

LIQUID CRYSTAL DISPLAY MODULE

**2.8" QVGA (240 x RGB x 320) TFT
with Touch-Panel**

Product Code: 28QVF1J-0

Product Specification

APPROVAL



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History of Revision

Revision	Contents	Date
1.0	First publication	Apr.27,2010

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1. General

1-1 Application

This specification applies to the LCD module designated 28QVF1J-0 LCD to be delivered from Seiko Instruments Inc. (hereinafter "SII").

1-2 Name of product, model number

Name of product: LCD module

Model number of SII: 28QVF1J-0

1-3 Mechanical Dimensions and Circuit diagram

Refer to drawing No "28QVF1J-0 1A".

1-4 Quality Assurance Standard

Quality assurance standard should be based on the Delivery Inspection Standard.

Note:

(): Target value for sample production. Might be modified after evaluation of sample.

TBD: To Be Determined after evaluation of sample.

2. Product specifications

This product is LCD module with 240 (x3:RGB) x 320 dots LCD module with LCD driver.

2-1 Basic Specifications

Display contents:	240x(3:RGB)x320 dots
LCD module size:	49.0x69.0(except FPC length)x3.16mm(typ)
Viewing area:	44.2x58.6mm min
Active area(LCD):	43.2x57.6mm typ
Active area(TP):	43.8x58.0mm typ
Dot pitch:	0.18x0.18mm
Display mode:	TFT LCD, 262,144 colors, Transmissive Mode
Viewing direction:	6h
Drive method:	Line inversion
Weight:	18.8g typ.
LCD driver:	R61505VorR61505W(Renesas)
Touch-Panel:	Film/Glass type
Surface treatment:	Clear type
Operating temperature:	From -20 to +70 °C (dry)
Storage temperature	From -30 to +80 °C (dry)

2-2 Interface(LCD)

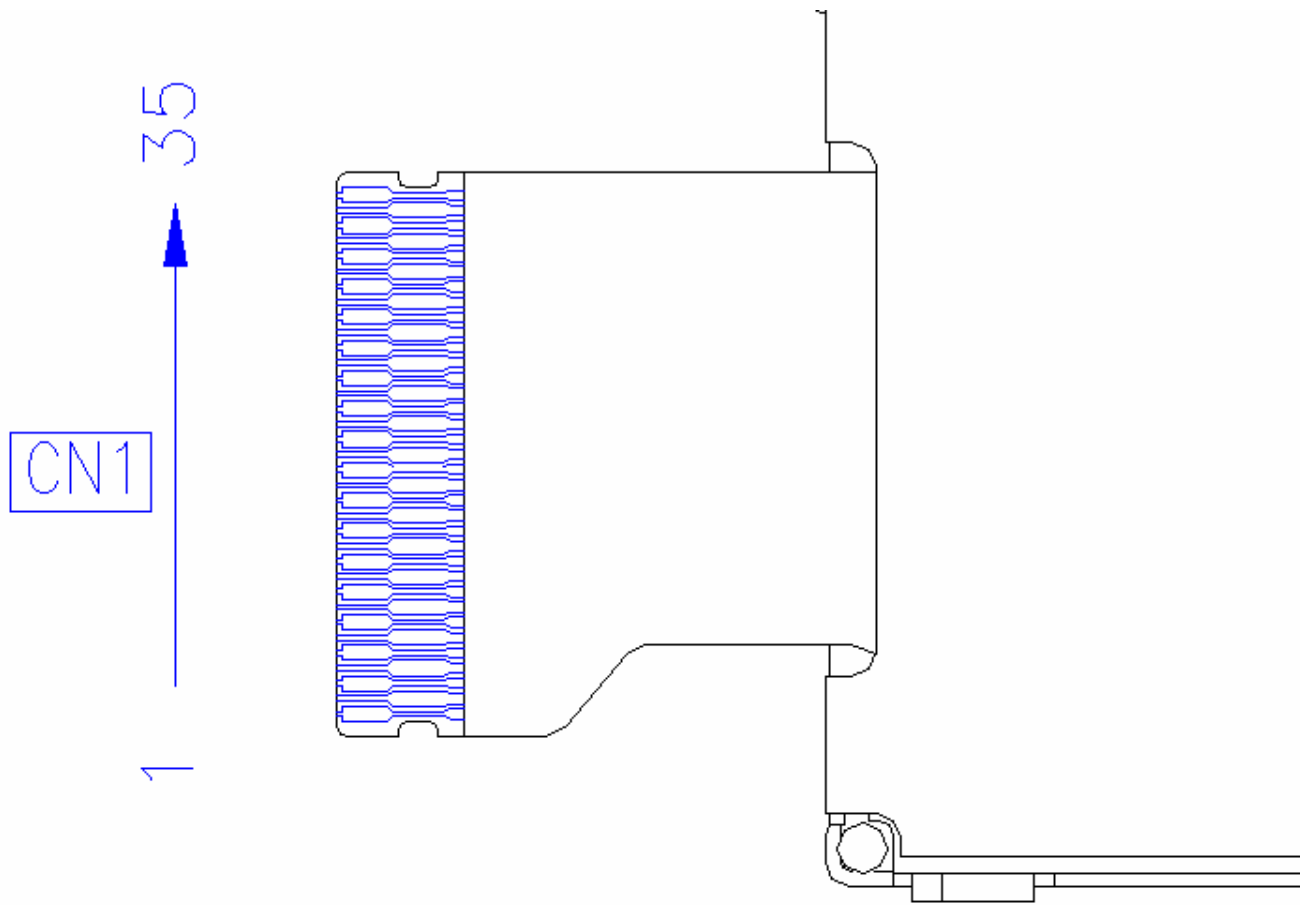
80-system interface

CN1

No.	Symbol	Description
1	GND(VPP3A)	Must be Conect to GND
2	IM0	IM3="GND" IM0="GND" then 16bit Interface IM3="GND" IM0="IOVCC" then 8bit Interface
3	IM3	IM3="IOVCC" IM0="GND" then 18bit Interface IM3="IOVCC" IM0="IOVCC" then 9bit Interface
4	FMARK	Frame head pulse signal
5	GND	GND
6	DB17	16bit Interface RAM Write DB17~DB10,DB8~DB1 Instruction set DB17~DB10,DB8~DB1 DB9,DB0 fixed IOVCC or GND 8bit Interface RAM Write DB17~DB10 Instruction set DB17~DB10 DB9~DB0 fixed IOVCC or GND 18bit Interface RAM Write DB17~DB0 Instruction set DB17~DB10,DB8~DB1 9bit Interface RAM Write DB17~DB9 Instruction set DB17~DB10 DB8~DB0 fixed IOVCC or GND IOVCC:Logic power supply (1.65V~3.3V)
7	DB16	
8	DB15	
9	DB14	
10	DB13	
11	DB12	
12	DB11	
13	DB10	
14	DB9	
15	DB8	
16	IOVCC	
17	DB7	
18	DB6	
19	DB5	
20	DB4	
21	DB3	
22	DB2	
23	DB1	
24	DB0	
25	/CS	Chip select :Low active
26	RS	Display data/Command selection pin RS="H":Display data. RS="L":Command data.
27	/WR	Write :Low active
28	/RD	Read: Low active
29	/RESET	RESET: Low active
30	VCI	Analog power supply (2.5V~3.3V)
31	GND	GND
32	LED+	LED power suply (+)
33	GND	GND
34	LED-	LED power suply (-)
35	GND	GND

Note:Molex connector's Pin assign is difference.

Please Pin assign is design by 28QVF0H-0 1A Assenmbly drawing
(Refer next drawing)



2-3 Interface (Touch-Panel)

No.	Symbol	Description
1	Y2	Top electrode – differential analog
2	X1	Right electrode – differential analog
3	Y1	Bottom electrode – differential analog
4	X2	Left electrode – differential analog

3. Power on/off sequence

3-1. Power on sequence

3-1-1. Reset and Power on(Before the following sequence)

No.	Register	Value	Contents
1	-	-	Power (IOVCC,VCI) on by holding '/RESET' as low-level.
2	-	-	Wait till power supply(IOVCC,VCI) will be stabilize.
3	-	-	Wait ≥ 1 ms
4	-	-	Set "/RESET" terminal to high-level.
5	-	-	Wait ≥ 150 ms

3-1-2.Power on Register set

No.	Register	Value	Contents
	(RS=0)	(RS=1)	
1	8-Bitor16Bbit interface synchronizing set RS=0 and "00"h instruction 4times		
2	0x00A4	0x0001	CALB=1
3	Wait time more than 1 ms		
4	0x0008	(0x2C2C)	FP=44LINE,BP=44LINE
5	0x0030	(0x0605)	
6	0x0031	(0x4608)	
7	0x0032	(0x0705)	
8	0x0033	(0x0209)	
9	0x0034	(0x0000)	
10	0x0035	(0x0902)	
11	0x0036	(0x4705)	
12	0x0037	(0x0806)	
13	0x0038	(0x0506)	
14	0x0039	(0x0000)	
15	0x0060	0x2700	NL=320line,SCN=00
16	0x0061	0x0000	
17	0x006A	0x0000	
18	0x0050	0x0000	HAS=0000h
19	0x0051	0x00EF	HEA=00Efh
20	0x0052	0x0000	VSA=0000h
21	0x0053	0x013F	VEA=013Fh
22	0x0080	0x0000	
23	0x0081	0x0000	
24	0x0082	0x001F	
25	0x0090	0x0015	
26	0x0092	0x0400	
27	0x0093	0x0402	

28	0x0094	0x0002	
No.	Register	Value	Contents
29	0x0007	0x0000	
30	0x0010	0x0530	
31	0x0011	0x0237	
32	0x0012	0x118F	
33	0x0013	0x0F00	
34	0x0001	0x0100	SS=1, SM=0
35	0x0002	0x0200	Line invers n=1
36	0x0003	0xD030	262k color(R6G6B6) 64K :1230h 18bit I/F :0x1030
37	0x0009	0x0001	
38	0x000A	0x0008	
39	0x000D	0x0000	
40	0x000E	0x0030	
41	-	-	Wait more than 150 msec.
42	0x0012	0x11BF	
43	0x0020	0x0000	RAM Address set (X)
44	0x0021	0x0000	RAM Address set (Y)
45	0x0022	<DATA>	GRAM data set
46	-	-	Wait more than 80 msec.
47	0x0007	0x0100	
			Display ON

3-2 Power off sequence

3-2-1 Power off (Deep standby mode)

No.	Register	Value	Comment
1	0x0007	0x0032	
2	0x0011	0x0667	
3	0x0012	0x0180	PON=0
4	-	-	Wait more than 80 msec.
5	0x0010	0x0000	
6	0x0010	0x0004	Deep standby

3-2-2. Power off(After the above sequence execution)

No.	Register	Value	Comment
1	-	-	Power (IOVCC,VCI) OFF
2	-	-	Set “ /RESET” terminal to low level.

3-3 Deep Standby sequence

3-3-1 Deep Stanby mode

No.	Register	Value	Contents
3-2-1 Power off (Deep standby mode) No1 ~ No6			
Deep Standby mode			

3-3-2 Deep Stanby cancel Sequence

8bit I/F mode

No.	Register	Value	Contents
1	0x00	-	
2	0x00	-	
3	-	-	Wait more than 1 msec.
4	0x00	-	
5	0x00	-	
6	0x00	-	
7	0xF0	-	Deep standby mode cancel
8	0x00	-	
9	0x00	-	
10	0x00	-	
11	0x00	-	8-Bit interface synchronizing set
12	-	-	Wait more than 1 msec.
3-1-2 LCD Power ON Register setting N2 ~ NO47 *note			

*note:needed RAM data rewriting

16bit I/F mode,18bit I/F mode

No.	Register	Value	Contents
1	0x00	-	
2	0x00	-	
3	-	-	Wait more than 1 msec.
4	0x00	-	
5	0x00	-	
6	0x00	-	
7	0x00	-	Deep standby mode cancel
8	-	-	Wait more than 1 msec.
3-1-2 LCD Power ON Register setting N2 ~ NO47 *note			

*note:needed RAM data rewriting

3-4 Image update sequence (When image data is changed)

No.	Register	Data	Contents
	(RS=0)	(RS=1)	
1	8-Bit or16bit interface synchronizing set		
	RS=0 and "00"h instruction 4times		
2	Read 0x0012		
	If data=0x118F then No2~No5		
	else Main LCD power-sq No2~No45		
3	0x0020	0x0000	RAM Address set (X)
4	0x0021	0x0000	RAM Address set (Y)
5	R22h	<DATA>	GRAM data set

Note:No2 is ESD software recovery

3-5 User ID Read sequence

No.	Register	Value	Contents
	(RS=0)	(RS=1)	
1	0x00A4	0x0001	CALB=1
2	Wait time more than 1ms		
3	0x0028	-	dummy read
4	0x0028	-	user ID Read (000Fh)

4. Electrical Characteristics

4-1 Absolute Maximum Rating

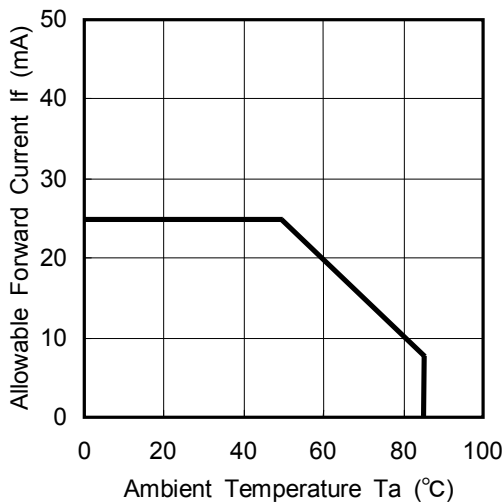
GND=0V

Item		Symbol	Standard	Unit	Remark
Supply Voltage		IOVCC,VCI	-0.3 to +4.6	V	
Input Voltage		Vin	-0.3 to IOVCC+0.3	V	
Backlight LED	DC forward current	If	25	mA	*1,2
	Reverse voltage	Vr	5	V	*2
	Power dissipation	Pd	88	mW	*2

Note: Use over the absolute maximum rating might affect reliability and might cause malfunction.

*1: Ambient Temperature vs. Allowable Forward Current

*2: Apply to 1 LED. Backlight consists of 4 LEDs.



4-2 Power supply voltage

GND=0V

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Operating Voltage	IOVCC	1.65	-	3.3	V	*1
	VCI	2.50	2.80	3.3	V	

*1: $VCI \geq IOVCC$

4-3 Electrical Characteristics

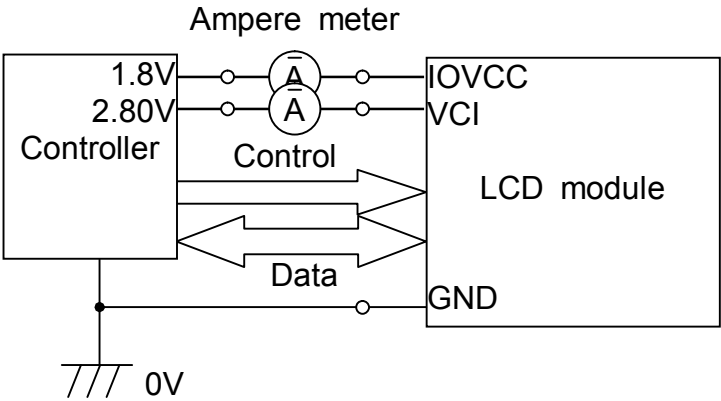
GND=0V, IOVCC=1.8V, VCI=2.80 V, Ta=25 degree C

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Current Consumption	Operating (all on:white)	IOVCC	-	-	(10)	uA	*1
		VCI		12	(21)	mA	
	Standby Deep standby	I _{dst} _{IOVCC}	-	-	(5)	μA	
		I _{dst} _{VCI}	-	-	(5)	μA	
Input high-level voltage		V _{ih}	0.8IOVCC	-	IOVCC	V	
Input low-level voltage		V _{il}	-0.3	-	0.2IOVCC	V	
Output low voltage		V _{oh}	0.8IOVCC	-	-	V	
Output high voltage		V _{ol}	-	-	0.2IOVCC	V	

*1: MPU does not access the driver IC.

Refer to R61505Vor R61505W data sheet for AC and other DC characteristics

Test circuit

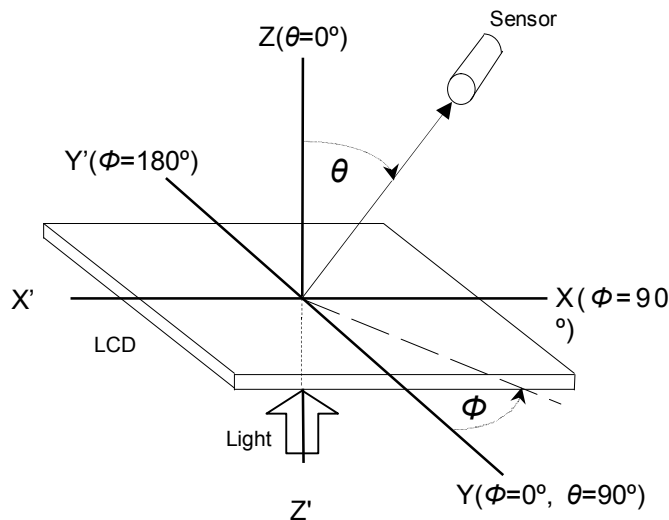


5. LCD Characteristics

5-1 LCD Optical Characteristics

GND=0V, IOVCC=1.8V, VCI=2.80V

Item		Symbol	Condition		Min.	Typ.	Max.	Unit
contrast ratio		C	$\theta=0^{\circ}$, $\varphi=0^{\circ}$	25°C	400	500	-	-
Range of Viewing angle (θ :6h–12h)		$\theta(6h)$ - $\theta(12h)$	$C\geq 10$	25°C	-	80	-	degree
Range of Viewing angle (θ :3h–9h)		$\theta(3h)$ - $\theta(9h)$	$C\geq 10$	25°C	-	80	-	degree
Color	White	x	BM-7 (TOPCON) $\theta=0^{\circ}$, $\varphi=0^{\circ}$	25°C	(0.27)	(0.32)	(0.37)	-
		y			(0.29)	(0.34)	(0.39)	-
	Red	x		25°C	(0.59)	(0.64)	(0.69)	-
		y			(0.28)	(0.33)	(0.38)	-
	Green	x		25°C	(0.28)	(0.33)	(0.38)	-
		y			(0.57)	(0.62)	(0.67)	-
	Blue	x		25°C	(0.10)	(0.15)	(0.20)	-
		y			(0.01)	(0.06)	(0.11)	-
NTSC ratio			↑	25°C	-	72	-	%
B/W Response time		Ton +Toff	$\theta=0^{\circ}$, $\varphi=0^{\circ}$	25°C	-	35	-	msec
		Ton +Toff	$\theta=0^{\circ}$, $\varphi=0^{\circ}$	-20°C	-	400	-	



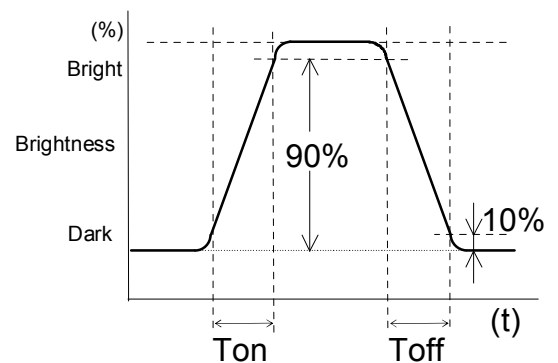
*Definition of contrast C

The contrast ratio is defined as follows:

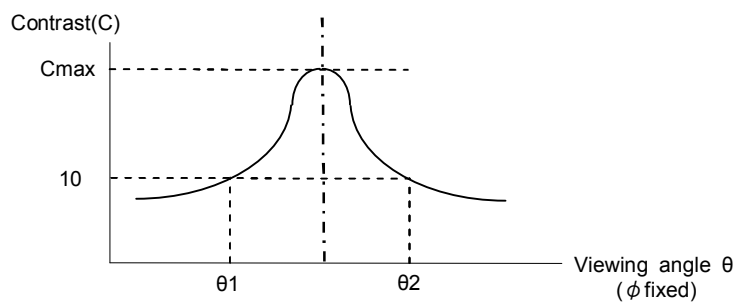
$$C = \frac{\text{Brightness of selected position(white)}}{\text{Brightness of unselected position(black)}}$$

*Definition of response time (Ton, Toff)

The response time is defined as the following figure.



*Definition of viewing angle θ1 and θ2

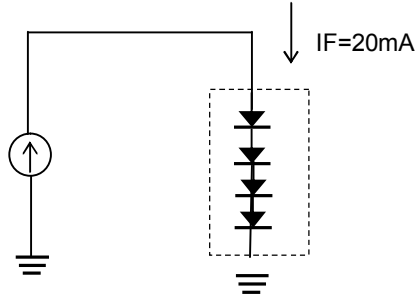


Note: Angle of optimized contrast with naked eye and viewing angle θ at C_{max} above are not always the same.

6. LED Backlight Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	unit
Brightness *1 *2 *3	B _p	T _a =25°C±3°C 30-80%RH	-	(300)	-	cd/m ²
Uniformity *1 *2 *4	Δ B _p		(70)	-	-	%

Note 1: The data is measured using the constant current (I_f=20mA) power supply.



*1 The data is measured after LEDs are turned on for 5 minutes.

*2 Tester: BM-7 (TOPCON) ; spot size=1°field ;Distance=500mm
Conditions

LED backlight power supply : 20mA

LCD: White color

*3 Brightness in the center of the LCD panel.

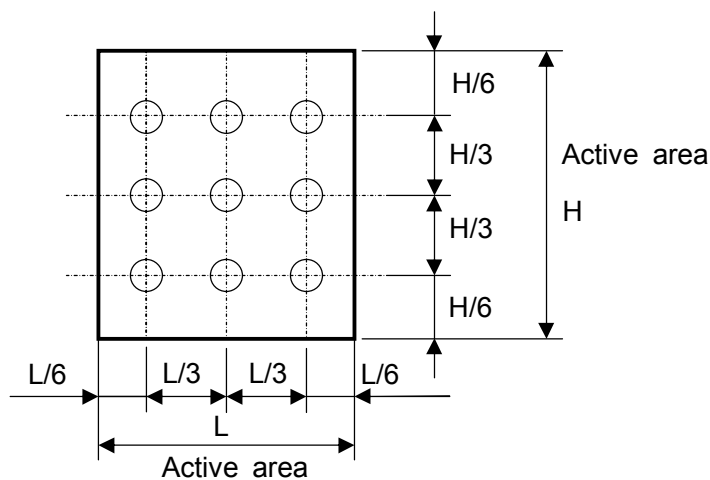
*4 Definition of Uniformity (ΔB_p)

$$\Delta B_p = B_p (\text{Min.}) / B_p (\text{Max.}) \times 100[\%]$$

B_p (max.) = Maximum brightness in 9 measurement spots (refer to below chart).

B_p (Min.) = Minimum brightness in 9 measurement spots (refer to below chart).

Measurement spots (9spots)



7. Touch Panel Characteristics

7-1 Electrical characteristics

Ta=25 degree C

Item	Min.	Typ.	Max.	Unit	Remark
Linearity	(-1.5)	-	(1.5)	%	*1, *2
Termial resistance	(150)	-	(800)	Ohm	X(Film side)
	(250)	-	(1300)	Ohm	Y(Glass side)
Insulation resistance	(20)	-	-	M Ohm	DC 25V
Input Voltage	-	(5.0)	(7.0)	V	
Chattering	-	-	(10)	ms	*3
Transparency	(80)	-	-	%	Clear type

Note: Do not operate it with a thing except a polyacetal pen (Tip R0.8 or less) or a finger,
Especially those with hard or sharp tips such as a ball point pen or a mechanical pencil.

*1: Definition of Linearity(%) = $\Delta V / (EV - SV) \times 100[\%]$

ΔV = The deffence between the ideal voltage and measured voltage on each measuring line

SV = Voltage of starting Points

EV = Voltage of ending Points

*2: 80gf less input with Tip R0.8 polyacetal pen.

*3: Tip R0.8 polyacetal pen, Tip R8.0 Rubber.

7-2 Mechanical characteristics

Ta=25 degree C

Item	Min.	Typ.	Max.	Unit	Remark
Activation force	-	(40)	(80)	gf	*1
Sliding life	100,000			characters	*2
Hitting Durability	1,000,000	-	-	times	*3
Surface hardness	(3)	-	-	H	Clear type *4

*1: Stylus pen Input: Tip R0.8 polyacetal pen

*2 Test area:each side within active area

-Pen change:2*10,000times

-Sharp of pen end:R0.8mm polyacetal pen

-Input force 250gf

-Frequency 60mm/sec

*3: Measurement for center part

- Hit 1,000,000 times at the same point

- Hitting Pad = Hardness 60° R8.0 silicon rubber

- Load:200g

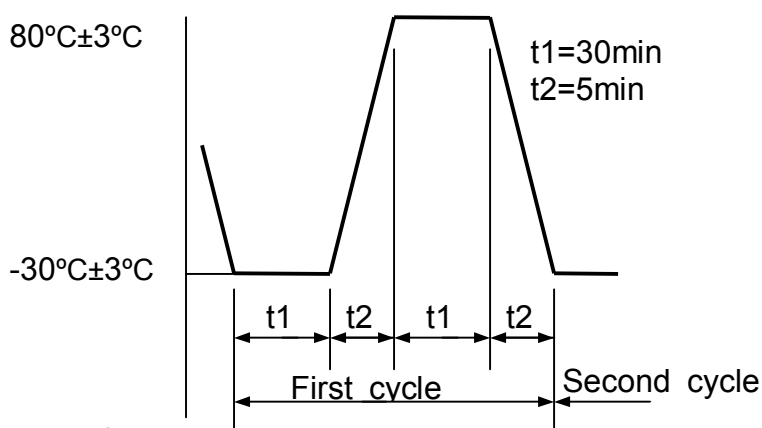
- Frequency:5Hz

*4: JIS K5600-5-4

8. Reliability

SII will develop engineering samples that meet the reliability level in mass production.

8-1 Reliability levels

Test Items	Condition
High temperature storage	+80°C±3°C, for 240 hours *Measure after 12hours left at normal temperature and humidity.
Low temperature storage	-30°C±3°C for 240 hours *Measure after 12hours left at normal temperature and humidity.
Operation at high temperature	+70°C±3°C, 30%RH max for 240 hours *Measure after 12hours left at normal temperature and humidity.
Operation at low temperature	-20°C±3°C, for 240 hours *Measure after 12hours left at normal temperature and humidity.
Operation at high temperature and high humidity	+40°C±3°C, 90%+2%/-3%RH max. (no condensation) for 240 hours * Measure after 12 hours left at normal temperature and humidity
Temperature cycle strage	 Repeat 5 cycles *Measure after 12hours left at normal temperature and humidity
Vibration	Sweep at 10Hz to 50Hz, amplitude 1.5mm for 2 hours each in X, Y, and Z directions. Apply shipping package to this test.
Mechanical shock	Drop onto the tiled floor from 60 centi meter heights, 6 faces. Apply shipping package to this test.
ESD	Machine model: 150V, Capacity: 200pF, Resistance: 0ohm Human body mode: 2000V, Capacity: 100pF, Resistance: 1500 ohm

8-2 Criteria

- | | |
|---------------------------------|--------------------------------|
| (1) Functional characteristics: | No abnormalities. |
| (2) Display characteristics: | Satisfy the original standard. |
| (3) Electrical characteristics: | Satisfy the original standard. |
| (4) Appearance: | No abnormalities. |
| (5) Brightness: | 50% of the original standard. |

9. Handling Precautions

9-1 Operation

Burn-in sometimes happens when the same character was displayed at along time. Therefore, to prevent Burn-in, SII recommended to set up a Screen-saver function.

9-2 Safety

DO NOT put it in your mouth in case LCD panel has broken. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

9-3 Handling

- (1) The LCD panel is plate glass. **DO NOT** subject the panel to mechanical shock or to excessive force on its surface.
- (2) The polarizer attached to the display is very easy to damage, handle it with care to avoid scratching.
- (3) To avoid contamination on the display surface, **DO NOT** touch the display surface with bare hands.
- (4) Provide a space so that the LCD panel does not come into contact with other components.
- (5) To protect the LCD panel from external pressure, put covering glass (acrylic board or similar board) to keep appropriate space between them.
- (6) Transparent electrodes may be disconnected if you use the LCD panel under environmental conditions where dew condensation occurs.
- (7) Property of semiconductor devices may be affected when they are exposed to light possibly resulting in malfunctioning of the ICs.
To prevent such malfunctioning of the ICs, your design and mounting layout done are so that the IC is not exposed to light in actual use.

9-4 Static Electricity

- (1) Ground soldering iron tips, tools and testers when they operate.
- (2) Ground your body when handling the products.
- (3) **DO NOT** apply voltage to the input terminal without applying power supply.
- (4) **DO NOT** apply voltage that exceeds the absolute maximum rating.
- (5) Store the products in an anti-electrostatic container.

9-5 Storage

Store the products in a dark place at +5~+25 degree C, low humidity (50%RH or less). **DO NOT** store the products in an atmosphere containing organic solvents or corrosive gases.

9-6 Cleaning

- (1) **DO NOT** wipe the polarizer with dry cloth, as it might cause scratch.
- (2) Wipe the polarizer with a soft cloth soaked with petroleum IPA, other chemical might damage.

9-7 Waste

When dispose of LCD module, manage it as the production waste.

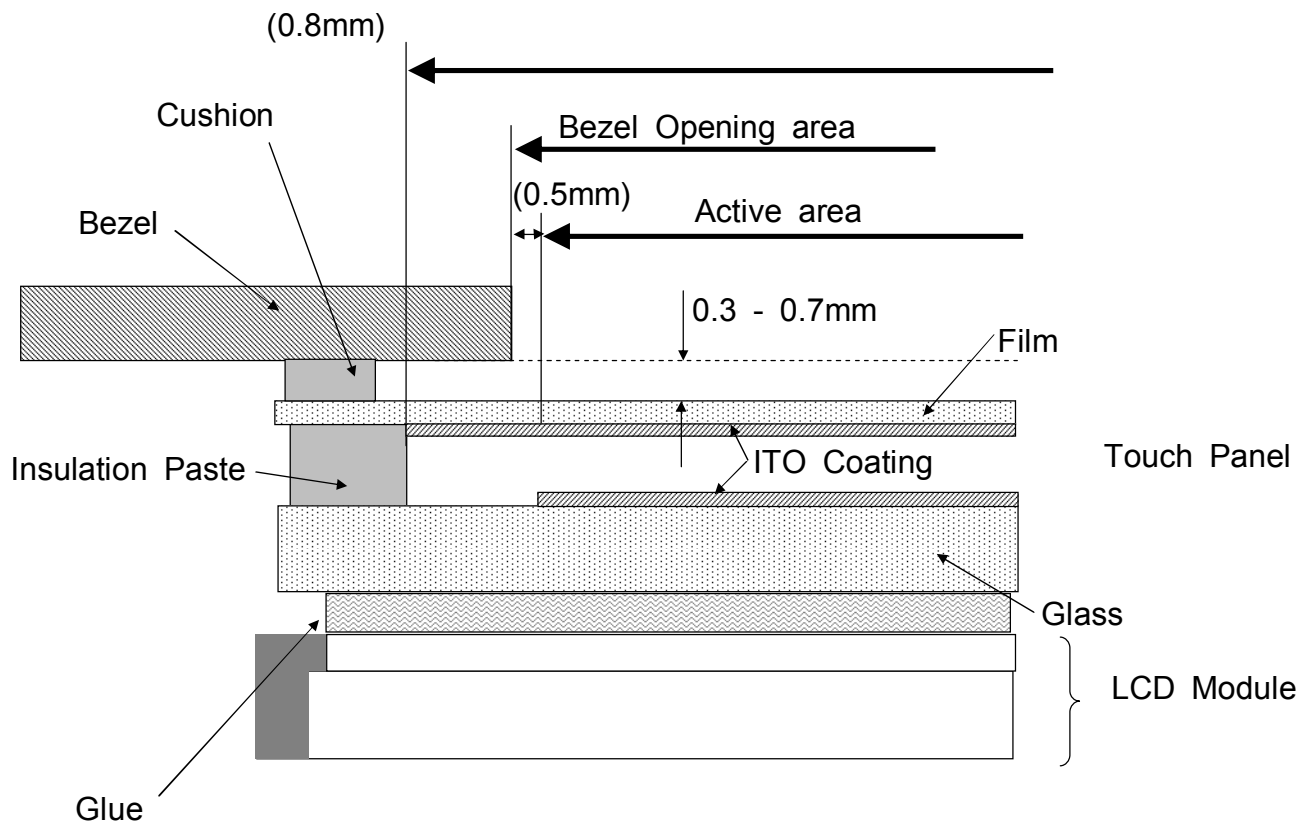
10. Guideline for Touch Panel

10-1 Setup for a bezel and Touch Panel

- (1) Keep the gap, for example 0.3 to 0.7mm, between bezel edge and Touch Panel surface. The reason is to avoid the bezel edge from contacting Touch Panel surface that may cause “short” or cracking with bottom layer.
- (2) Insertion a cushion material is recommended.
- (3) The cushion material should be limited just on the insulation paste area. If it is over the insulation paste area, a “short” may be occurred.
- (4) Set the bezel opening area between Active area and Viewing area.
- (5) Do not to use an adhesive tape to bond it on the front of Touch Panel and hang it to the bezel.

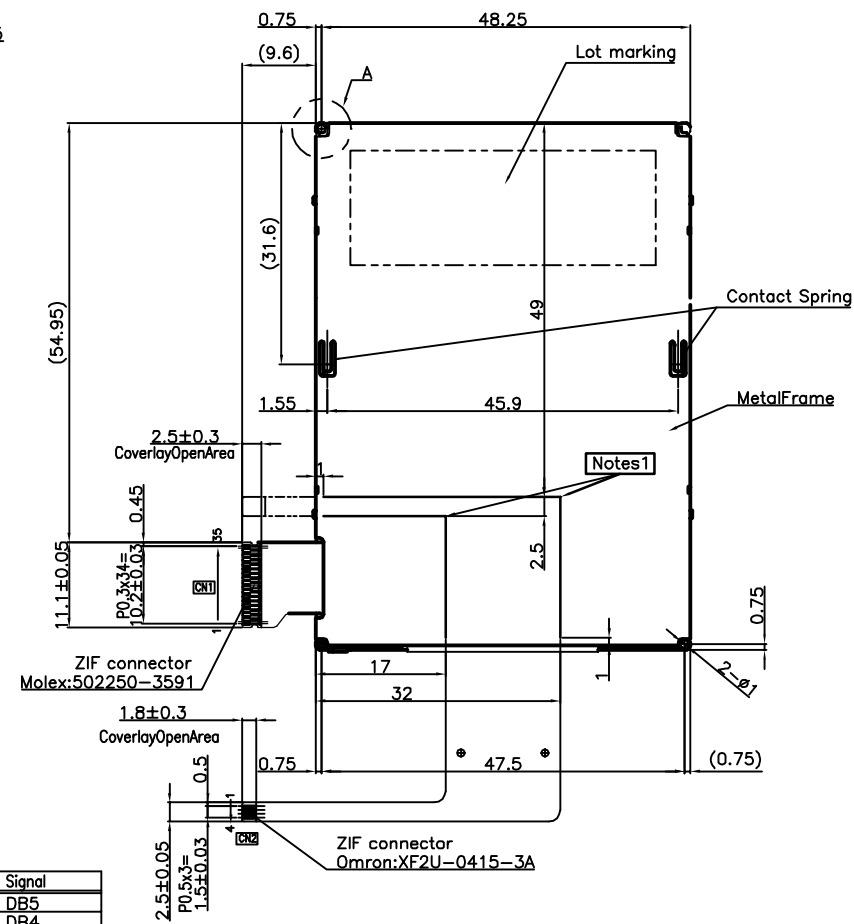
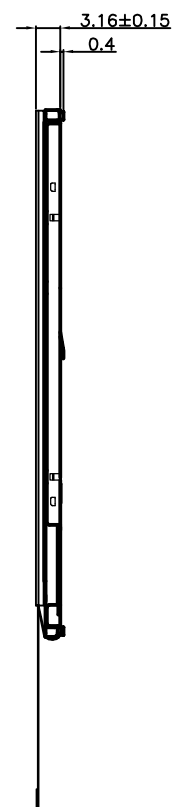
10-2 Prohibited Operation

To using the stylus pen or fingernail sliding at the edge of the bezel is prohibited. It would cause the cracking of the ITO coating and damage the Touch Panel. It also request not to press this area while assembling.



※ (mm);reference dimension

Detail A(5/1)



CN1			
Pin No.	Signal	Pin No.	Signal
1	GND(VPP3A)	19	DB5
2	IM0	20	DB4
3	IM3	21	DB3
4	FMARK	22	DB2
5	GND	23	DB1
6	DB17	24	DB0
7	DB16	25	/CS
8	DB15	26	RS
9	DB14	27	/WR
10	DB13	28	/RD
11	DB12	29	/RESET
12	DB11	30	VCI
13	DB10	31	GND
14	DB9	32	LED+
15	DB8	33	GND
16	IOVCC	34	LED-
17	DB7	35	GND
18	DB6		

					MATERIAL			
					TREATMENT			
					PART NUMBER	SCALE	UNIT	DATE
					(1)	2/1	1=1mm	Dec.7,2009
					CAL.	28QVF1J-0		
ST10-003	2	Change the drawing			TITLE	Assembly drawing		REV. 2
ST09-414	1	Setup for mass production			DRAWING No.	28QVF1J-0 1A		PAGE 1
CHIEF	LEADER	DESIGNED	DRAWN	CHECKED	Seiko Instruments Inc.			
TAKAHASHI	ICHINO	ICHINO	ICHINO	SAITO				