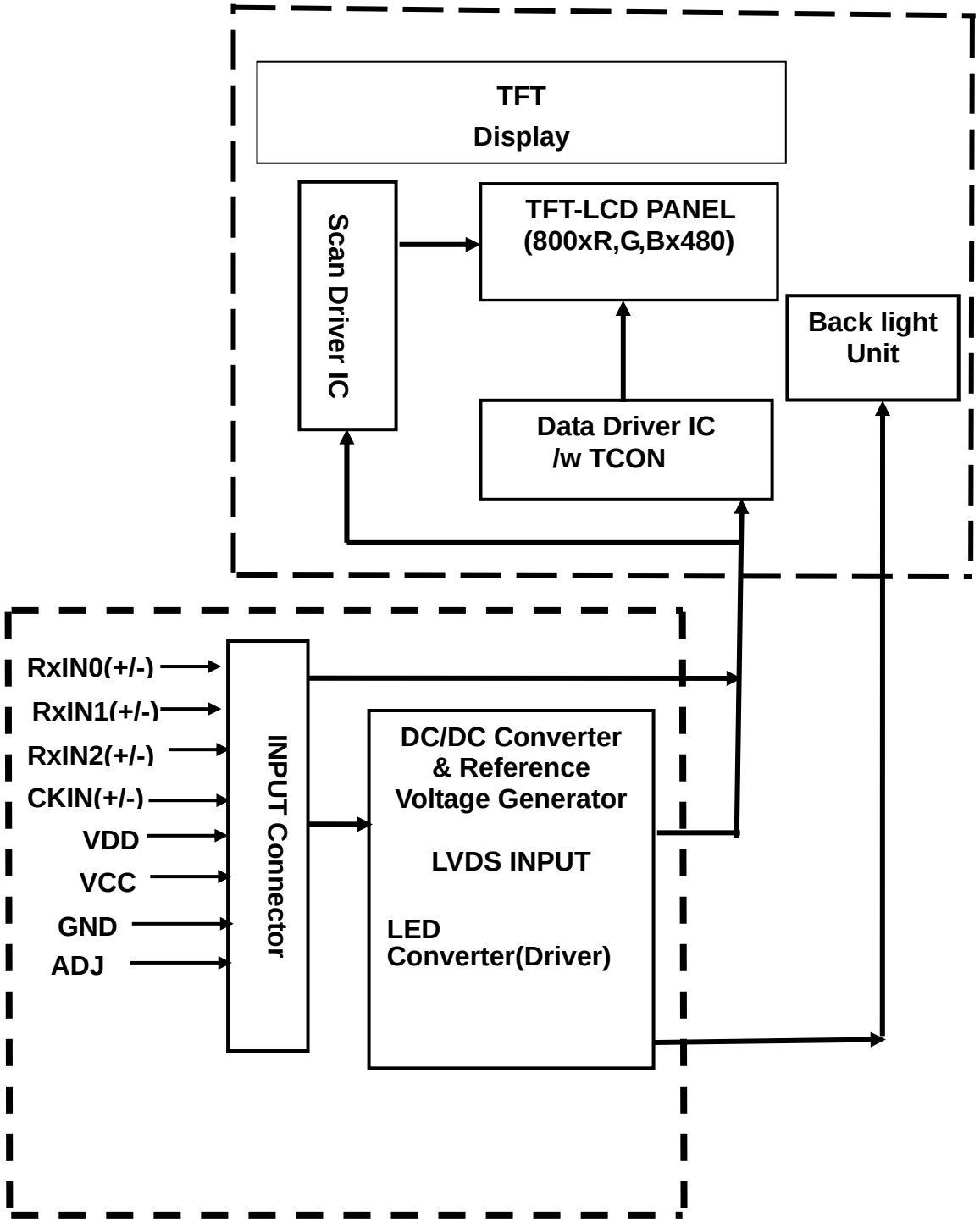
VCC-dip condition:

(1) 2.7 V ≤VCC <3.0V,td ≤ 10 ms

(2) VCC>3.0V,VCC-dip condition should be the same with VCC-turn-on condition。

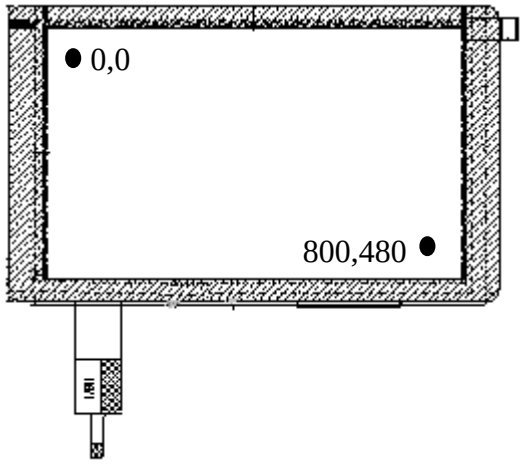


9. LCD BLOCK DIAGRAM



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
(X,Y) Position		

10.1 ABSOLUTE MAXIMUM RATINGS

Symbol	Description	Min	Typ	Max	Unit
VDD1	Supply voltage	-0.3	-	3.6	V
V_I	Logic input voltage	-0.3	-	VDD1+0.3	V

10.1.2 ELECTRICAL CHARACTERISTICS

Symbol	Description	Min	Typ	Max	Unit
VDD1	Supply voltage	2.5	3.3	3.6	V
GND	Supply voltage	-	0	-	V
V_{IH}	Input H voltage	0.8VDD1	-	VDD1	V
V_{IL}	Input L voltage	0	-	0.2VDD1	V

10.3 POWER CONSUMPTION

Symbol	Description	Fingers	F_{scan}(Hz)	Min	Typ	Max	Unit
IVDD1	Active mode	1	280		-	4	mA
		2	160		-	5	mA
		3	90		-	5.2	mA
		4	80		-	5.4	mA
		5	75		-	5.6	mA
I_{sleep}	Sleep mode	0	10		-	0.11	mA
	Deep sleep mode	-			-	50	uA
I_{freeze}	Freeze mode	-			-	2	uA
	Boot load	-			-	6.2	mA
	Calibration	-			-	6.2	mA

10.4 I²C Protocol Specifications

1. Supports 100 KHz clock frequency and up to 400 kHz (Fast Mode).
2. Only support single master solution.
3. Only support 7 bit addressing.
4. If I²C master can't finish 1byte data in 100ms, I²C slave will restart. The CTP controller operates only as a slave device. The I²C interface is functional in active and sleep modes. In sleep mode, asynchronous address match detector hardware allows a sleeping controller to recognize its address and wake up. And the firmware can implements different I²C touch protocols. The timings for example that as table 10.1 and figure 10.1.
5. I²C slave can hold off the master in the middle of a transaction using what's called clock stretching (the slave keeps SCL pulled low until it's ready to continue). Refer to figure 10.2 for an example.
6. Slave device address = 0x5C.

Table 10.1: I²C timing

Symbol	Parameter	Min	Typ	Max	Unit
T_{LOW}	I²C clock low time	2 • T_{CPU}			
T_{HIGH}	I²C clock high time	2 • T_{CPU}			
$T_{HD,STA}$	I²C clock hold time	2 • T_{CPU}			
$T_{SU,STA}$	I²C start setup time				
$T_{SU,STO}$	I²C stop setup time				
$T_{HD,DAT}$	I²C data hold time, when driven by master side				
$T_{SU,DAT}$	I²C data setup time, when driven by master side				
T_{BUF}	I²C bus free time	4.7			us
T_{CSR}	I²C clock stretching release time	9 • T_{CPU}			
$T_{VD,DAT}$	I²C data valid after clock change, when data is driven by slave side	9 • T_{CPU}			
TT_{CPU}	CPU master clock period			55	ns

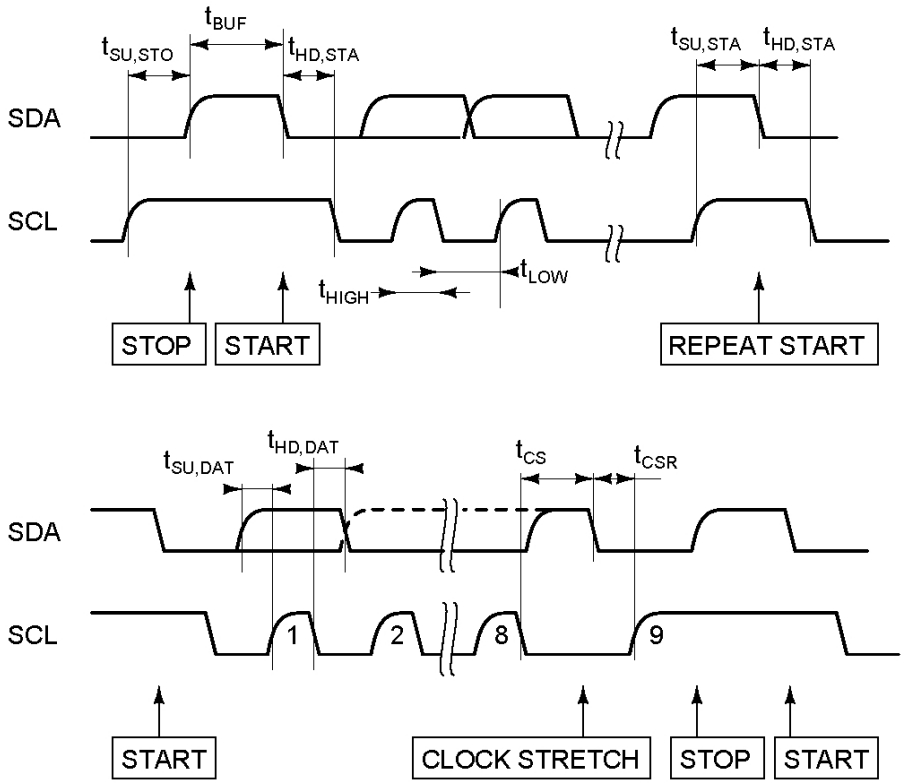


Figure 11.1: I²C clock stretching example

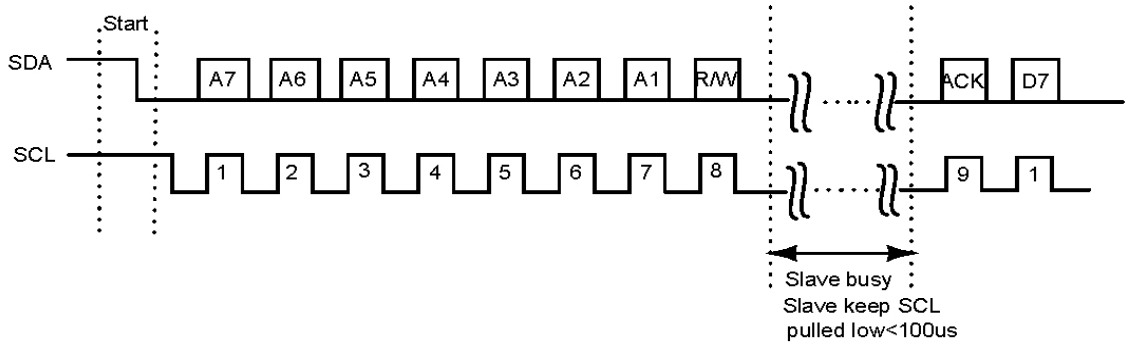


Figure 11.2: I²C clock stretching example

10.5. Data Protocol

The communication follows I²C convention. Refer to figure 10.3 for a definition of the symbols used.

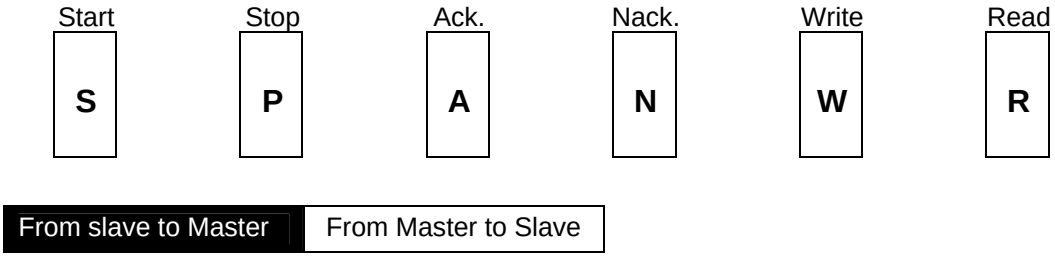


Figure 10.3: I²C symbols

10.6 Introduction

The protocol for data exchange has been designed with the following considerations

- Most of the data traffic is read operation to get the finger or fingers position.
- Read operation do need an initial write operation.
- Write operations are most of the time power management and interrupt setting instructions.
- Interrupt pulse width setting adjustments need a write operation.

10.6.1 Read operation

Read packets have variable content length, decided by the host. It is available to do a single read operation or a sequential read operation. Therefore, the beginning register address is needed to set before a read operation. And the data sent exactly follow the register table 10.2, table 10.5. And, the firmware in the slave will use a memory copy of the register for I²C slave read operation, so that firmware can continue updates, and I²C slave is still using a consistent (but old) coordinates for read operation.

- In a sequential read operation, the first data sent by the controller is therefore the touching register, and then the X and Y coordinates of the first finger, then 2nd finger, 3rd finger, 4th finger and then coordinates of the 5th finger, and so on. Referred in figure 10.5.
- If the host do not finish the read operation when the INT line is set again, the slave firmware will delay to update coordinates registers for I²C read operation until the host finish the read operation. referred to first part of figure 10.6.
- I²C stop condition will release data protection and allow the slave firmware update the coordinates registers for I²C read operation. So, the host has the chance to get incorrect data when it get the coordinates data with single read operation. Because the host send many times of I²C stop condition in each multi-fingers coordinates position reading, it will give the slave firmware chance to update the coordinates registers for I²C read operation, the host will give a combines unrelated data (combines new and old coordinates together), referred to the second part of figure 10.6.

Figure 11.4: Read operation

Figure 11.5: Coordinates read operation

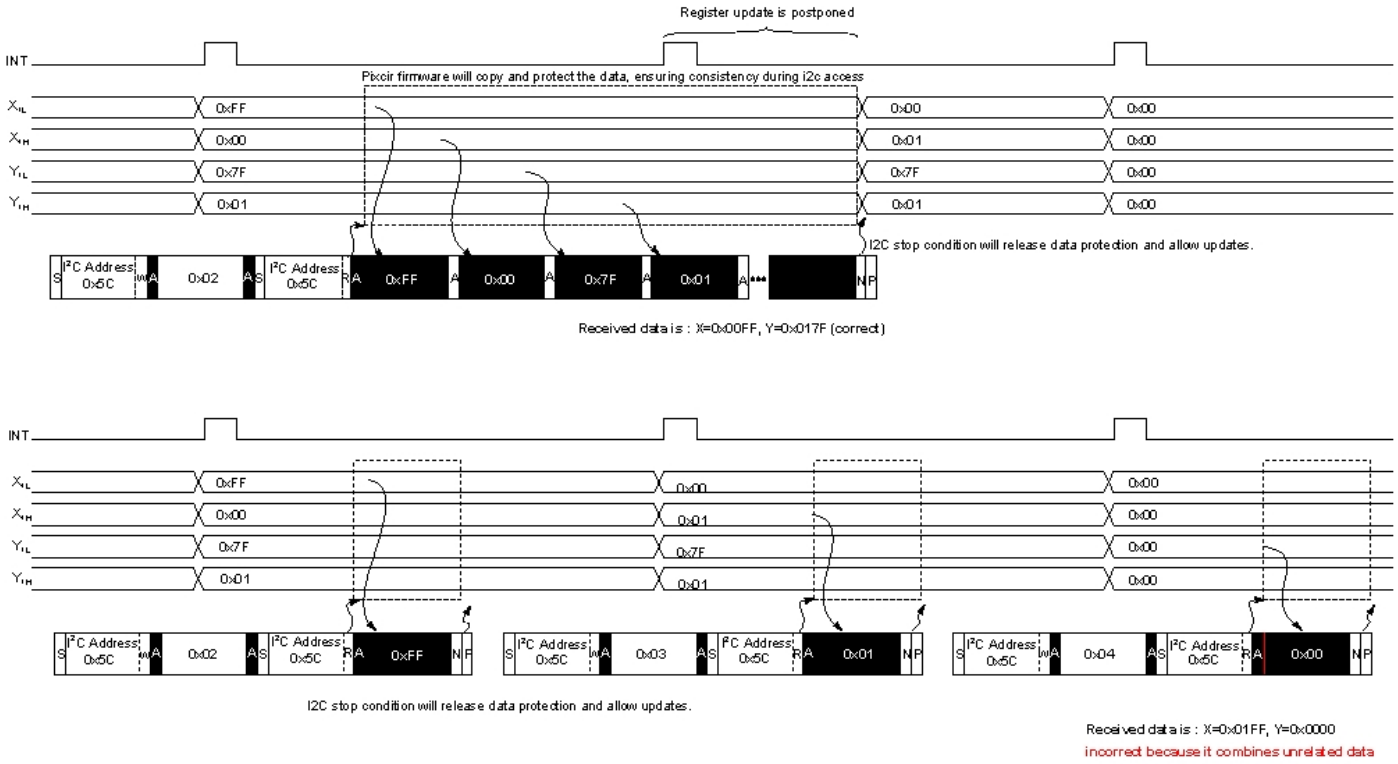


Figure 10.6: Coordinates read operation explanation

10.6.2 Write operation

Write packets have variable content length, decided by the host. Write operation stops when host issues an I²C STOP symbol. The write packet is illustrated in figure 10.7 and figure 10.8. Following the I²C device address, the first byte of the write packet is always the destination register address, referred in table 10.2, table 10.5. Subsequent data value are written at the register pointed by the address, immediately upon reception of the byte. The address counter is automatically incremented. Subsequent data bytes are treated in continuation of the writing operation.

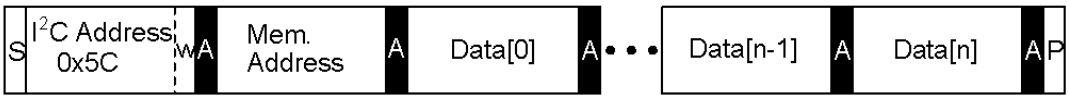


Figure 10.7: Write operation.

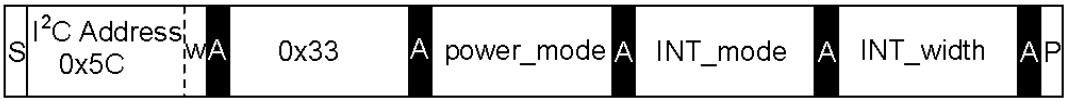


Figure 10.8: Write mode setting operation.

10.7 Registers

10.7.1 Endianness

Data are little endian, which means LSB byte appears before MSB byte.

10.7.2 Registers organization

The accessible registers are shown in the table 10.2, table 10.5. These registers are technically accessible both for reading or writing direction. However, most registers have only one meaningful direction: finger position registers, for example, are typically used in read direction, and writing to them will have no effect; their content will be overridden after a new sensor scan.

Table 10.2: registers table

Address	Type	Name	Description	Category
0	Char	Touching	Bit field, see table 11.3	Touch
1	Char	Buttons	Reserved	
2 (LSB) 3 (MSB)	Int	PosX1	Finger #1 X position	
4 (LSB) 5 (MSB)	Int	PosY1	Finger #1 Y position	
6	Char	ID1	Finger #1 identificator	
7 (LSB) 8 (MSB)	Int	PosX2	Finger #2 X position	
9 (LSB) 10 (MSB)	Int	PosY2	Finger #2 Y position	
11	Char	ID2	Finger #2 identificator	
12 (LSB) 13 (MSB)	Int	PosX3	Finger #3 X position	
14 (LSB) 15 (MSB)	Int	PosY3	Finger #3 Y position	
16	Char	ID3	Finger #3 identificator	
17 (LSB) 18 (MSB)	Int	PosX4	Finger #4 X position	
19 (LSB) 20 (MSB)	Int	PosY4	Finger #4 Y position	
21	Char	ID4	Finger #4 identificator	
22 (LSB) 23 (MSB)	Int	PosX5	Finger #5 X position	
24 (LSB) 25 (MSB)	Int	PosY5	Finger #5 Y position	
26	Char	ID5	Finger #5 identificator	
27	Char	Strength1	Finger #1 strength	
28	Char	Strength2	Finger #2 strength	
29	Char	Strength3	Finger #3 strength	
30	Char	Strength4	Finger #4 strength	
31	Char	Strength5	Finger #5 strength	
32 (LSB) 33 (MSB)	int	Initial_ distance	Distance separating fingers on the first time multi touch is detected	Gesture
34 (LSB) 35 (MSB)	int	Distance	Distance separating fingers	
36 (LSB) 37 (MSB)	int	Ratio	100˙distance / initial_ distance	
38	Char	Water_ level		Monitor
39	Char	Noise_ level		
40	Char	Palm_ level		
41	Char	Signal_ x		
42	Char	Signal_ y		
43 50	Char	Button1button8	Reserved	Buttons
51	Char	Power_ mode	Power management register. See subsection §11.7.4 and table 11.6	power management
52	Char	INT_ mode	Control of the INT pin, see table 11.7	
53	Char	INT_ width	INT pulse width	
54	Char	Sleep_ freq	Scanning frequency in Sleep mode	
55	Char	Auto_ sleep_ delay	The delay time, the start is the last touch released in Active mode and the end is switch into Sleep mode	

			successful	
56-57	Char		Reserved	Special operations
58	Char	SPECOP	Reserved	
59 (LSB) 60 (MSB)	Int	EEPROM_ read_ addr	Reserved	
61	Char	Engineering_ cmd	Allows, with I^2C, to send "hyper terminal like commands" for engineering modes	
62 (LSB) 63 (MSB)	Int	CRC	Reserved	version
64-95	Char	Version[0..31]	Customer version control (32bytes)	
96-135	Char	Message[0..39]	Null terminated ASCII message string for engineering and debug purpose	
136 (LSB) 137 (MSB)	Int	RAW_CTRL	Controls RAW data mode (internal, raw, etc. . .) see table 11.3	
138	Char	Cross_ X	X coordinate for method 1 crossing node measurement request	Method 1
139	Char	Cross_ Y	Y coordinate for method 1 crossing node measurement request	
140 (LSB) 141 (MSB)	Int	Cross_ node	Measurement result for method 1	
142 (LSB) 143 (MSB)	Int	RAW[0..69] Shared with History_ buffer	Raw data, content controlled by RAW_CTRL register, or alternatively, history buffer (see Below)	RAW data
144 (LSB) 145 (MSB)	Int			
Etc.	Int			

Table 10.3: touching register (R0)

Bit 0,1,2	Nb of fingers touching (NBF)
Bit 3	Noise flag (indicates the report is unreliable) (NOI)
Bit 4	Message flag (indicates a message string is sent by slave) (MSG)
Bit 5	Buffer indicates the master has missed more than 2 reports, which are stored in buffer array (BUF)
Bit 6	Palm flag (indicates the algorithm has a palm or similar blocking issue) (PAL)
Bit 7	Water flag, indicates the algorithm has a rejected inputs due to water (WAT)

10.7.3 RAW_CTRL write & read

It is advised to use INT mode=0x08 when debug information are consulted (RAW_CTRL register not zero). Also, the slave can not instantly refresh the RAW tables following a modification by the master to the RAW_CTRL register, since in some conditions a relatively lengthy collection of measurements has to be performed. The master however can have the guaranty that the data reported in the RAW table reflects the request placed in RAW_CTRL if 2 INT pulses have elapsed. If the request in RAW_CTRL is unchanged, to every new INT pulse corresponds a refresh of the RAW table.

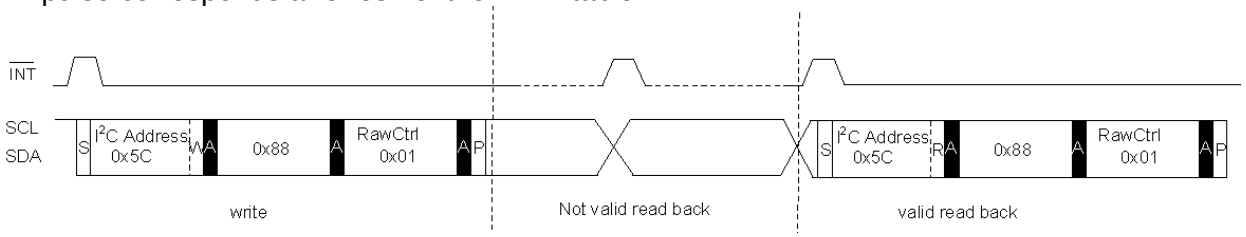


Figure 11.9: RAW_CTRL write & read

Table 10.4: RAW_CTRL (R136, 137)

Bit 0	Choose function (0: history buffer, 1: RAW data, 2: system info) See table 12.5
Bit 1	
Bit 2	Method (0 or 1)
Bit 3	Show offset correction (and low-pass filtering for M0)
Bit 4	Show m0 sensitivity adjustment (bit3 must also be set)
Bit 5	M1 pattern small (0) or pattern large (1)
Bit 6	M1 sense direction (0:Y,1:X)
Bit 7	M1 band scan. if 0, only report a single cross node. If 1,report a full X axis scan at RAW position
Bit 8	Disable Algorithm
Bit 9	Enable single shot RAW refresh, must be set to 1 and bit9 to 0. Auto back to 0 and bit9 to 1 after single shot is done
Bit 10	Refresh frozen after single shot is done when 1. Set to 0 to release the freeze and go back to normal refreshing
Bit 11	
Bit 12	
Bit 13	
Bit 14	
Bit 15	

Table 10.5: History buffer registers

Address	Type	Name	Description	Category
142	Char	Interval	Sub sampling rate when filling the history buffer. Disable: 0. Keep all points. 1. Keep one out of two. 2. Etc.	History buffer
143	Char	Buffer_ level	Number of fingers report in the buffer	
144 (LSB) 145 (MSB)	Int	Pos X	Coordinate X of the reported point, at time=0	
146 (LSB) 147 (MSB)	Int	Pos Y	Coordinate Y of the reported point, at time=0	
148 (LSB) 149 (MSB)	Int	Pos X	Coordinate X of the reported point at time=1	
150 (LSB) 151 (MSB)	Int	Pos Y	Coordinate Y of the reported point at time=1	

298 (LSB) 299 (MSB)	Int	Pos X	Coordinate X of the reported point, at time=19	
300 (LSB) 301 (MSB)	Int	Pos Y	Coordinate Y of the reported point, at time=19	

10.7.4 Power_ mode register

The POWER_MODE register controls the power management and operation of the controller. However, modification becomes effective at any time. There are shown in the table 10.6.

Table 10.6: Power_ mode register (R51)

Bit	Name	Description
7-3	--	Not used
2	ALLOW_SLEEP	Allow self demotion from active to sleep mode, provide that this flag is set. If the controller is in active mode and no finger is detected for more than IDLE_PERIOD time, then it allow automatically jumps to sleep mode. If this flag is not set, the host must explicitly switch the device from active to sleep mode.
1-0	POWER_MODE[1-0]	Power mode setting: 00: Active Mode 01: Sleep Mode 11: Freeze Mode

10.7.5 INT_ mode register

The slave can set the INT line, and host can read and write controller device, so the controller behaves like an I^2C slave device and fully complies with I^2C addressing and usual I^2C hand shake protocol. As such, controller is suitable in a bus shared with other I^2C slaves.

Table 10.7: INT_ mode register (R52)

Bit	Name	Description
7-4	-	Not used
3	EN_INT	0:disable interrupt mode 1:enable interrupt mode
2	INT_POL	0:the interrupt is low active(default) 1:the interrupt is high-active
1-0	INT_MODE[1-0]	00:INT assert periodically 01:INT assert only when finger moving(default) 10:INT assert only when finger touch 11: INT pulse assert only when finger touch

When INT_MODE=00 in the INT mode register, the slave will set the INT line with INT_ width pulse width after each scan in order to request the attention from the host, as shown in figure 11.10 and figure 10.11.

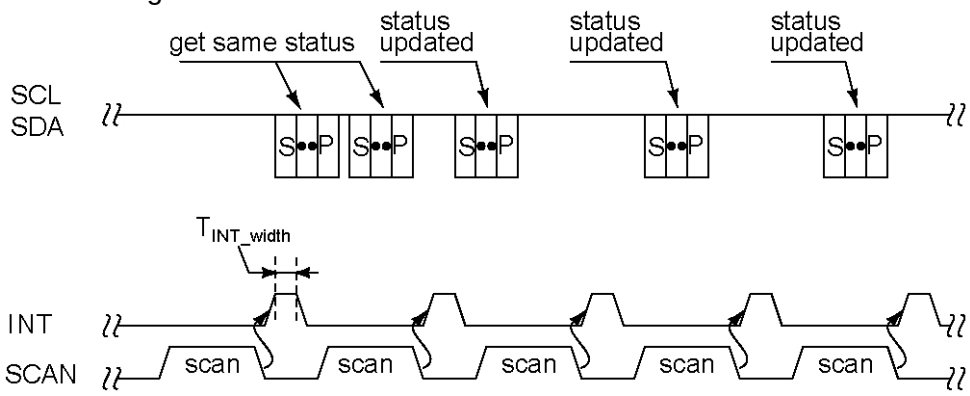


Figure 11.10: INT line pull up by slave (INT_POL=1,INT_MODE=00 in the INT mode register)

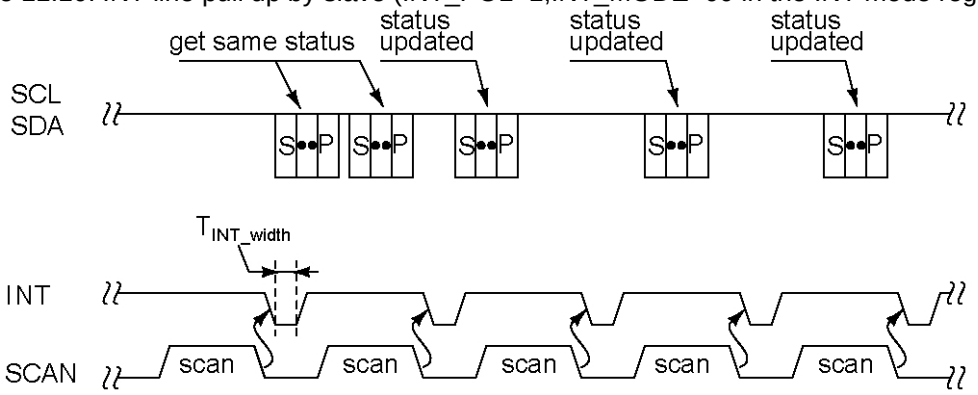


Figure 11.11: INT line pull down by slave (INT_POL=0, INT_MODE=00 in the INT mode register)

When INT_Mode=01 in the INT mode register and finger moving on the panel, the slave will set the INT line after each scan, as shown in figure 10.12. When finger leaves the panel, the slave will continue to pulse INT line for each scan; but once the master has serviced this request and become now aware that there is no more finger touching, the slave will stop pulse the INT line, and will also gradually reduce the scan speed, as shown in figure 10.12.

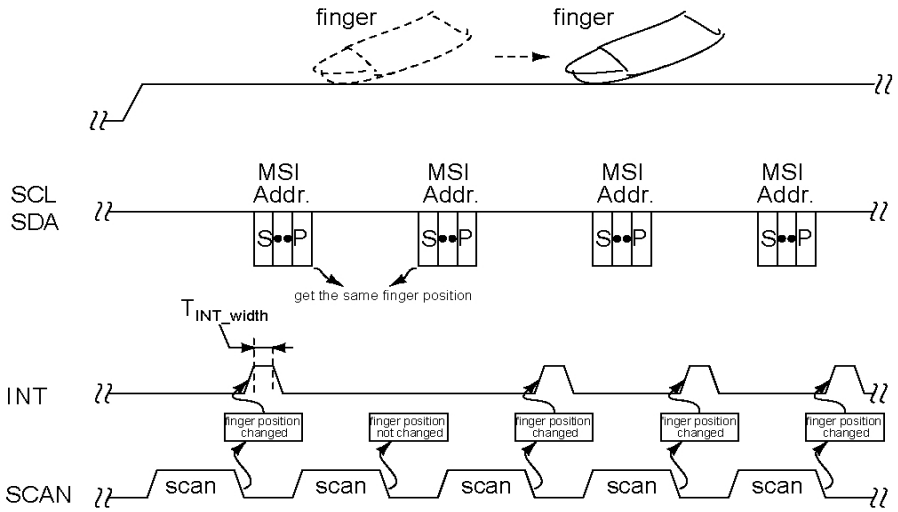


Figure 10.12: INT line pull up when finger moving (INT_POL=1, INT_MODE=01 in the INT mode register)

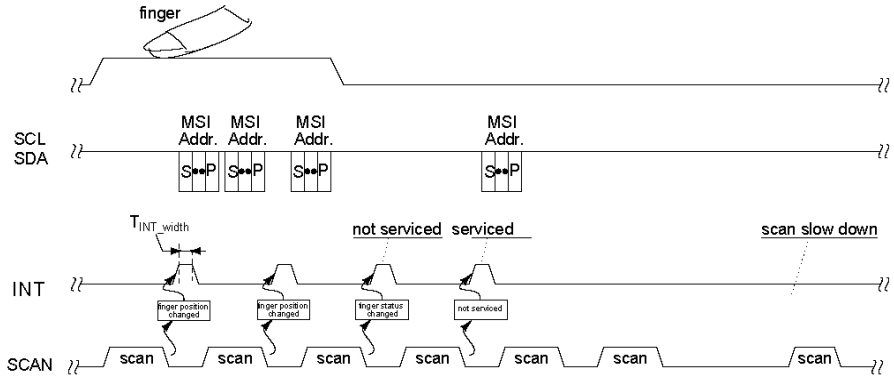


Figure 10.13: INT line will stop pulse when finger leaves and master has acknowledged the situation (INT_POL=1 in the INT mode register)

When INT_Mode=10 in the INT mode register and finger touch the panel, the slave will set the INT line after each scan, as shown in figure 10.14. When finger leaves the panel, the slave will continue keep INT line status for each scan; but once the master has serviced this request and become now aware that there is no more finger touching, the slave will release the INT line, and will also gradually reduce the scan speed, as shown in figure 10.15 .

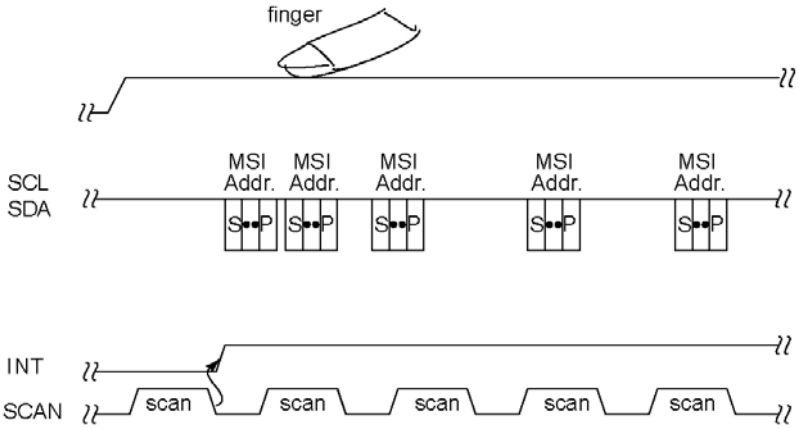


Figure 10.14: INT line pull up when finger touch (INT_POL=1, INT_MODE=10 in the INT mode register)

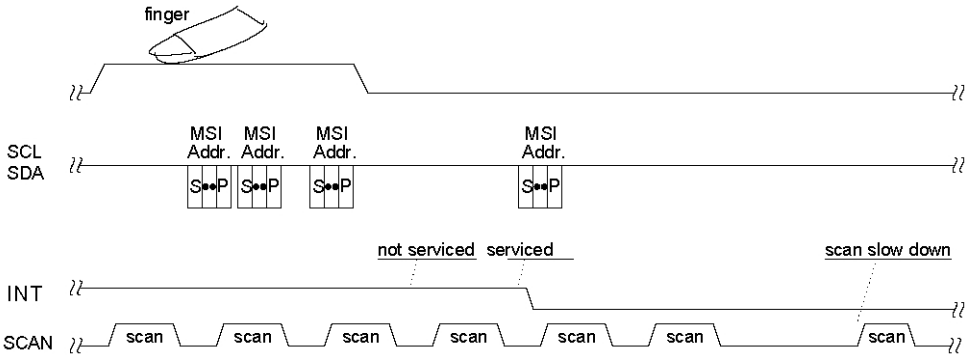


Figure 10.15: INT line will reset level when finger leaves and master has acknowledged the situation (INT_POL=1 in the INT mode register)

The only difference is send INT pulse instead of level between INT_ Mode=10 to INT_ Mode =11.

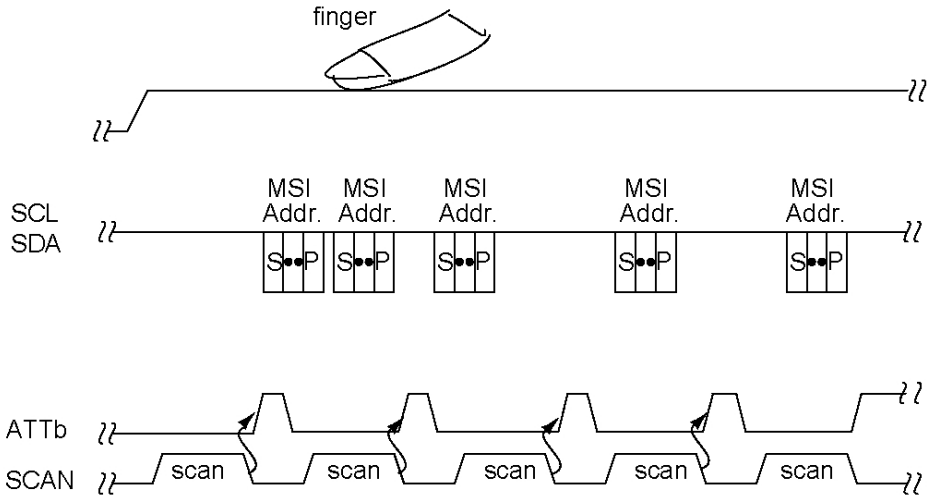


Figure 11.16: INT line pull up when finger touch (INT_POL=1, INT_MODE=11 in the INT mode register)

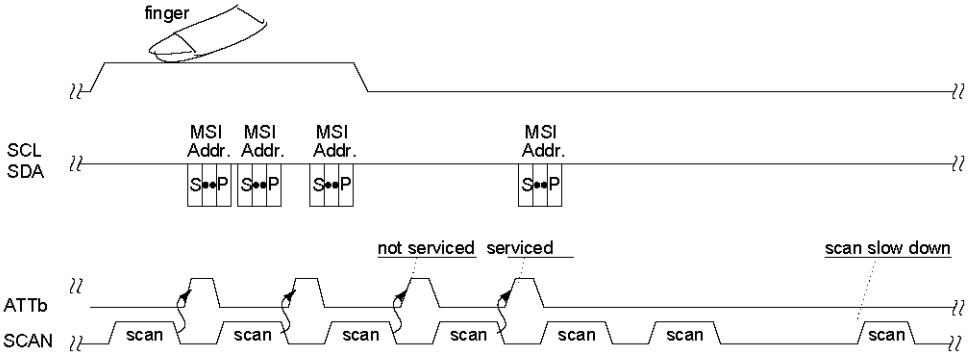
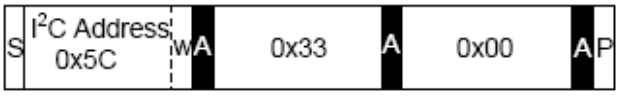


Figure 10.17: INT line will stop pulse when finger leaves and master has acknowledged the situation (INT_POL=1 in the INT mode register)

10.8 Power management

Active mode

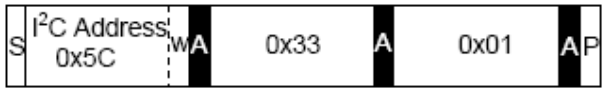
In this mode, the slave resumes with a new scan directly after each I²C transfer (after INT rising edge). This is used to reach the highest refresh rate (reach to 400Hz), but also has the highest current consumption. Below is shows how to force the slave into Active mode.



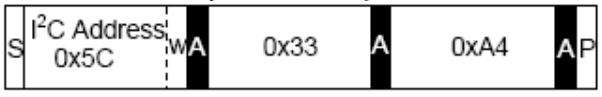
Active mode sequence

Sleep mode

This mode is selected to decrease the current consumption during low activity phases on the sensor, which need a lower refresh rate (10Hz or can be controlled by **Sleep_ freq** in table 10.2). The controller does automatically switch to Active mode when finger is detected or by setting the POWER_MODE register to Active mode. Also, the controller can automatically switch from Active to Sleep mode when no finger is detected for more than IDLE_PERIOD time, provided that ALLOW_SLEEP bit is set in the POWER_MODE register. Below are shows how to force the slave into Sleep mode and force the slave to switch automatically into Sleep mode (set ALLOW_SLEEP bit in POWER_MODE register).



Sleep mode sequence

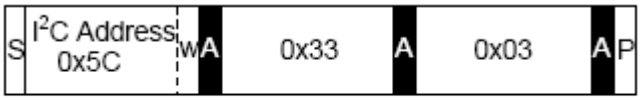


Sleep mode automatically switch sequence

Freeze mode

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

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

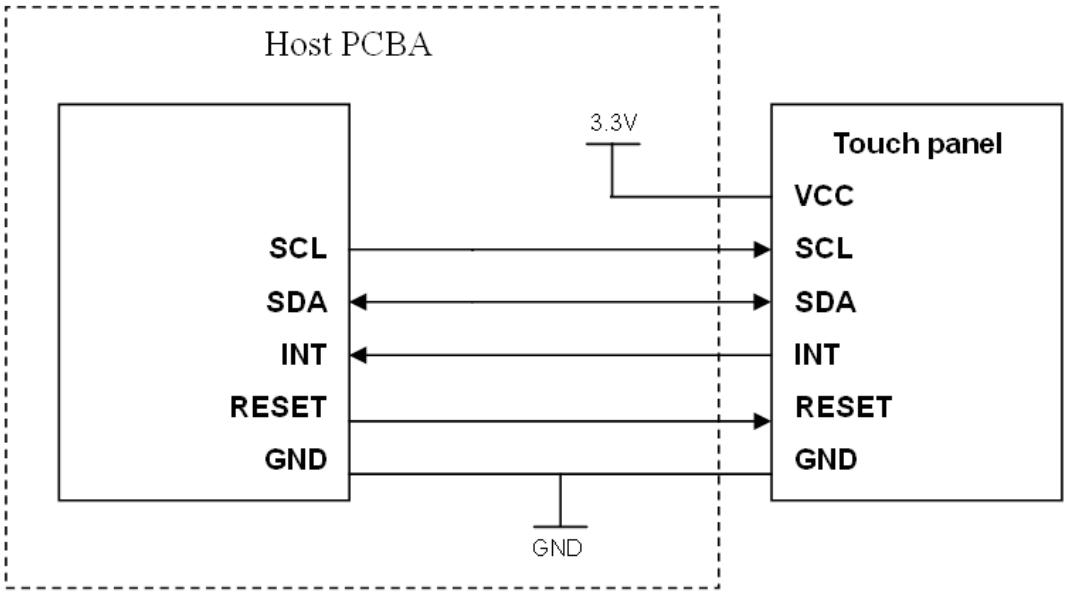


Freeze mode sequence

10.9. PIN CONNECTIONS

No.	Name	I/O	Description
1	VDD1	P	Power
2	GND	P	Ground
3	RST	I	Reset, **active high**
4	SCL	I	I^2C clock input
5	SDA	I/O	I^2C data signal
6	INT	O	Interrupt output
7	NC	--	No connect
8	NC	--	No connect

10.10. BLOCK DIAGRAM



Note : 1. To reduce the noise from the power, we suggest you use the independent power for the touch panel (VDD1)

11. QUALITY ASSURANCE

11.1 Test Condition

11.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : 20 ± 5°C

Humidity : 65 ± 5%

11.1.2 Operation

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

11.1.3 Container

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

11.1.4 Test Frequency

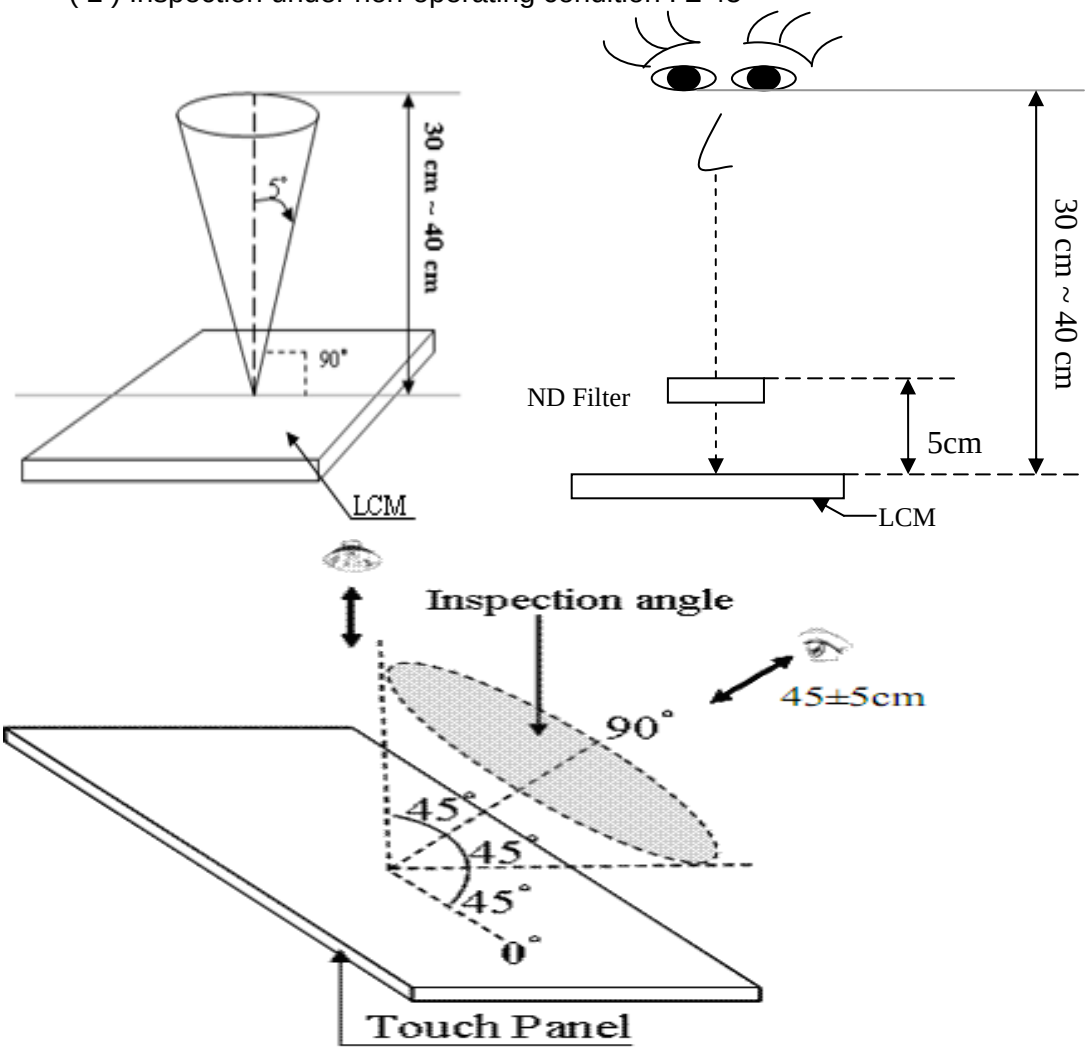
In case of related to deterioration such as shock test. It will be conducted only once.

11.1.5 Test Method

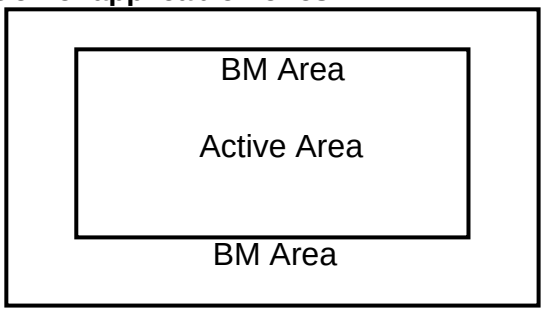
No.	Reliability Test Item & Level	Test Level	Remark
1	High Temperature Storage Test	T=80°C,240hrs	IEC68-2-2
2	Low Temperature Storage Test	T=-30°C,240hrs	IEC68-2-1
3	High Temperature Operation Test	T=70°C,240hrs	IEC68-2-2
4	Low Temperature Operation Test	T=-20°C,240hrs	IEC68-2-1
5	High Temperature and High Humidity Operation Test	T=60°C,90% RH,240hrs	IEC68-2-3
6	Temperature Cycle Test (No operation)	-30°C → +25°C → +80°C,50 Cycles 30 min 5min 30 min	IEC68-2-14
7	Vibration Test (No operation)	Frequency:10 ~ 55 Hz Amplitude:1.0 mm Sweep Time:11min Test Period:6 Cycles for each Direction of X,Y,Z	IEC68-2-6
8	Shock Test (No operation)	100G, 6ms Direction：± X,± Y,± Z Cycle：3 times	IEC68-2-27

12. APPEARANCE SPECIFICATION

12.1.1 Temperature: 25± 5℃
12.1.2 Humidity: 55 ± 10% RH
12.1.3 Light source: Fluorescent Light
12.1.4 Inspection: Viewing distance: 35±5cm
12.1.5 Ambient Illumination:
(1) Cosmetic Inspection: 500 ~ 800 lux
(2) Functional Inspection: 400 ~ 600 lux
12.1.6 Inspection View angle:
(1) Inspection under operating condition : ±5°
(2) Inspection under non-operating condition : ± 45°



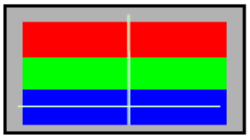
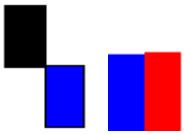
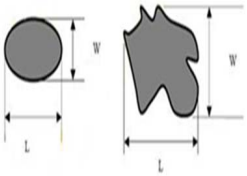
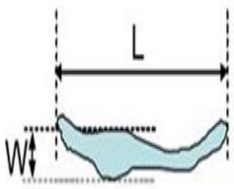
12.2 Definition of applicable Zones

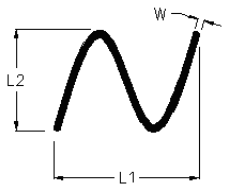
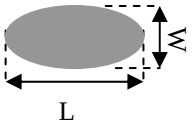


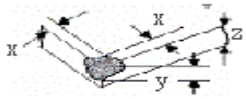
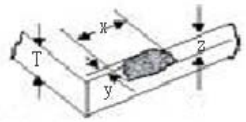
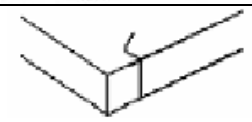
12.3 Judgment standard

The Judgment of the above test should be made after exposure in room temperature for two hours as follow:
Pass: Normal display image with no obvious non-uniformity and no line defect. Partial transformation of the module parts should be ignored.
Fail: No display image, obvious non-uniformity, or line defect.

12.4 Cosmetic Specification and Inspection Items

<table>
<tr><th>Inspection Item</th><th>Inspection Criteria</th><th>Illustration</th></tr>
<tr><td>Display function</td><td>No Display malfunction</td><td>  </td></tr>
<tr><td>Contrast ratio</td><td>Does not meet specified range in the spec.</td><td>(Major) (Note:2)</td></tr>
<tr><td>Line Defect</td><td>No obvious Vertical and Horizontal line defect in black and White.</td><td>  </td></tr>
<tr><td>Point Defect</td><td>
<table>
<tr><th rowspan="2">Item</th><th>Acceptable number</th><th rowspan="2">Total</th></tr>
<tr><th>Active Area</th></tr>
<tr><td>Bright</td><td>2</td><td rowspan="2">5</td></tr>
<tr><td>Dark</td><td>4</td></tr>
<tr><td>Two adjacent dot</td><td>2</td><td>2</td></tr>
</table>
</td><td>One Dot
 
Two adjacent dot
  </td></tr>
<tr><td>Foreign material (Black or White spots shape)</td><td>
<table>
<tr><th>Zone / Dimension</th><th>Acceptable number</th><th>Class of Defects</th></tr>
<tr><td>D> 0.8 mm</td><td>0</td><td rowspan="3">Minor</td></tr>
<tr><td>0.3mm ≦D≦ 0.8 mm</td><td>5</td></tr>
<tr><td>D< 0.3mm</td><td>*</td></tr>
</table>
</td><td> 
D= (L + W) / 2</td></tr>
<tr><td>Foreign Material (Line shape)</td><td>
<table>
<tr><th>Zone / Dimension</th><th>Acceptable number</th><th>Class of Defects</th></tr>
<tr><td>W> 0.1mm or L >10mm</td><td>0</td><td rowspan="3">Minor</td></tr>
<tr><td>0.05 mm≦W≦0.1 mm
L ≦10mm</td><td>5</td></tr>
<tr><td>W< 0.05mm</td><td>*</td></tr>
</table>
</td><td> 
L : Long W : Width</td></tr>
<tr><td>Non-uniformity</td><td>Visible through 2 %ND filter White, R, G, B and gray 50% pattern.</td><td>(Minor)</td></tr>
<tr><td>Dimension</td><td>Outline</td><td>(Major)</td></tr>
<tr><td>Bezel appearance</td><td>uneven</td><td>(Minor)</td></tr>
</table>

<table>
<tr>
<td>Scratch on the Touch panel</td>
<td>
<table>
<tr><th>Zone / Dimension</th><th>Acceptable number</th><th>Class of Defects</th></tr>
<tr><td>W> 0.1mm or L >10mm</td><td>0</td><td rowspan="2">Minor</td></tr>
<tr><td>W≦0.1 mm
L≦10mm</td><td>5</td></tr>
</table>
</td>
<td> 
</td>
</tr>
<tr>
<td>Dent on the Touch panel</td>
<td>
<table>
<tr><th>Zone / Dimension</th><th>Acceptable number</th><th>Class of Defects</th></tr>
<tr><td>D> 0.8 mm</td><td>0</td><td rowspan="2">Minor</td></tr>
<tr><td>0.3mm ≦D≦ 0.8 mm</td><td>5</td></tr>
</table>
</td>
<td> 

D= (L + W) / 2</td>
</tr>
<tr><td>Polarizer flaw or leak out resin</td><td>Defect is defined as the active area.</td><td></td></tr>
<tr><td>Corner Chipping</td><td>X<3 mm, Y<3 mm, Z< Glass thickness</td><td> 
</td></tr>
<tr><td>Edge Chipping</td><td>X<3 mm, Y<3 mm, Z< Glass thickness</td><td> 
</td></tr>
<tr><td>Crack</td><td>reject</td><td>  </td></tr>
</table>

12.5 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

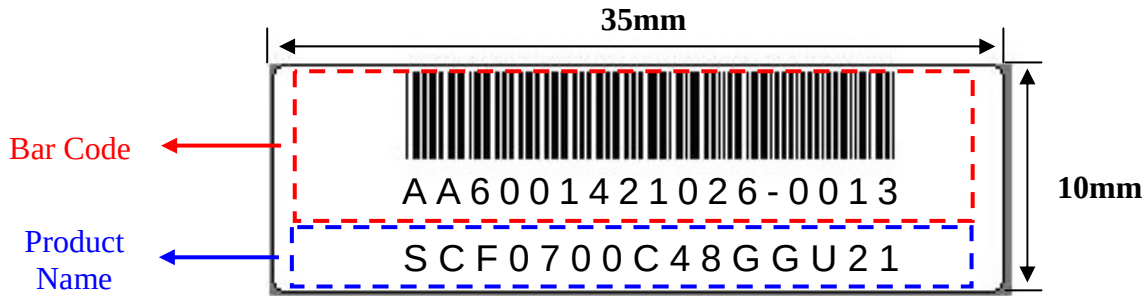
Class of defects	Definition		
	Major	AQL 0.65%	It is a defect that is likely to result in failure or to reduce materially the usability of the product for the intended function.
	Minor	AQL 1.5%	It is a defect that will not result in functioning problem with deviation classified.

Note:1.(a)Bright point defect is defined as point defect of R,G,B with area >1/2 pixel respectively
(b)Dark point defect is defined as visible in full white pattern.
(c)Definition of distribution of point defect is as follows:
-minumum separation between dark point defects should be larger than 5mm.
-minumum separation between bright point defects should be larger than 5mm.
(d)Definition of joined bright point defect and joined dark point defect are as follows:
- Three or more joined bright point defects must be nil.
- Three joined dark point defects must be nil.
- Two Joined dark point is counted as two dark points with 2 pair maximum.
(e) Line defect is defined as visible by using 5 % ND filter.

Note:2 Luminance measurement for contrast ratio is at the distance 50± 5cm between the detective head and the panel with ambient illuminance less than 1 lux. Contrast ratio is obtained at optimum view angle.

13. PRODUCT LABEL DEFINE

Product Label style:

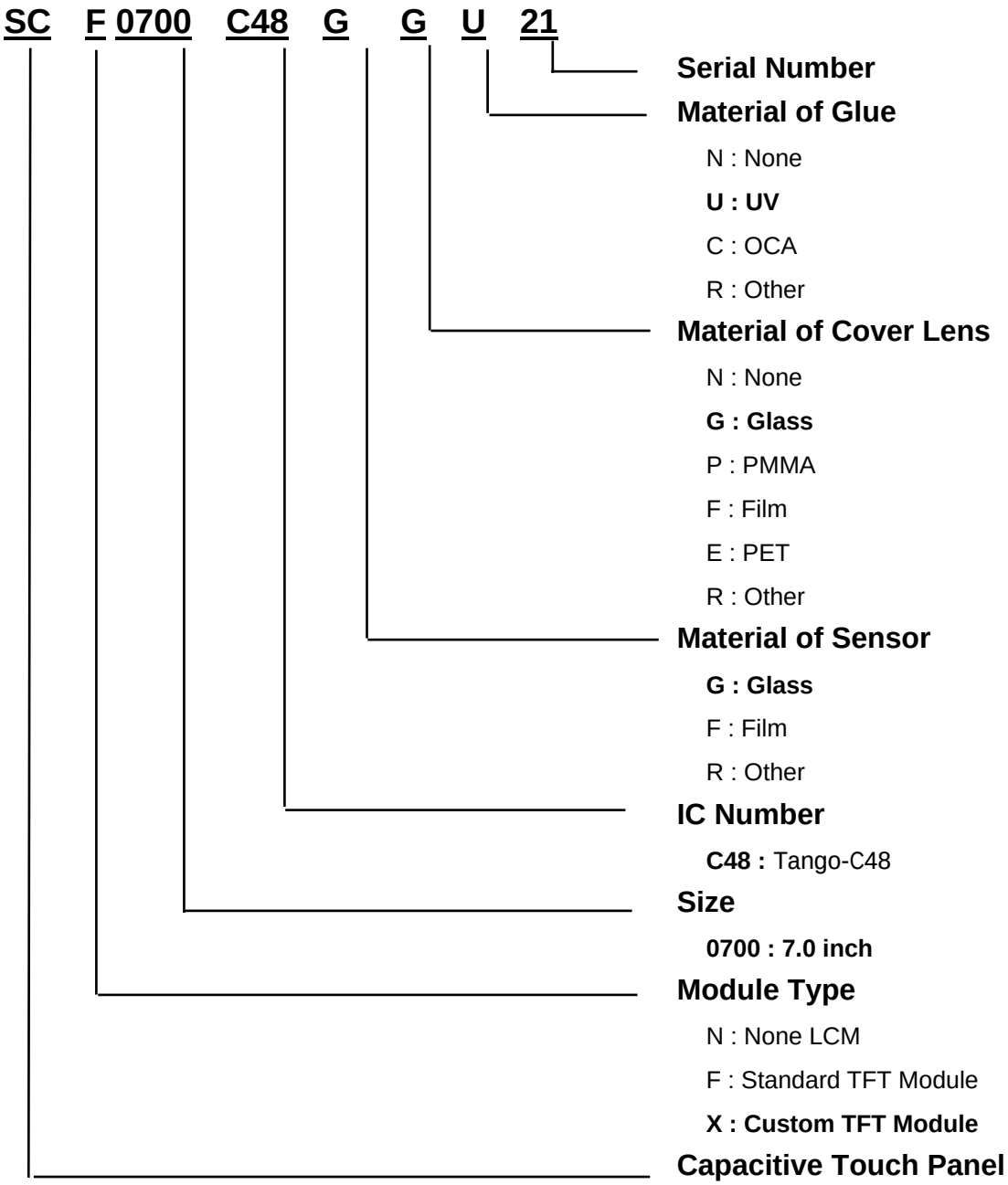


BarCode Define:

A A 6 0014 2 10 26-0013

- Serial number of the products
  Serial number starts from 0000
  Every work order is 10K at most
- Week of production
- Year of production
- Storage area
- Serial number of work order
  Serial number starts from 0000 each month
- Month of work order
- Year of work order
- The first 3 numbers of work order

Product Name Define:

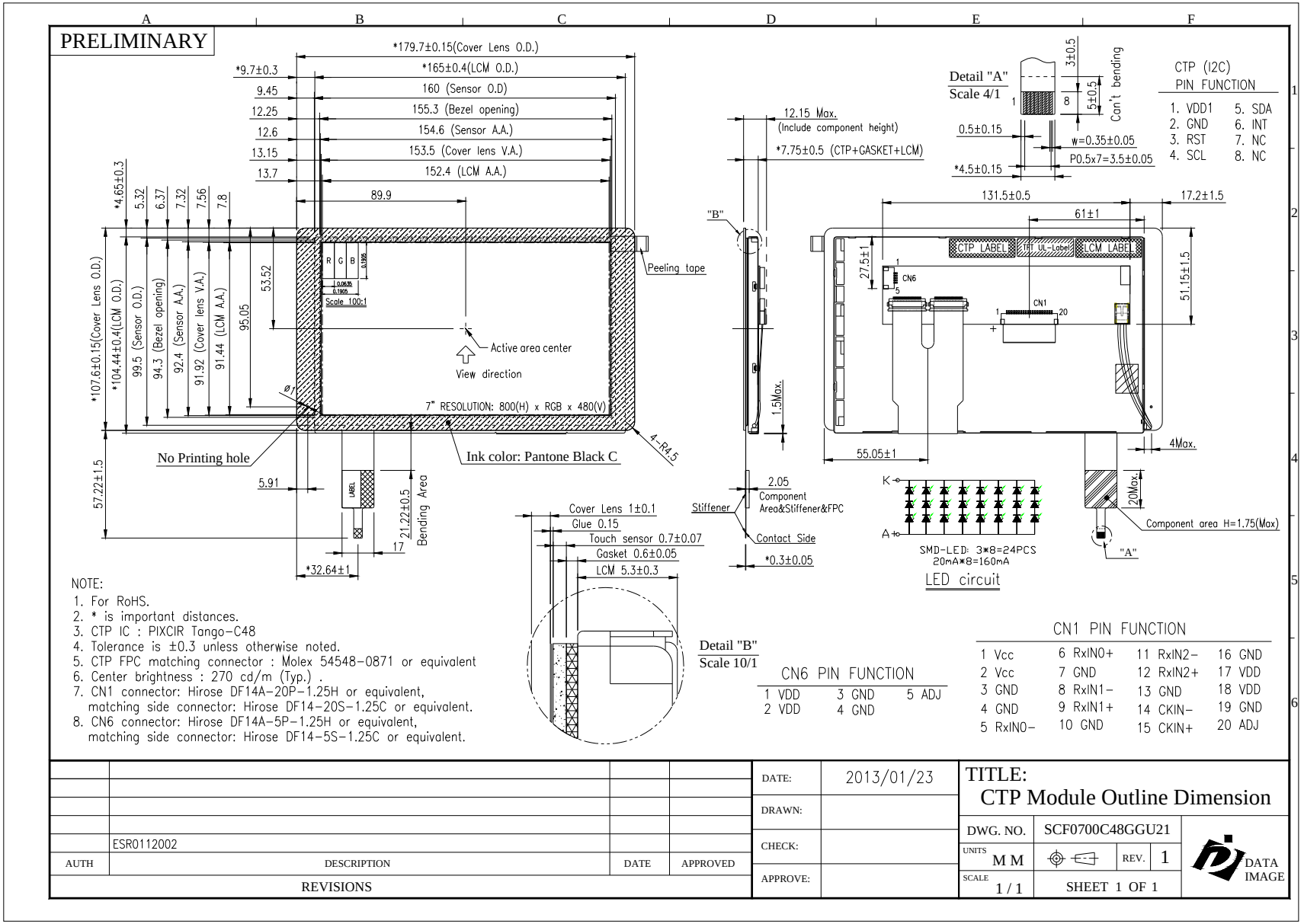


14. PRECAUTIONS IN USE LCM

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
   (1) 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 Land 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.)
6. LIMITED WARRANTY

Unless otherwise agreed between DATA IMAGE and customer, DATA IMAGE will replace or repair any of its LCD and LCM 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.

15. OUTLINE DRAWING



NOTE:
1. For RoHS.
2. * is important distances.
3. CTP IC : PIXCIR Tango-C48
4. Tolerance is ±0.3 unless otherwise noted.
5. CTP FPC matching connector : Molex 54548-0871 or equivalent
6. Center brightness : 270 cd/m (Typ.) .
7. CN1 connector: Hirose DF14A-20P-1.25H or equivalent, matching side connector: Hirose DF14-20S-1.25C or equivalent.
8. CN6 connector: Hirose DF14A-5P-1.25H or equivalent, matching side connector: Hirose DF14-5S-1.25C or equivalent.

CN6 PIN FUNCTION

1 VDD	3 GND	5 ADJ
2 VDD	4 GND	

CN1 PIN FUNCTION

1 Vcc	6 RxIN0+	11 RxIN2-	16 GND
2 Vcc	7 GND	12 RxIN2+	17 VDD
3 GND	8 RxIN1-	13 GND	18 VDD
4 GND	9 RxIN1+	14 CKIN-	19 GND
5 RxIN0-	10 GND	15 CKIN+	20 ADJ

AUTH	DESCRIPTION	DATE	APPROVED
	ESR0112002		

REVISIONS

DATE:	2013/01/23
DRAWN:	
CHECK:	
APPROVE:	

TITLE: CTP Module Outline Dimension

DWG. NO.	SCF0700C48GGU21		
UNITS M M		REV.	1
SCALE 1 / 1	SHEET 1 OF 1		

DATA IMAGE

16. PACKAGE INFORMATION

TBD