Integrated PCAP Touch TFT Display Modules

Product Specification
Part No. SCF0700C48GGU33
7.0” WVGA Ultra-Wide Viewing Angle
TFT Display with PCAP Touchscreen

Version 1

For more information, please visit www.andersdx.com
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Interfaces to Inspire

Confidential Document

TFT Module Specification

Preliminary

ITEM NO.: SCF0700C48GGU33

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Customer Companies	R&D Dept.	Q.C. Dept.	Eng. Dept.	Prod. Dept.
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2. RECORD OF REVISION

Rev	Date	Item	Page	Comment
1	10/OCT/13’			Initial PRELIMINARY

3. GENERAL SPECIFICATIONS

Composition: 7inch 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 (diagonal)	inch
Display Format	800(H) x (R,G,B) x 480(V)	dot
LCD Active Area	152.4(H) x 91.44(V)	mm
CTP Active Area	154.6(H) x 92.4(V)	mm
Dot Pitch	0.0635(H) x 0.1905(V)	mm
Pixel Configuration	Stripe	
Outline Dimension	199.5(H) x 139.5(V) x 8.7(D)	mm
Surface treatment	Clear and hardness 7H	
Back-light	LED	
Display mode	Normally white	
Weight	TBD	g
View Angle direction	All	
Our components and processes are compliant to RoHS standard		

4. LCD ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	MIN.	MAX.	Unit	Remark
Power supply voltage		Vcc	-0.3	7	V	Ta=25°C
Logic input voltage		VI	-0.3	V_{CC}+0.3	V	
Operating temperature		Top	-20	70	°C	Module surface*
Storage temperature		Tst	-30	80	°C	-
Humidity	Operation	20%~90% relative humidity				Ta<=38°C
	Non Operation	5%~90% relative humidity				Ta<=38°C

5. LCD ELECTRICAL CHARACTERISTICS

GND=0V, fH=31.5KHz, fV=60Hz,

fCLK=33.26MHz,Ta=25°C

Parameter	Symbol	MIN.	Typ.	MAX.	Unit	Remark
Power Supply voltage	V_{CC}	3.0	3.3	3.6	V	
Power Supply Current	I_{CC}		150	200	mA	V_{CC} =3.3V
Power Supply voltage for LED	VDD	3.0	3.3	5.5	V	
Power Supply Current for LED	IDD	-	650	850	mA	V_{DD} =3.3V
		-	400	550	mA	V_{DD} =5.0V
Ripple voltage	V_{RF}	-	-	100	mV_{P-P}	
“H” level logical input voltage	V_{IH}	0.7Vcc	-	Vcc	V	
“L” level logical input voltage	V_{IL}	0	-	0.3Vcc	V	
ADJ frequency		19K	20K	21K	Hz	
ADJ input voltage	VIH	3.0	-	3.3	V	
	VIL	0	-	0.3	V	
LED life time		20,000	30,000	-	Hr	

6. INPUT SIGNAL CHARACTERISTICS

6.1 AC Characteristics

6.1.1 AC Electrical Characteristics

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

6.1.2 Resolution：800x480

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT
CLK frequency	F_{CPH}	-	33.26	-	MHz
CLK period	T_{CPH}	-	30.06	-	ns
CLK pulse duty	T_{CWH}	40	50	60	%
DE period	$T_{DEH}+T_{DEL}$	1000	1056	1200	T_{CPH}
DE pulse width	T_{DH}	-	800	-	T_{CPH}
DE frame blanking	T_{HS}	10	45	110	$T_{DEH}+T_{DEL}$
DE frame width	T_{EP}	-	480	-	$T_{DEH}+T_{DEL}$

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT
OEV pulse width	T_{OEV}	-	150	-	T_{CPH}
CKV pulse width	T_{CKV}	-	133	-	T_{CPH}
DE(internal)-STV time	T_1	-	4	-	T_{CPH}
DE(internal)-CKV time	T_2	-	40	-	T_{CPH}
DE(internal)-OEV time	T_3	-	23	-	T_{CPH}
DE(internal)-POL time	T_4	-	157	-	T_{CPH}
STV pulse width	-	-	1	-	T_H

6.2 Timing Controller Timing Chart

6.2.1 Clock and Data input waveforms

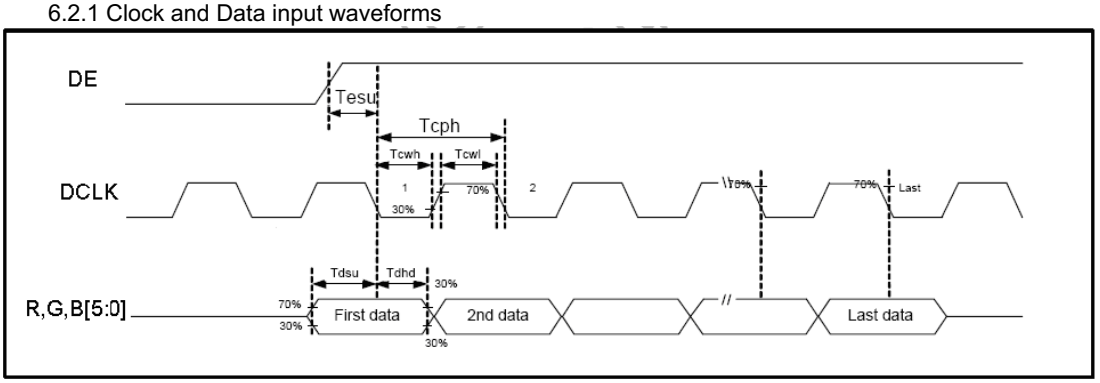


Figure 1 Clock and Data input waveforms.

6.2.2 DE Mode Data Format

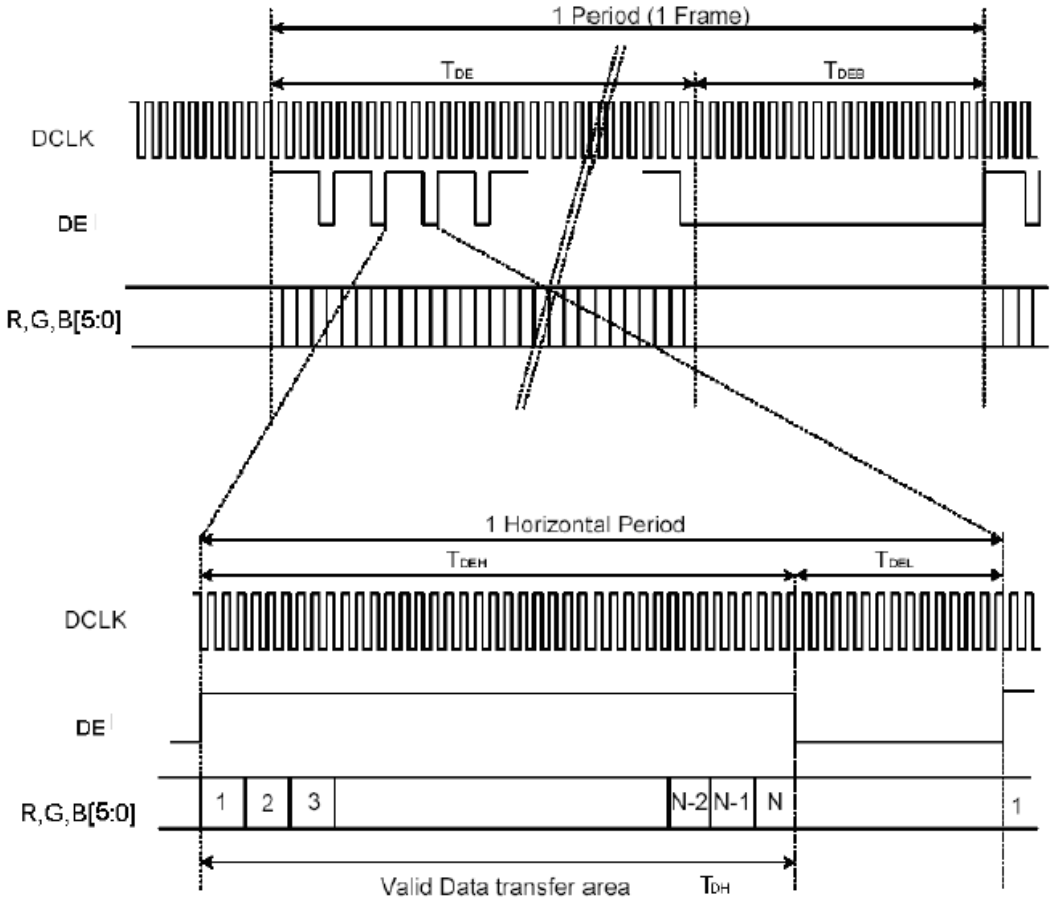


Figure 2 DE Mode Data Format

6.3 Color Data Input Assignment

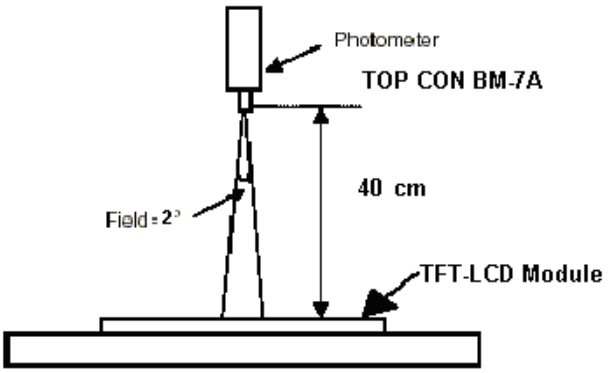
Color		Data Signal																	
		Red						Green						Blue					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	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

7. OPTICAL CHARACTERISTIC

Parameter		Symbol	Condition	MIN.	TYP.	MAX.	Unit	Remarks
Viewing Angle	Horizontal	θ_x+	Center CR≥10	70	80	--	deg	Note 1,4
		θ_x-		70	80	--		
	Vertical	θ_Y+		70	80	--		
		θ_Y-		70	80	--		
Contrast Ratio		CR	at optimized viewing angle	500	600			Note 1,3
Response time	Rise	Tr	Center θx=θy =0°	-	5	10	ms	Note 1,6
	Fall	Tf		-	15	20	ms	
Uniformity		B-uni	θx=θy =0°	70	-		--	Note1,5
Brightness		L	θx=θy =0°	-	400	--	cd/㎡	Note 1,2
Chromaticity		x_W	Center θx=θy =0°	0.268	0.318	0.368		Note 1,7
		y_W		0.289	0.339	0.389		
		x_R		0.525	0.575	0.625		
		y_R		0.310	0.360	0.410		
		x_G		0.281	0.331	0.381		
		y_G		0.521	0.571	0.621		
		x_B		0.099	0.149	0.199		
		y_B		0.088	0.138	0.188		
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:

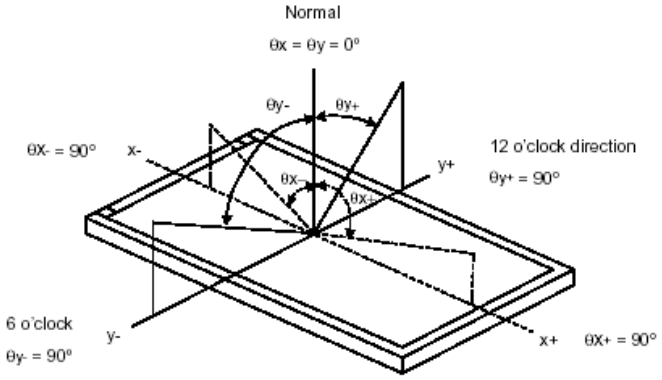


Note2: Measured at the center area of the panel and at the viewing angle of the θx=θy =0°

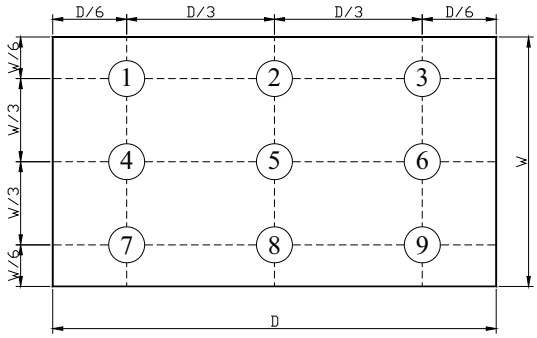
Note3: Definition of Contrast Ratio (CR):

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

Note4: Definition of Viewing Angle



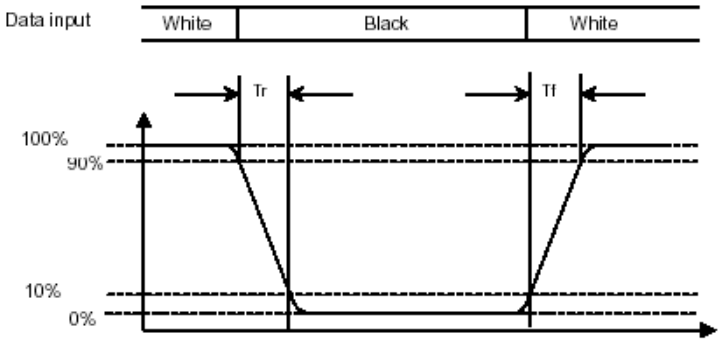
Note 5: Definition of Brightness Uniformity (B-uni):



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

Note6: Definition of Response Time:

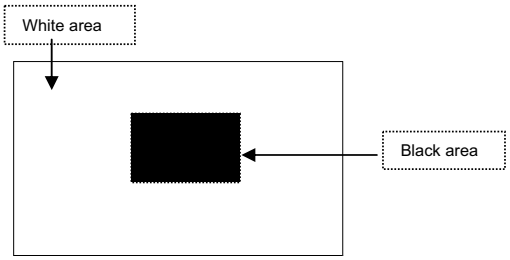
The Response Time is set initially by defining the “Rising Time (Tr)” and the “Falling Time (Tf)” respectively. Tr and Tf are defined as following figure.



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



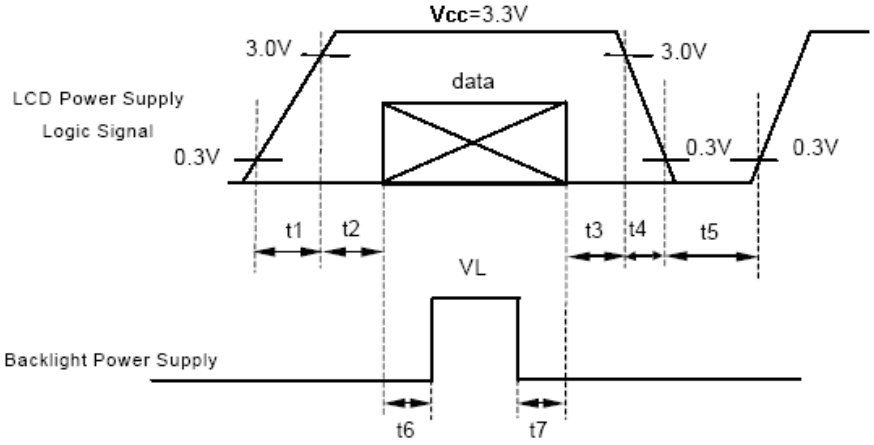
8. LCD PIN CONNECTIONS

Pin NO.	SYMBOL	DESCRIPTION
1	Vss	Power Ground
2	Vss	Power Ground
3	ADJ	Brightness control for LED B/L
4	VDD	Power Supply for LED Driver circuit
5	VDD	Power Supply for LED Driver circuit
6	VDD	Power Supply for LED Driver circuit
7	Vcc	Power Supply for Digital Circuit
8	Vcc	Power Supply for Digital Circuit
9	DE	Data Enable
10	Vss	Power Ground
11	Vss	Power Ground
12	Vss	Power Ground
13	B5	Blue Data 5 (MSB)
14	B4	Blue Data 4
15	B3	Blue Data 3
16	Vss	Power Ground
17	B2	Blue Data 2
18	B1	Blue Data 1
19	B0	Blue Data 0 (LSB)
20	Vss	Power Ground
21	G5	Green Data 5 (MSB)
22	G4	Green Data 4
23	G3	Green Data 3
24	Vss	Power Ground
25	G2	Green Data 2
26	G1	Green Data 1
27	G0	Green Data 0 (LSB)
28	Vss	Power Ground
29	R5	Red Data 5 (MSB)
30	R4	Red Data 4
31	R3	Red Data 3
32	Vss	Power Ground
33	R2	Red Data 2
34	R1	Red Data 1
35	R0	Red Data 0 (LSB)
36	Vss	Power Ground
37	Vss	Power Ground
38	DCLK	Clock Signals ; Latch Data at the Falling Edge
39	Vss	Power Ground
40	Vss	Power Ground

Remarks：

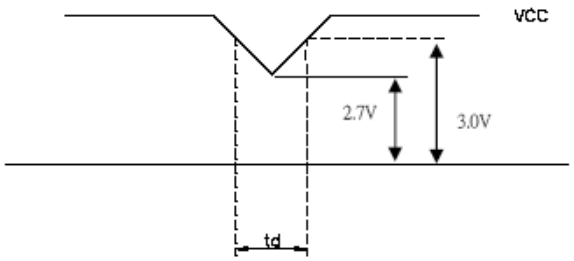
1) ADJ is brightness control Pin. The larger of the pulse duty is, the higher of the brightness.
2) ADJ signal is 0~3.3V.Operation frequency is 20KHz
3) VSS PIN must be grounding, can not be floating.

Remarks:
Power Signal sequence:
t1 ≤10ms ; 1 sec≤ t5
50ms≤ t2 ; 200ms ≤t6
0<t3 ≤50ms ; 200ms≤ t7
0<t4 ≤10ms

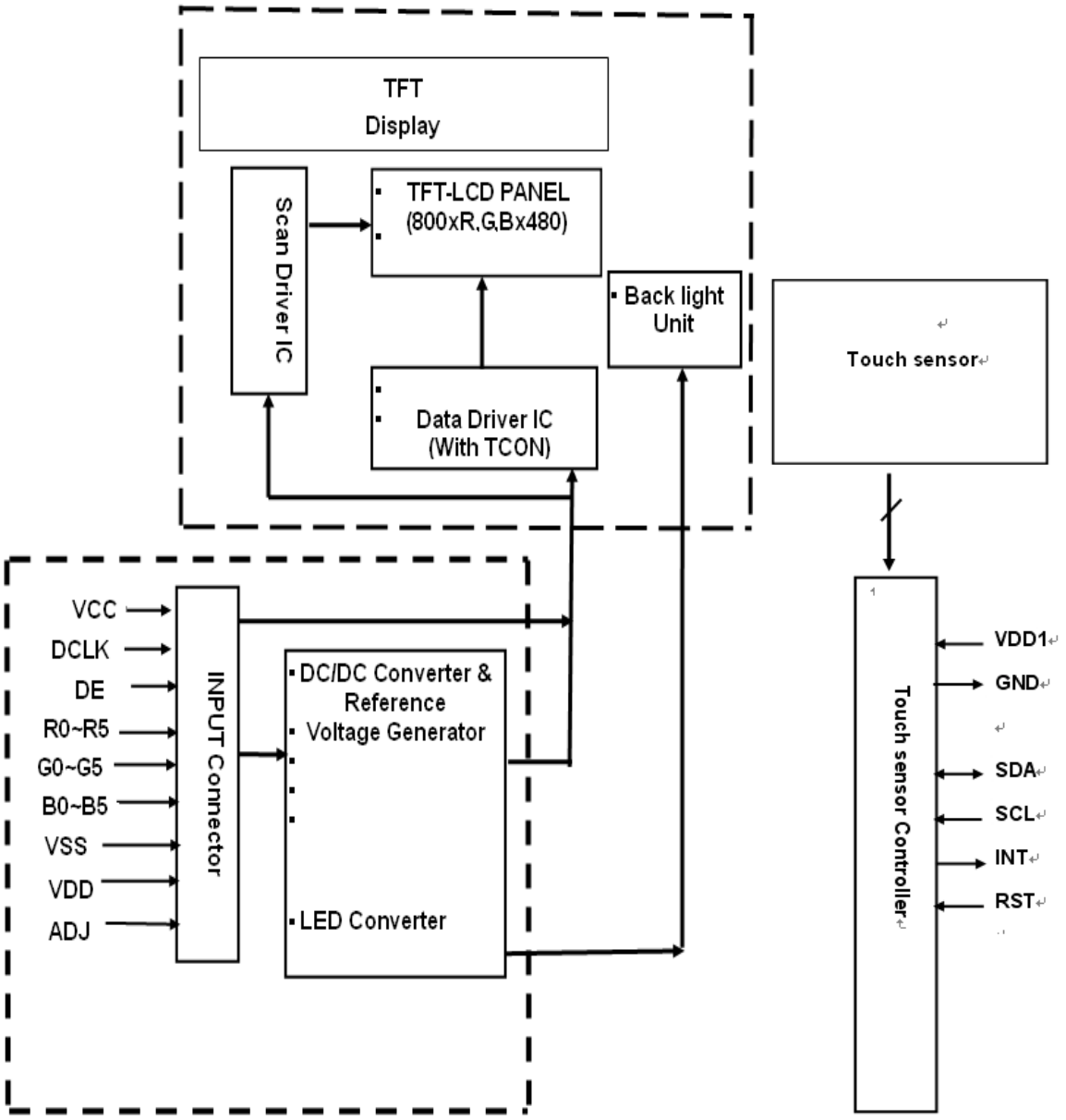


Data: RGB DATA, DCLK, DE

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. BLOCK DIAGRAM



10. CTP SPECIFICATIONS

10.1 ABSOLUTE MAXIMUM RATINGS

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

10.2 ELECTRICAL CHARACTERISTICS

Symbol	Description	Min	Typ	Max	Unit
VDD1	Supply voltage	2.5	3.3	3.6	V
GND	Supply voltage	-	0	-	V
VIH	Input H voltage	0.8VDD1	-	VDD1	V
VIL	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
Isleep	Sleep mode	0	10		-	0.11	mA
	Deep sleep mode	-			-	50	uA
Ifreeze	Freeze mode	-			-	2	uA
	Boot load	-			-	6.2	mA
	Calibration	-			-	6.2	mA

10.4 I^2C 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 I^2C master can't finish 1byte data in 100ms, I^2C slave will restart. The CTP controller operates only as a slave device. The I^2C 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 I^2C touch protocols. The timings for example that as table 10.1 and figure 10.1.
5. I^2C 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
TLOW	I²C clock low time	2 • TCPU			
THIGH	I²C clock high time	2 • TCPU			
THD,STA	I²C clock hold time	2 • TCPU			
TSU,STA	I²C start setup time				
TSU,STO	I²C stop setup time				
THD,DAT	I²C data hold time, when driven by master side				
TSU,DAT	I²C data setup time, when driven by master side				
TBUF	I²C bus free time	4.7			us
TCSR	I²C clock stretching release time	9 • TCPU			
TVD,DAT	I²C data valid after clock change, when data is driven by slave side	9 • TCPU			
TTCPU	CPU master clock period			55	ns

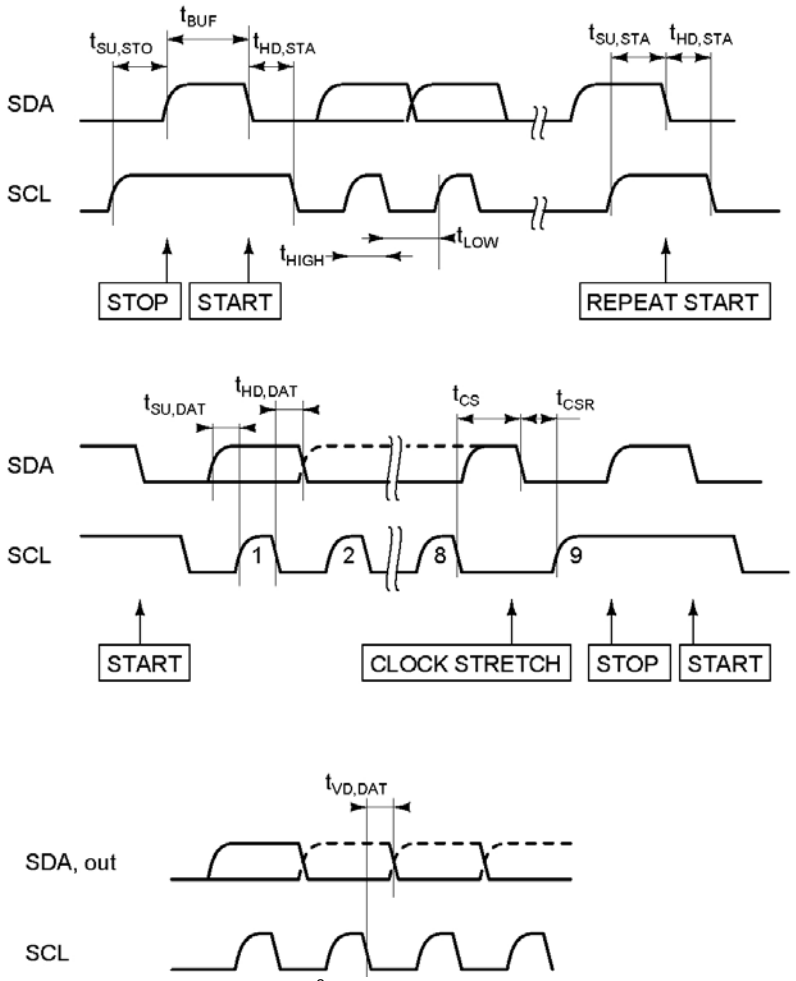


Figure 11.1: I²C clock stretching example

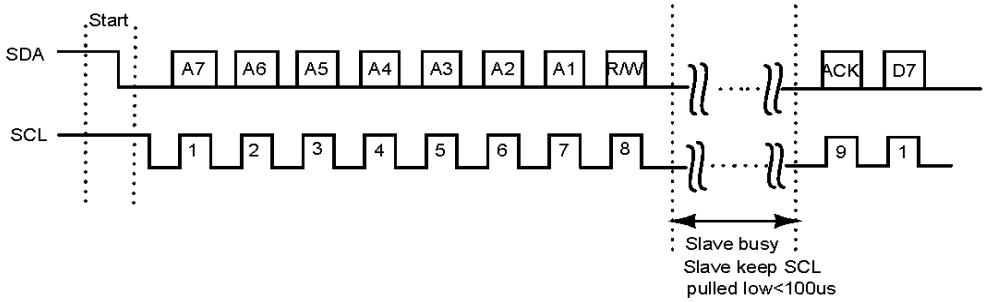


Figure 11.2: I²C clock stretching example

10.5. Data Protocol

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

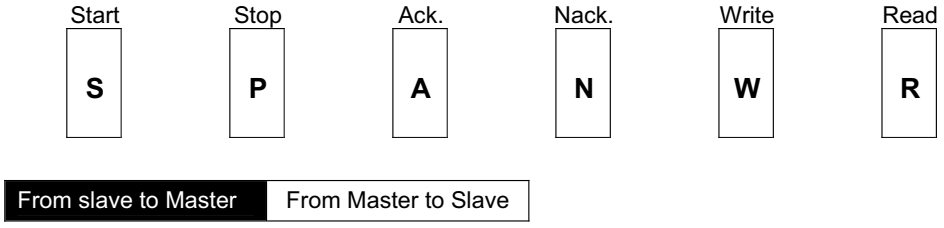


Figure 10.3: I²C symbols

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

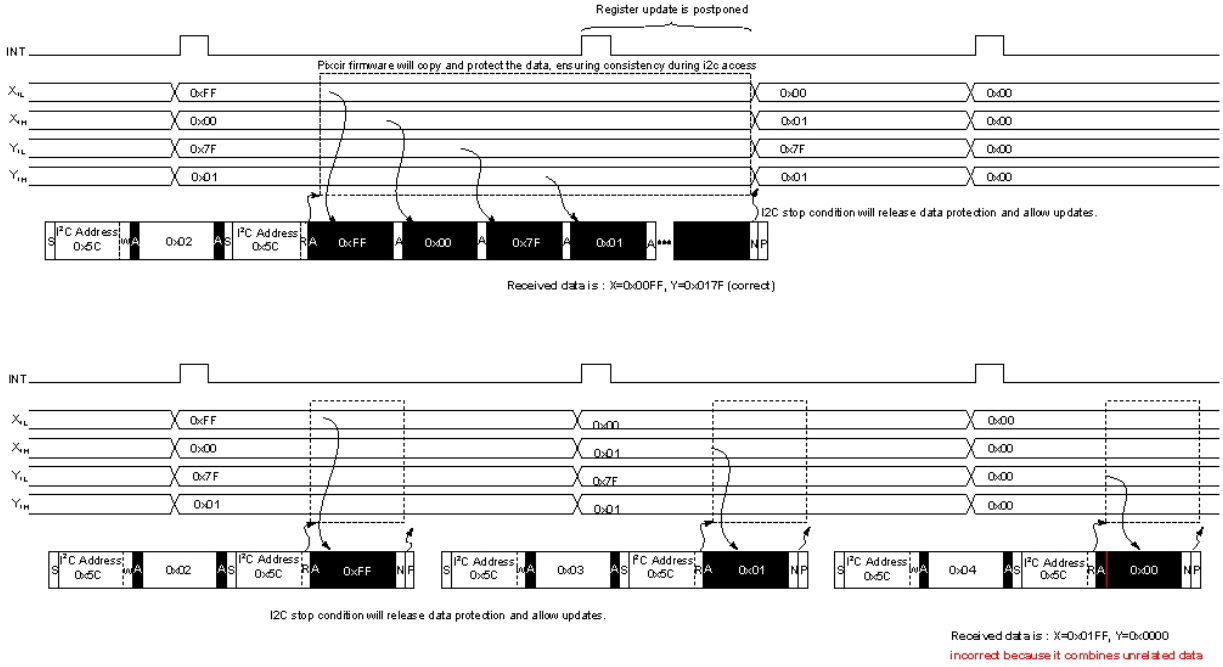


Figure 10.6: Coordinates read operation explanation

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.

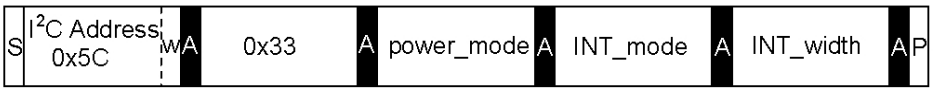


Figure 10.8: Write mode setting operation.

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.

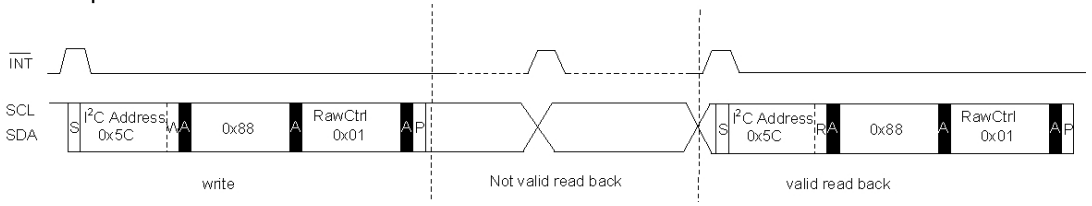


Figure 11.9: RAW_CTRL write & read

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.

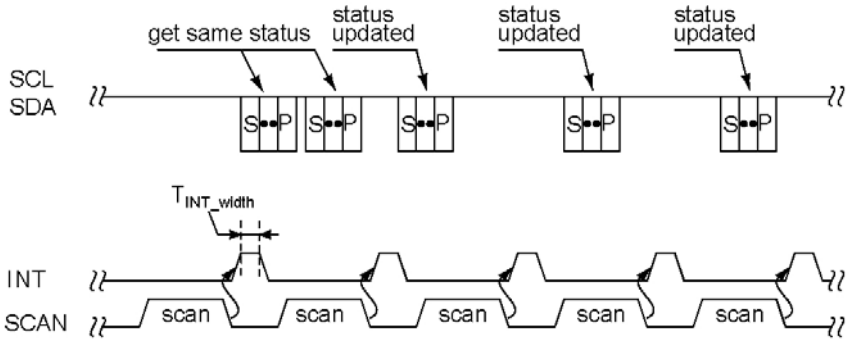


Figure 11.10: INT line pull up by slave (INT_POL=1,INT_MODE=00 in the INT mode register)

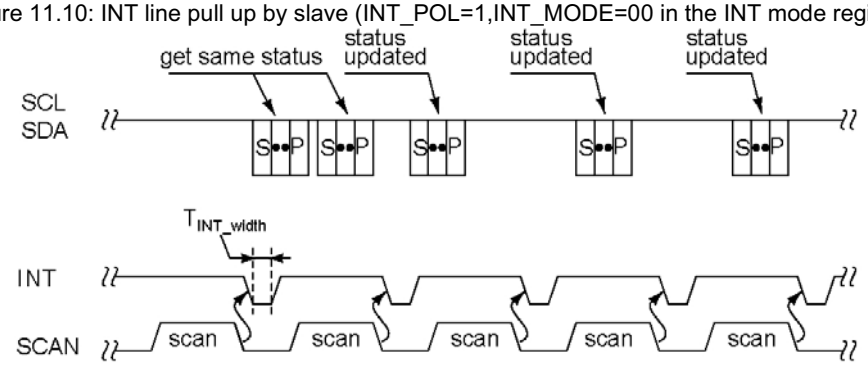


Figure 11.11: INT line pull down by slave (INT_POL=0, INT_MODE=00 in the INT mode register)

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.

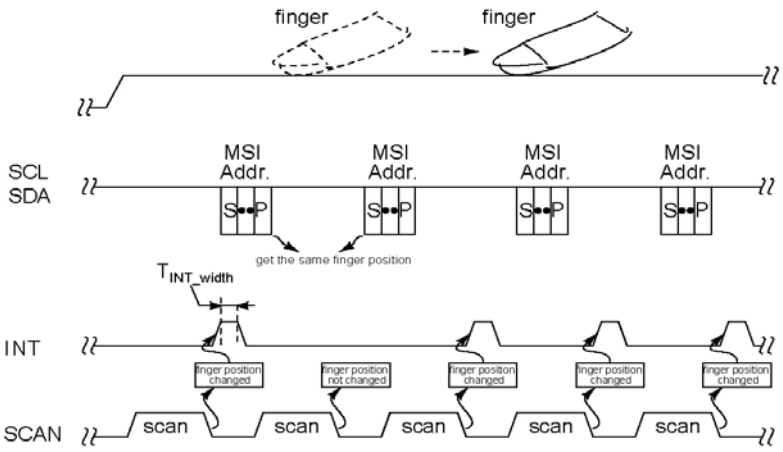


Figure 10.12: INT line pull up when finger moving (INT_POL=1, INT_MODE=01 in the INT mode register)

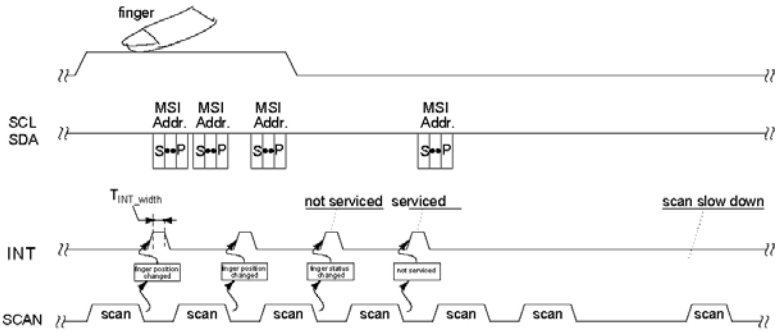


Figure 10.13: INT line will stop pulse when finger leaves and master has acknowledged the situation (INT_POL=1 in the INT mode register)

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 .

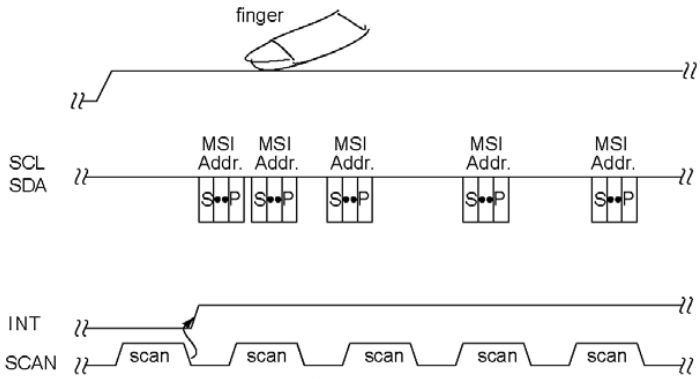


Figure 10.14: INT line pull up when finger touch (INT_POL=1, INT_MODE=10 in the INT mode register)

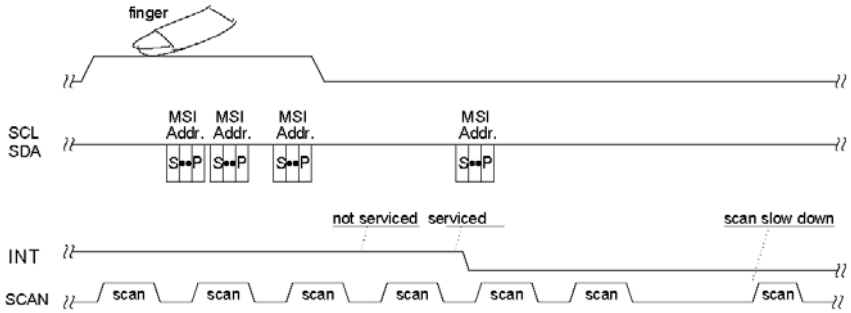


Figure 10.15: INT line will reset level when finger leaves and master has acknowledged the situation (INT_POL=1 in the INT mode register)

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

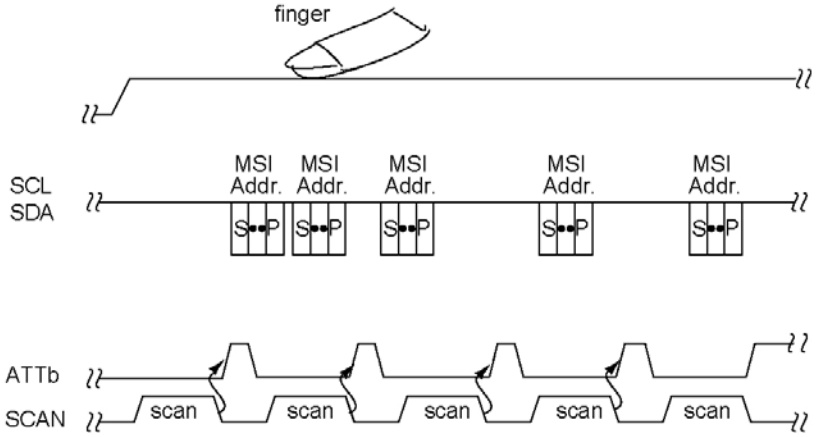


Figure 11.16: INT line pull up when finger touch (INT_POL=1, INT_MODE=11 in the INT mode register)

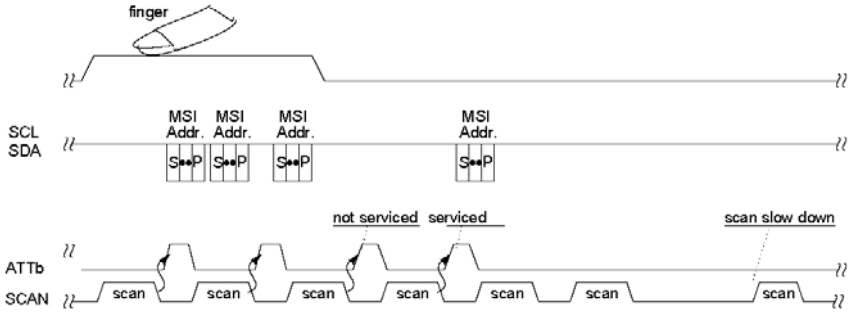
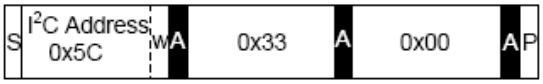


Figure 10.17: INT line will stop pulse when finger leaves and master has acknowledged the situation (INT_POL=1 in the INT mode register)

10.8 Power management

Active mode

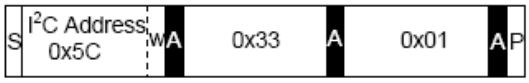
In this mode, the slave resumes with a new scan directly after each I²C transfer (after INT rising edge). This is used to reach the highest refresh rate (reach to 400Hz), but also has the highest current consumption. Below is shows how to force the slave into Active mode.



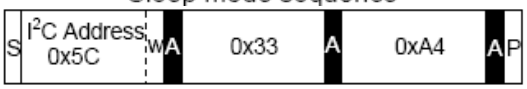
Active mode sequence

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

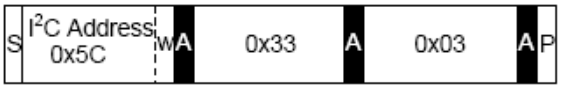


Sleep mode automatically switch sequence

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”)

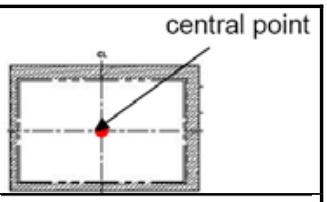
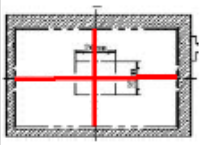


Freeze mode sequence

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 CTP Life Test

1	Point hitting life (no contact CTP)	> 1,000,000；Use 11mm diameter/copper column to knock on the same point twice per second under system operating.	
2	Line Drawing life (no contact CTP)	> 100,000；Use 11mm diameter/copper column to draw straight lines back and forth as the following red lines at the speed of 100mm/sec under system operating.	

11. QUALITY ASSURANCE

11.1 Test Condition

11.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : 25 ± 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

Reliability Test Item & Level		Test Level	Remark
No.	Test Item		
1.	High Temperature Storage Test	T= 80℃,240hrs	IEC68-2-2
2.	Low Temperature Storage Test	T= -30℃,240hrs	IEC68-2-1
3.	High Temperature Operation Test	T= 70℃ ,240hrs	IEC68-2-2
4.	Low Temperature Operation Test	T= -20℃, 240hrs	IEC68-2-1
5.	High Temperature and High Humidity Operation Test	T= 60℃, 90%RH,240hrs	IEC68-2-3
6.	Thermal Cycling Test (No operation)	-30℃ → +25℃ → +80℃, 100 Cycles 30 min 5 min 30 min	IEC68-2-14
7.	Vibration Test (No operation)	Frequency :10 ~ 55 H_Z Amplitude :1.5 mm Sweep time : 11 mins 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

11.2 Inspection condition

11.2. 1 Inspection condition

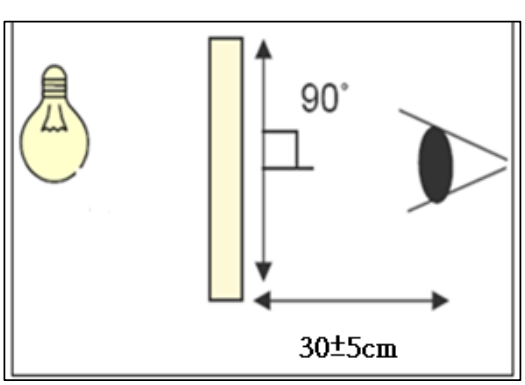
11.2.1.1 Inspection conditions

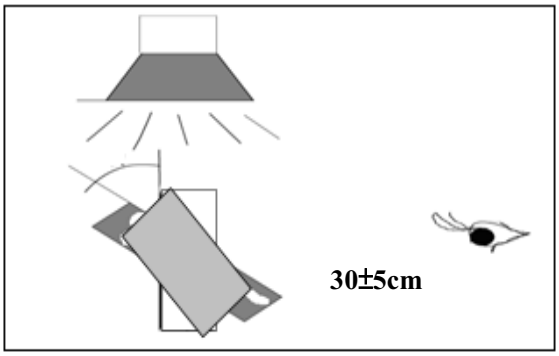
11.2.1.1.1 Inspection Distance : 30 ± 5 cm

11.2.1.1.2 View Angle :

(1) Inspection that light pervious to the product: 90±15°

(2) Inspection that light reflects on the product: 90±15°



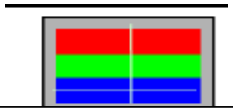


11.2.1.2 Environment conditions :

Ambient Temperature :	25±5℃
Ambient Humidity :	30~75%RH
Ambient Illumination	600~800 lux

11.2.2 Inspection Parameters

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

Inspection item	Inspection standard	Description
No image	Prohibited	
Image abnormal	Prohibited	
Bright line	Prohibited	
Thin line	It is acceptable that the defect can not be seen with 10% ND filter.	
Mura	It is acceptable that the defect can not be seen with 2% ND filter.	

<table>
<tr>
<td>Dot</td>
<td>
<table>
<tr><th>Item</th><th>Acceptable
Visible area</th><th>Total</th></tr>
<tr><td>Bright dot</td><td>3</td><td rowspan="2">6</td></tr>
<tr><td>Dark dot</td><td>5</td></tr>
<tr><td>Bright adjacent dots</td><td>1</td><td>1</td></tr>
<tr><td>Dark adjacent dots</td><td>2</td><td>2</td></tr>
<tr><td>Adjacent dots with a bright dot and a dark dot</td><td>2</td><td>2</td></tr>
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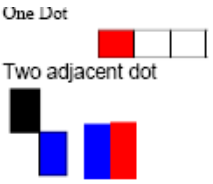
<td> 
</td>
</tr>
<tr>
<td>Foreign material in dot shape</td>
<td>
<table>
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<tr><td>D≦0.5</td><td>Ignored</td></tr>
<tr><td>0.5<D≦0.8, distance>5</td><td>n≦5</td></tr>
<tr><td>D＞0.8</td><td>0</td></tr>
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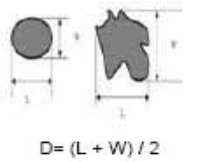
<td> 
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<tr>
<td>Foreign material in line shape</td>
<td>
<table>
<tr><th>SPEC(unit: mm)</th><th>Acceptable</th></tr>
<tr><td>W≦0.05 and L≦10</td><td>Ignored</td></tr>
<tr><td>0.05<W≦0.1, L≦10, distance >5</td><td>n≦5</td></tr>
<tr><td>W>0.1 or L>10</td><td>0</td></tr>
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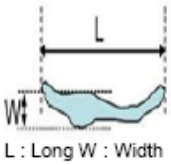
<td> 
</td>
</tr>
<tr>
<td>Contamination</td>
<td>It is acceptable if the dirt can be wiped.</td>
<td></td>
</tr>
<tr>
<td>Inspection item</td>
<td>Inspection standard</td>
<td>Description</td>
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<tr>
<td>Scratch</td>
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<tr><td>0.08<W≦0.1, L≦10, distance >5</td><td>n≦3</td></tr>
<tr><td>W>0.1 or L>10</td><td>0</td></tr>
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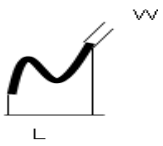
<td> 
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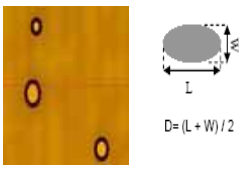
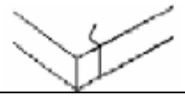
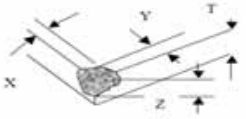
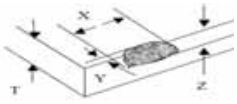
Bubble	SPEC (unit: mm)	Acceptable	
	D≦0.3	Ignored	
	Non visible area	Ignored	
	0.3<D≦0.5, distance >5	n≦5	
	D＞0.5	0	
Cover & Sensor Crack	Prohibited		
Cover angle missing	SPEC (unit: mm)	Acceptable	
	Side/Bottom	Ignored	
	It is prohibited if the defect appears on the front.	0	
Cover edge break	SPEC (unit: mm)	Acceptable	
	X≦3.0, Y≦3.0, Z≦T	Ignored	
	X>3.0, Y>3.0, Z＞T	0	
Ink	SPEC (unit: mm)	Acceptable	
	word unclear, inverted, mistake, break line	0	
Bubble under protection film	SPEC (unit: mm)	Acceptable	
	NA		
Function	Prohibited		

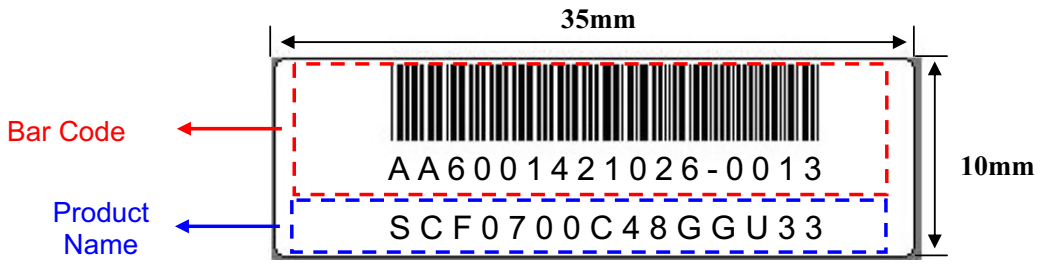
11.2.3 Sampling Condition

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: MIL-STD-105E
Inspection level: Level II

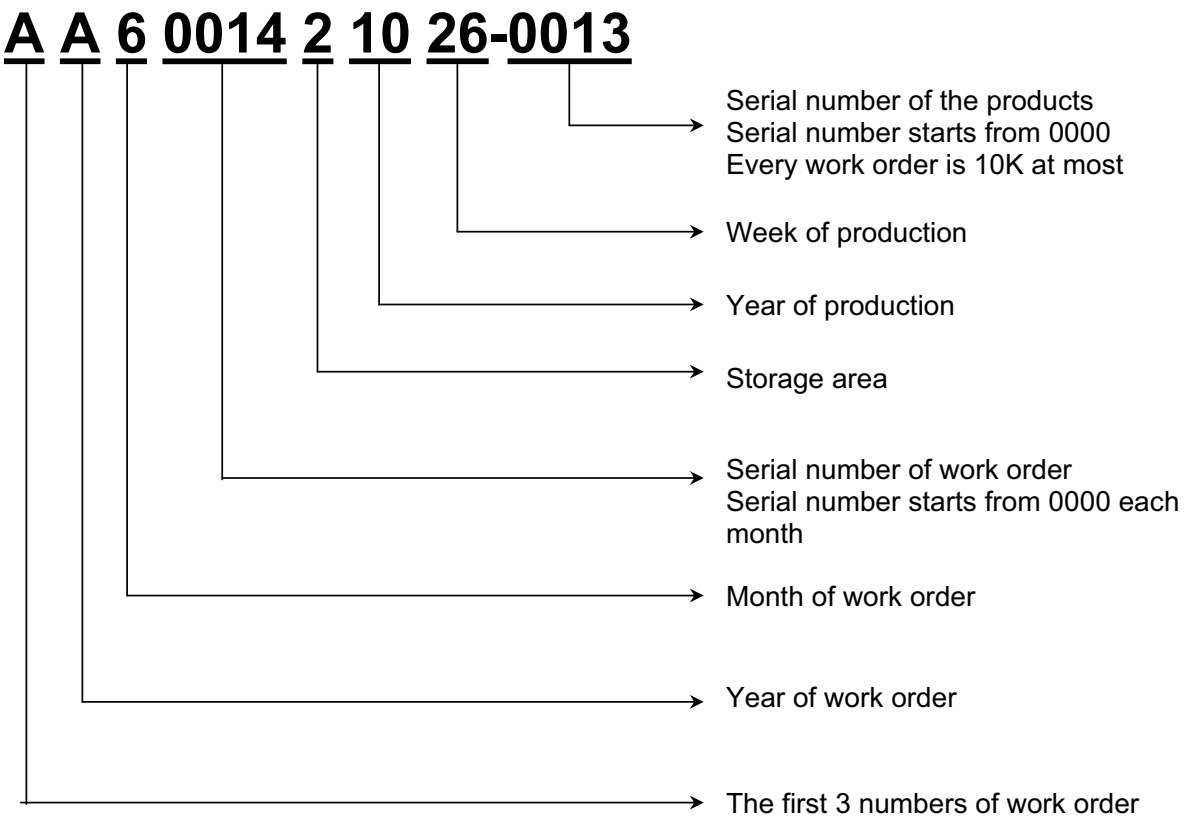
	Definition		
Class of defects	**Major**	AQL 0.65%	It is a defect that is likely to result in failure or to reduce materially the usability of the product for the intended function.
	Minor	AQL 1.5%	It is a defect that will not result in functioning problem with deviation classified.

12. PRODUCT LABEL DEFINE

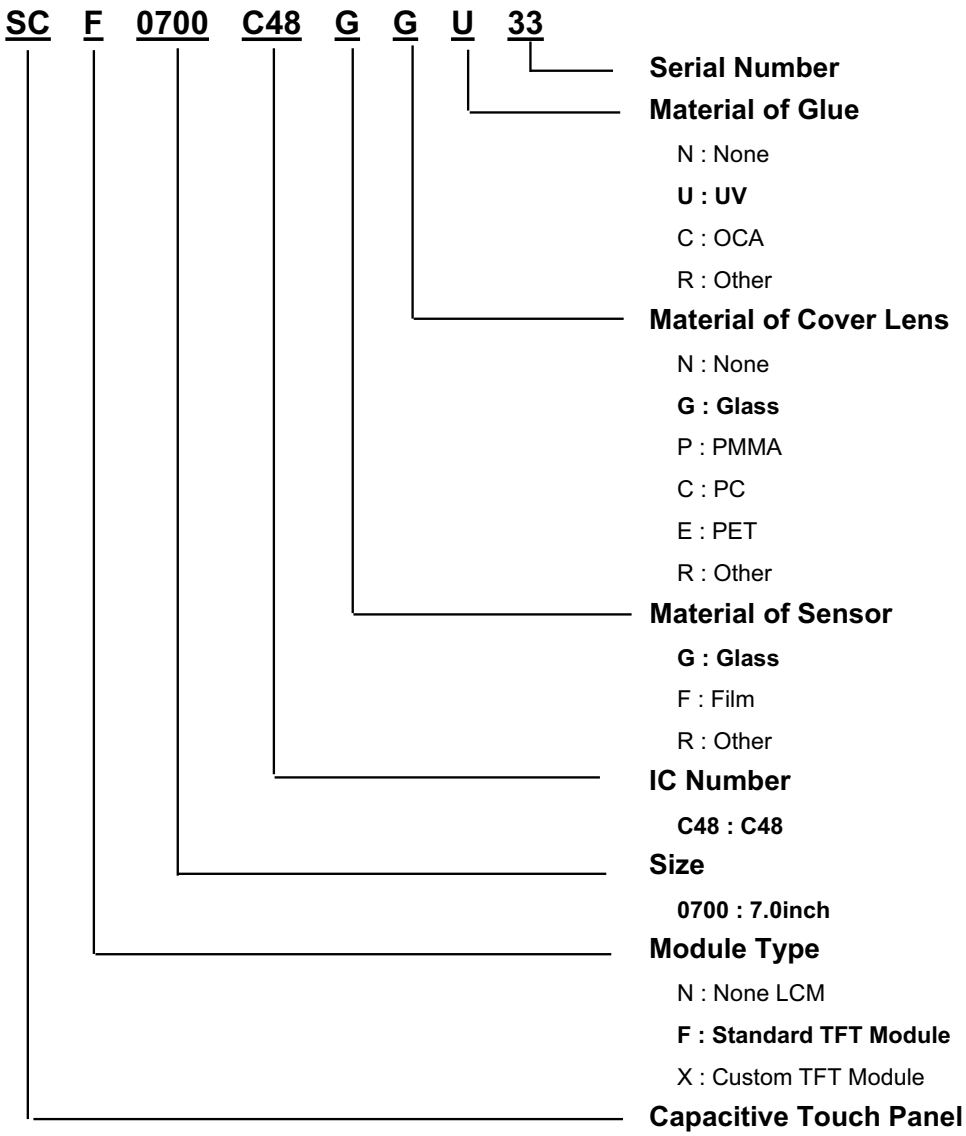
Product Label style:



BarCode Define:



Product Name Define:



13. PRECAUTION FOR USING LCM

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

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

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

3. ELECTROSTATIC DISCHARGE CONTROL
   (1) The operator should be grounded whenever he/she comes into contact with the CTP. Never touch any of the conductive parts such the copper leads on the FPC and the interface terminals with any parts of the human body.
   (2) The CTP should be kept in antistatic bags or other containers resistant to static for storage.
   (3) Only properly grounded soldering irons should be used.
   (4) If an electric screwdriver is used, it should be well grounded and shielded from commutator sparks.
   (5) The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended
   (6) Since dry air is inductive to statics, a relative humidity of 50-60% is recommended.

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

5. OTHERS

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

6. LIMITED WARRANTY

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

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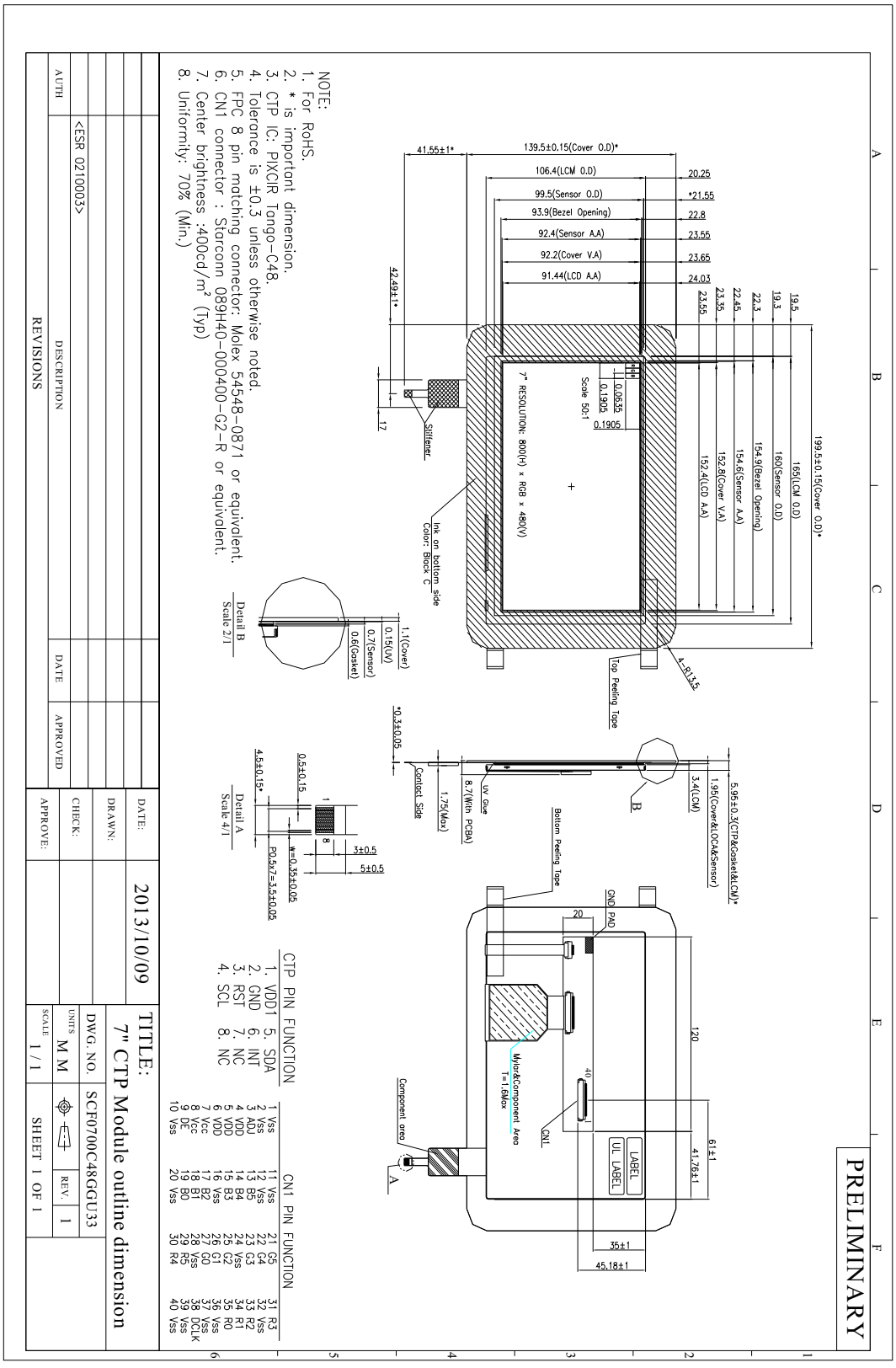
14. OUTLINE DRAWING



15. PACKAGE INFORMATION

T.B.D.