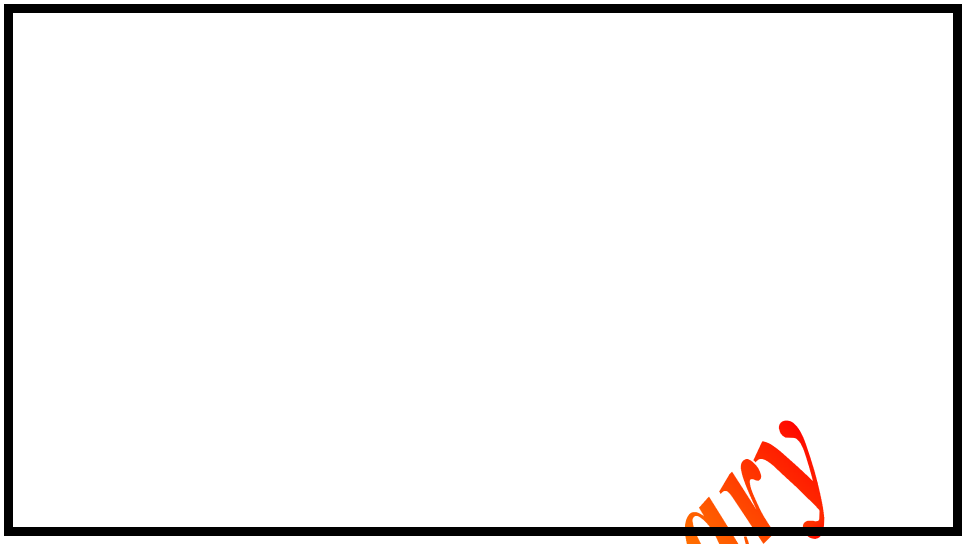
LIQUID CRYSTAL DISPLAY MODULE

3.5” HVGA (320 x RGB x 480) TFT

Product Code: 35HVF0HZ2

Product Specification

APPROVAL



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History of Revision

Revision	Contents	Date
a	First publication	May. 20, 2010
b	Changed P4 1-3 Mechanical Dimensions and Circuit diagram 35HVF0HZ0 1A→35HVF0HZ2 1A P4 LCD module size: 55.04x84.26x1.98mm→55.34x84.55x2.08mm P5 2-2 Interface LEDPWM Description P8 3-3 DPI(RGB_IF) P10 4. Power on/off sequence P13 5-1 Absolute Maximum Rating *2 6 LEDS → 5 LEDS P14 5-3 Electrical Characteristics Current consumption All on white, Deep standby Added P4 2-1 Basic Specification Dynamic Backlight Control Function BLC P14 5-3 Electrical Characteristics Current consumption Line stripe	Jul. 13, 2010

Contents

41. General

1-1 Application

This specification applies to the LCD module designated 35HVF0HZ2 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: 35HVF0HZ2

1-3 Mechanical Dimensions and Circuit diagram

Refer to drawing No “35HVF0HZ2 1A,35HVF0HZ0 6A,35HVF0HZ0 6B ”.

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 320 (x3:RGB) x 480dots LCD module with LCD driver.

2-1 Basic Specifications

Display contents:	320x(3:RGB)x480 dots
LCD module size:	55.34x84.55x2.08mm(typ) (except FPC length,Contact Spring and components)
Viewing area:	50.44x75.16mm(Min.)
Active area:	49.44x74.16mm
Dot pitch:	0.1545x0.1545mm
Display mode:	TFT LCD, 262K colors, Transmissive Mode
Viewing direction:	6h
Drive method:	Frame inversion
Weight:	TBDg typ.
LCD driver:	R61581(RenesasSP)
Backlight Control : (for Low current consumption)	BLC for R61581
Operating temperature:	From -20 to +70 °C (dry)
Storage temperature	From -30 to +80 °C (dry)

2-2 Interface

Mipi DBI TypeC(Option1) + 18bit DPI Interface (=SPI + 18bitRGB IF)

No.	Synbol	Description
1	GND	GND
2	LED-	LED power suplly (-)
3	GND	GND
4	LED+	LED power suplly (+)
5	LEDPWM	B/L PWM for Backlight Control Function *1
6	GND	GND
7	RESX	RESET: Active Low
8	VCI	Analog and Lojic power supply (2.7V～2.9V)
9	GND	GND
10	IOVCC	Interface power supply (1.7～1.9V)
11	GND	GND
12	CSX	(DBI TypeC) Chip select :Active Low
13	SCL	(DBI TypeC) Serial Clock :Active High
14	DIN	(DBI TypeC) Serial Input
15	DOUT	(DBI TypeC) Serial Output
16	DB0	(DPI) Color Coding B0
17	DB1	(DPI) Color Coding B1
18	DB2	(DPI) Color Coding B2
19	DB3	(DPI) Color Coding B3
20	DB4	(DPI) Color Coding B4
21	DB5	(DPI) Color Coding B5
22	DB6	(DPI) Color Coding G0
23	DB7	(DPI) Color Coding G1
24	DB8	(DPI) Color Coding G2
25	DB9	(DPI) Color Coding G3
26	DB10	(DPI) Color Coding G4
27	DB11	(DPI) Color Coding G5
28	DB12	(DPI) Color Coding R0
29	DB13	(DPI) Color Coding R1
30	DB14	(DPI) Color Coding R2
31	DB15	(DPI) Color Coding R3
32	DB16	(DPI) Color Coding R4
33	DB17	(DPI) Color Coding R5
34	DE	(DPI) Data Enable Signal Active High
35	GND	GND
36	PCLK	(DPI) Pixel Clock :Active High
37	GND	GND
38	HSYNC	(DPI) Horizontal Frame Synchronization Signal Active Low
39	VSYNC	(DPI) Vertical Frame Synchronization Signal :ActiveLow

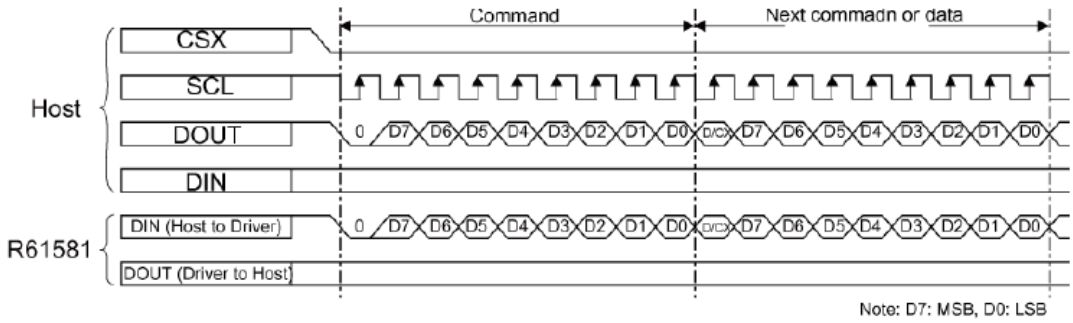
*1 Please set the optimum value on the customer side.

3. Mipi DBI TypeC and DPI

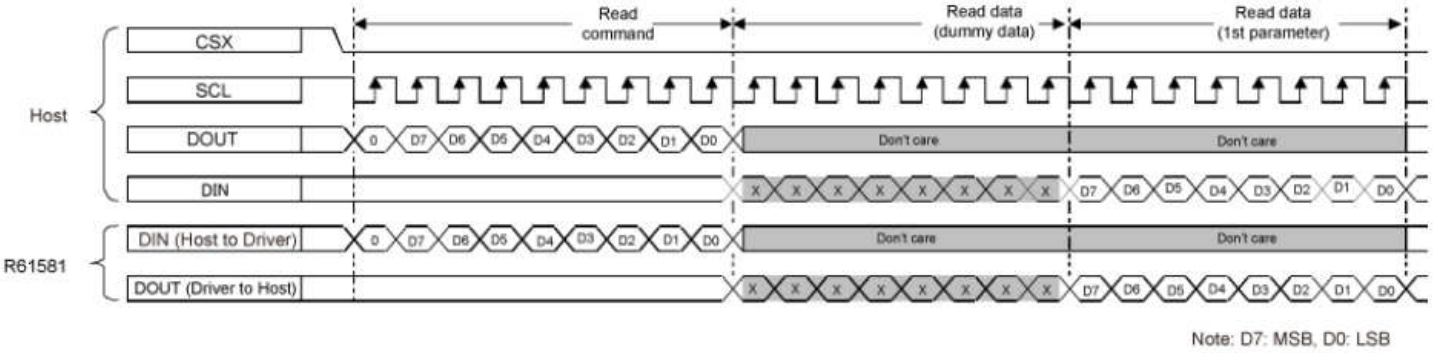
3-1 Mipi DBI TypeC Option1(SPI_IF)

Refer to R61581 data sheet for AC and other DC characteristics

Write Sequence



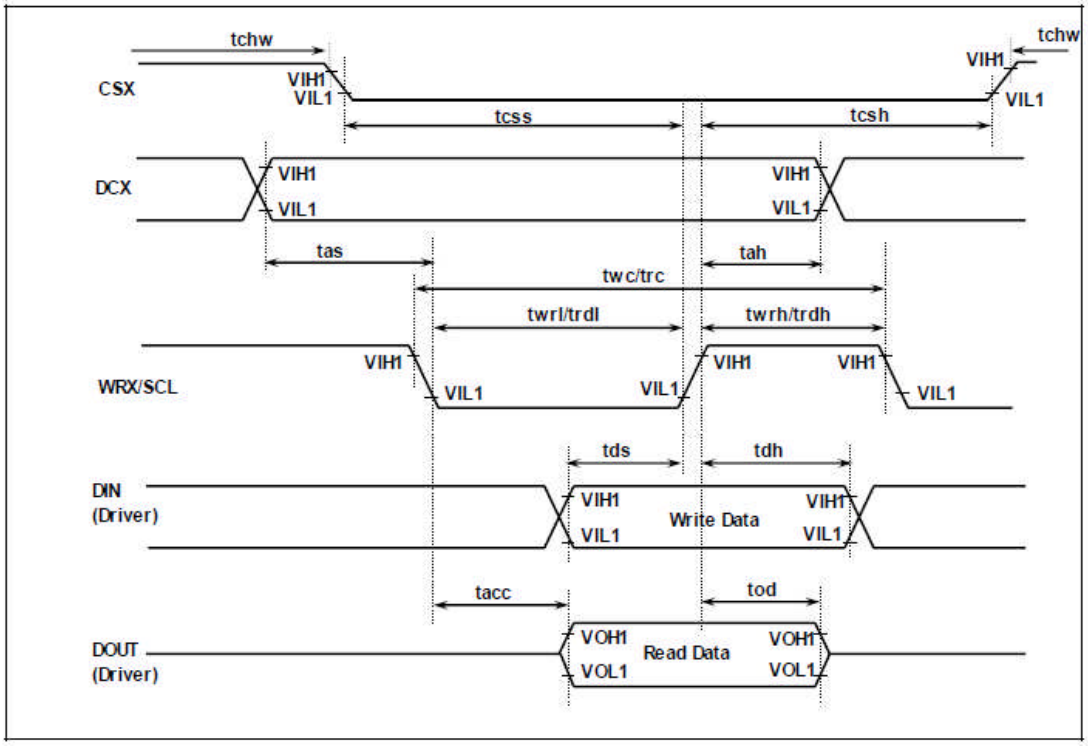
Read Sequence



3-2 Mipi DBI TypeC Option1(SPI_IF) AC Characteristics

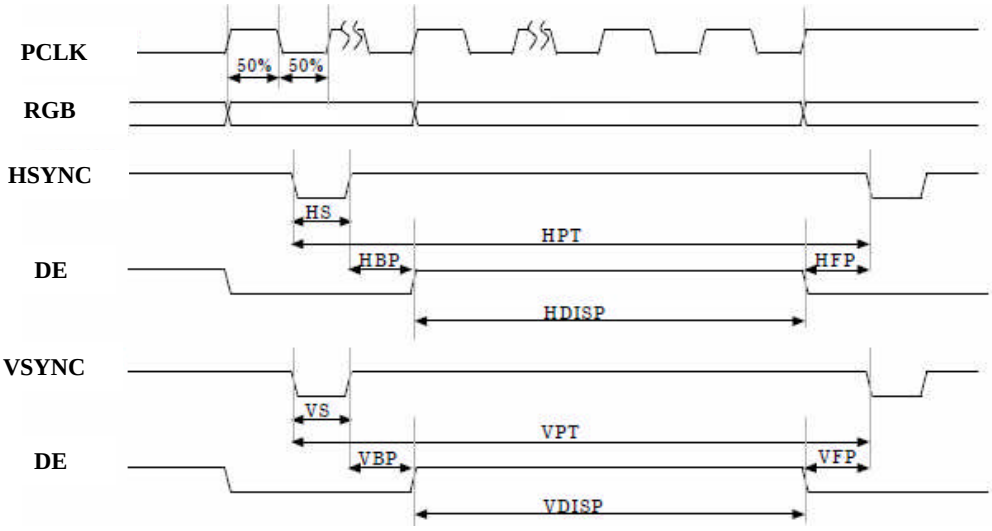
Refer to R61581 data sheet for AC and other DC characteristics

Item	Symbol		Unit	Test Condition	Min.	Max.
Chip select setup time	CSX	tcss	ns		40	-
Chip select hold time		tcsh	ns		40	-
Chip select "High" pulse width		tchw	ns		100	
Address setup time	DCX	tas	ns		10	-
Address hold time (Write/Read)		tah	ns		10	-
Write cycle time	WRX/SCL (Write)	twc	ns		100	-
WRX/SCL "High" period (Write)		twrh	ns		40	-
WRX/SCL "Low" period (Write)		twrl	ns		40	-
Read cycle time	WRX/SCL (Read)	trc	ns		300	-
WRX/SCL "High" period (Read)		trdh	ns		120	-
WRX/SCL "Low" period (Read)		trdl	ns		120	-
Data setup time	DIN	tds	ns		30	-
Data hold time		tdh	ns		30	-
Access time	DOUT	tacc	ns	CL Max.30pF Min.8pF	-	110
Output disable time		tod	ns		10	-



3-3 DPI(RGB_IF)

Refer to R61581 data sheet for AC and other DC characteristics

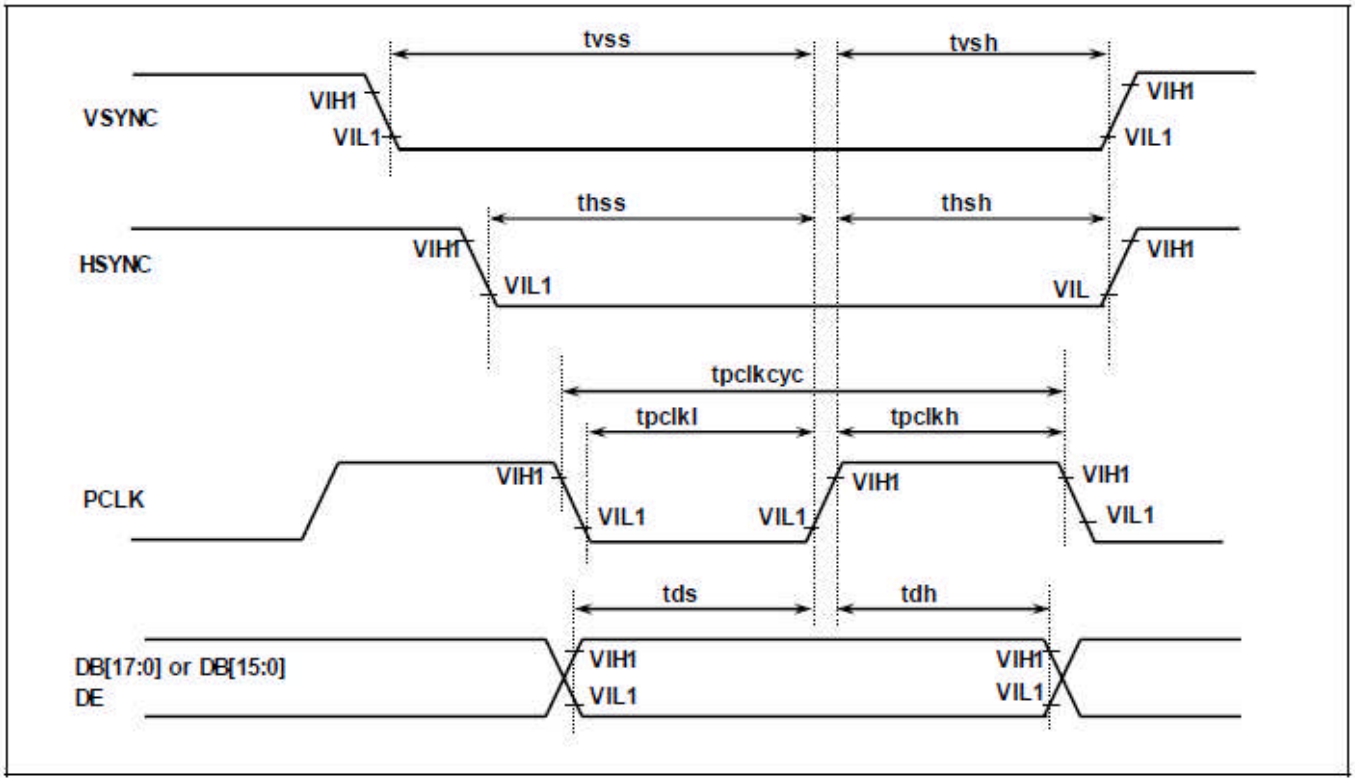


Data				備考
PCLK		16.7	MHz	Duty=50%
Horizontal	HS	10	clk	-
	HBP	20	clk	-
	HDISP	320	clk	-
	HFP	10	clk	-
	HPT	360	clk	-
Vertical	VS	2	Line	-
	VBP	2	Line	-
	VDISP	480	Line	-
	VFP	10	Line	-
	VPT	494	Line	-

3-4 DPI(RGB_IF) AC Characteristics

Refer to R61581 data sheet for AC and other DC characteristics

Item	Symbol		Unit	Test condition	Min.	Max.
VSYNC Setup Time	VSYNC	tvss	ns		30	-
VSYNC Hold Time		tvsh	ns		30	-
HSYNC Setup Time	HSYNC	thss	ns		30	-
HSYNC Hold Time		thsh	ns		30	-
Pixel Clock Cycle Time	PCLK	tpclkcyc	ns		60	-
Pixel Clock "Low" period		tpclkl	ns		30	-
Pixel Clock "High" period		tpclkh	ns		30	-
Data Setup Time	DB[17:0] or DB[15:0] DE	tds	ns		30	-
Data Hold Time		tdh	ns		30	-



4. Power on/off sequence

4-1 Power on sequence

No.	Command	Paramater	Contents
1	-	-	Power (VCI,IOVCC) On by holding '/RESET' as low-level.
2	-	-	Wait until power stabilization.
3	-	-	Wait more than 1 ms
4	-	-	Set '/RESET' terminal to high-level.
5	-	-	Wait more than 5 ms
6	B0h	00h	Manufacturer Command Access Protect MCAP1-0=00
7	C0h	01h	Panel Driving Setting REV=0,SM=0,GS=0,BGR=0,SS=1
	-	3Bh	NL5-0=111011
	-	00h	SCN5-0=000000
	-	03h	BLV=1,PTV=1
	-	**04h**	**NDL=0,PTDC=0,PTS2-0=100**
	-	01h	PTG=0,ISC3-0=0001
	-	00h	BLS=0,NW=0(1Line)
	-	BAh	PCDIVH3-0=1011,PCDIVL3-0=1010
8	C1h	00h	Display Timing Setting Normal BC0=0(Frame),DIV01-00=00
	-	11h	RTN04-0=10001(17)
	-	04h	BP0=04h(4)
	-	0Ah	FP0=0Ah(10)
9	C4h	11h	Source/VCOM/Gate Driving Timing Setting SDT2-0=001,NOW2-0=001
	-	01h	MCP2-0=001
	-	53h	VEQW2-0=101,VEM1-2=11
	-	05h	SPCW2-0=101
10	C6h	02h	Interface Setting VSPL=0,HSPL=0,EPL=0,DPL=0
11	C8h	09h	Ganmma set 1st PR0P00[4-0]=01001
	-	0Ah	2st PR0P01[4-0]=01010
	-	0Bh	3st PR0P02[4-0]=01011
	-	58h	4st PR0P04[3-0]=0101,PR0P03[3-0]=1000
	-	05h	5st PR0P05[3-0]=0101
	-	05h	6st PR0P06[4-0]=0101
	-	04h	7st PR0P07[4-0]=00100
	-	08h	8st PR0P08[4-0]=01000
	-	00h	9st PIR0P1[1-0]=00,PIR0P0[1-0]=00
	-	32h	10st PIR0P3[1-0]=11,PIR0P2[1-0]=10
	-	08h	11st PR0N00[4-0]=01000
	-	0Ch	12st PR0N01[4-0]=01100
	-	11h	13st PR0N02[4-0]=10001
	-	E9h	14st PR0N04[3-0]=1110,PR0N03[3-0]=1001
	-	0Fh	15st PR0N05[3-0]=1111
	-	0Ch	16st PR0N06[4-0]=01100
	-	13h	17st PR0N07[4-0]=10011
	-	05h	18st PR0N08[4-0]=00101
	-	32h	19st PIR0N1[1-0]=11,PIR0N0[1-0]=10
	-	11h	20st PIR0N3[1-0]=01,PIR0N2[1-0]=01

12	2Ah	00h	Set column address SC8=0
	-	00h	SC7-0=00000000
	-	01h	EC8=1
	-	3Fh	EC7-0=00111111
13	2Bh	00h	Set page address SP8=0
	-	00h	SP7-0=00000000
	-	01h	EP8=1
	-	DFh	EP7-0=11011111
14	34h	–	Set tear off
15	3Ah	66h	Set Pixel format D6-4=110,D2-0=110(262K-Colors)
16	B3h	02h	Frame Memory Access and Interface Setting WEMMODE=1
	-	00h	TEI2-0=000
	-	00h	DENC2-0=000
	-	00h	DFM=0
17	B4h	00h	Display Mode and Frame Memory Write Mode Setting RM=0(DBI),DM1-0=00(InternalClock)
18	11h	-	Exit_Sleep_Mode
	-	-	Wait more than 120 ms
19	D0h	07h	Power Setting WCVC=1,WCVRH=1,WCBT=1
	-	07h	VC2-0=111(VCI=VCI1)
	-	19h	VRH4-0=11001
	-	66h	BTMODE=0,BTH2-0=110,BT2-0=110
20	D1h	00h	VCOM Setting WCVDV=WCVDV=0(NVM)
	-	26h	VCM6-0=010 0110
	-	0Eh	VDV4-0=01110
21	D2h	03h	Power Setting for Normal Mode AP0[1-0]=11
	–	24h	DC10[2-0]=010,DC00[2-0]=100
	-	00h	DC30[2-0]=000
22	B0h	00h	Manufacturer Command Access Protect MCAP1-0=00
23	B3h	02h	Frame Memory Access and Interface Setting WEMMODE=1
	-	00h	TEI2-0=000
	-	00h	DENC2-0=000
	-	00h	DFM=0
24	36h	00h	Set addres mode B5=0
25	2Ah	00h	Set column address SC8=0
	-	00h	SC7-0=00000000
	-	01h	EC8=1
	-	3Fh	EC7-0=00111111
26	2Bh	00h	Set page address SP8=0
	-	00h	SP7-0=00000000
	-	01h	EP8=1
	-	DFh	EP7-0=11011111

27	B4h	11h	Display Mode and Frame Memory Write Mode Setting RM=1(DPI),DM1-0=01(DPI)
28	-	-	Wait more than 5 ms
29	2Ch	[data]	Write Memory Start
30	–	–	DPI(RGB_IF) Enable
31	–	–	Wait more than 1Frme
32	29h	-	set_display_on
33	2Ch	[data]	Write Memory Start

4-2 Power off sequence

No.	Command	Paramater	Contents
1	28h	-	set_display_off
2	-	-	Wait more than 2Frme
3	10h	-	Enter_Sleep_Mode
4	-	-	Wait more than 7Frme
5	B4h	00h	Display Mode and Frame Memory Write Mode Setting RM=0(DBI),DM1-0=00(InternalClock)
6	-	-	Power (VCI,IOVCC) Off

4-3 Deep stadby on sequence

No.	Command	Paramater	Contents
1	28h	-	set_display_off
2	-	-	Wait more than 2Frme
3	10h	-	Enter_Sleep_Mode
4	-	-	Wait more than 7Frme
5	B4h	00h	Display Mode and Frame Memory Write Mode Setting RM=0(DBI),DM1-0=00(InternalClock)
6	B1h	01h	DSTB=1

4-4 Deep stadby off sequence

No.	Command	Paramater	Contents
1	-	-	CS="Low"->"High" x 2 times
2	-	-	Wait more than 1 ms
3	-	-	CS="Low"->"High" x 4 times
2	-	-	Wait more than 5 ms
4	Power On Sequence 6-33		

5. Electrical Characteristics

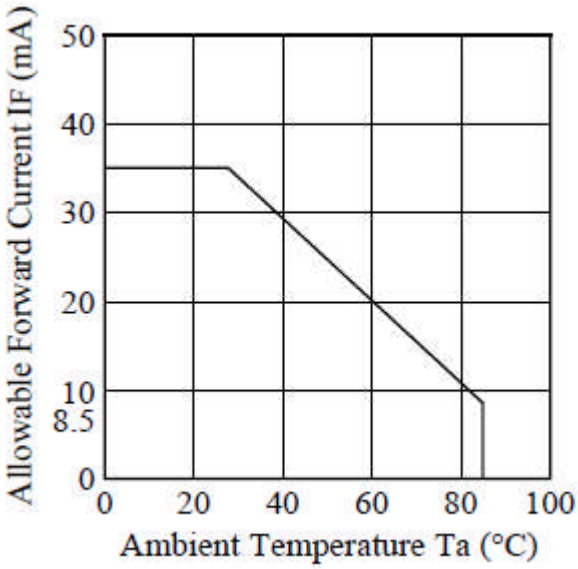
5-1 Absolute Maximum Rating

GND=0V

Item		Symbol	Standard	Unit	Remark
Supply Voltage		VCI,VDD	-0.3 to +4.5	V	-
Input Voltage		Vin	-0.3 to VDD+0.3	V	-
Backlight LED	DC forward current	If	35	mA	*1,*2
	Reverse voltage	Vr	5	V	*2
	Power dissipation	Pd	123	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 5 LEDs.



5-2 Power supply voltage

VSS=0V

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Operating Voltage	VDD	1.7	1.8	1.9	V	*1
	VCI	2.70	2.80	2.90	V	

*1: VCI ≧ VDD

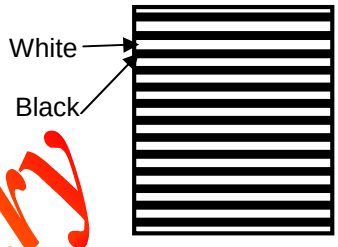
5-3 Electrical Characteristics

VSS=0V, VDD=1.8V,VCI=2.80 V, Ta=25 degree C

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Current Consumption	Operating (All on:White)	IIOVCC	-	(2.5)	(4.5)	mA	-
		IVCI	-	(2.9)	(4.5)	mA	
	Operating (H Line stripe)	IIOVCC	-	(2.5)	(4.5)	mA	*1 Test pattern
		IVCI	-	(17)	(25)	mA	
	Standby Deep standby	IIOVCC	-	-	(15)	μA	*2
		$IVCI_l$	-	-	(15)	μA	
Input high-level voltage		Vih	0.8IOVCC	-	IOVCC	V	-
Input low-level voltage		Vil	0	-	0.2IOVCC	V	
Output low voltage		Voh	0.8IOVCC	-	-	V	
Output high voltage		Vol	-	-	0.2IOVCC	V	

*1 H Line Stripe(White and Black Line)

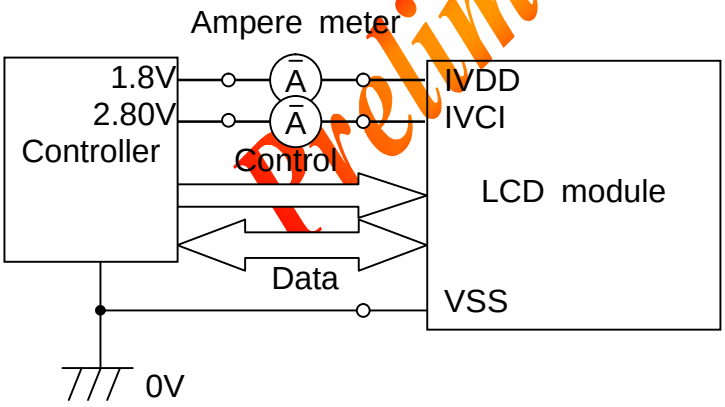
*2 RGB_IF is Disable



H Line Stripe

Refer to R61581 data sheet for AC and other DC characteristics

Test circuit

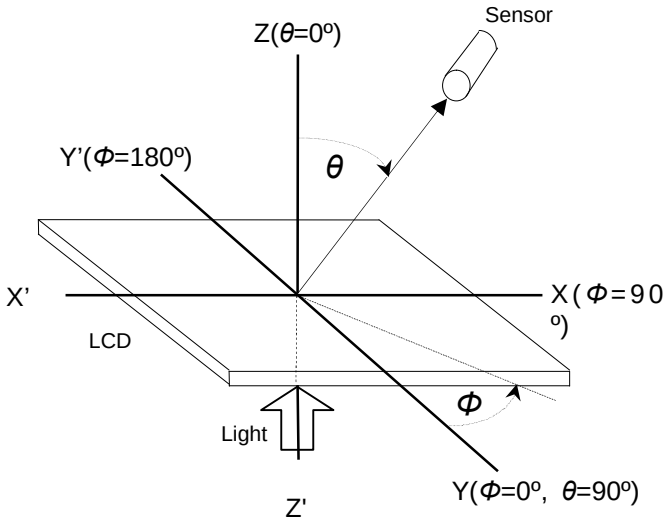


6. LCD Characteristics

LCD Optical Characteristics

VSS=0V, VDD=1.8V,VCI=2.80V

Item		Symbol	Condition		Min.	Typ.	Max.	Unit
contrast ratio		C	θ=0°, φ=0°	25°C	(500)	(800)	-	-
Range of Viewing angle (θ:6h–12h)		θ(6h) - θ(12h)	C≥10	25°C	80	-	-	degree
Range of Viewing angle (θ:3h–9h)		θ(3h) - θ(9h)	C≥10	25°C	80	-	-	degree
Color	White	x	BM-7 (TOPCON) θ=0°, φ=0°	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			(0.29)	(0.34)	(0.39)	-
	Green	x		25°C	(0.28)	(0.33)	(0.38)	-
		y			(0.58)	(0.63)	(0.68)	-
	Blue	x		25°C	(0.10)	(0.15)	(0.20)	-
		y			(0.04)	(0.09)	(0.14)	-
NTSC ratio		-	↑	25°C	-	70	-	%
B/W Response time		Ton +Toff	θ=0°, φ=0°	25°C	-	35	-	msec
		Ton +Toff	θ=0°, φ=0°	-20°C	-	(240)	-	



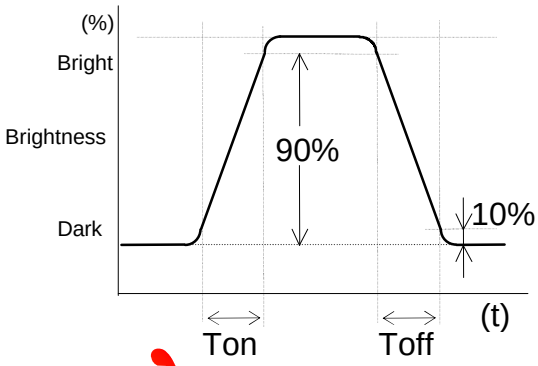
*Definition of contrast C

The contrast ratio is defined as follows:

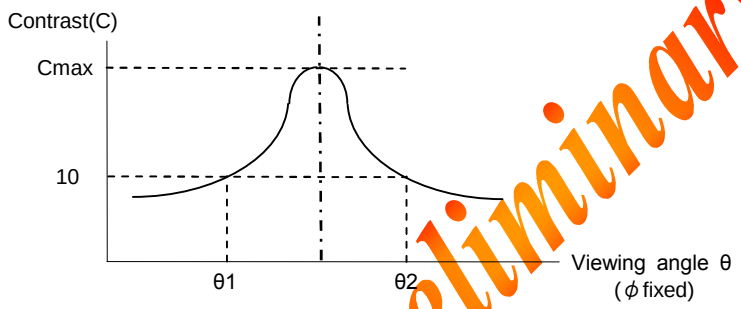
$$C = \frac{\text{Brightness of selected position(white)}}{\text{Brightness of unselected position(black)}}$$

*Definition of response time (Ton, Toff)

The response time is defined as the following figure.



*Definition of viewing angle θ1 and θ2



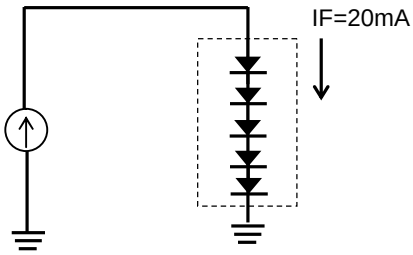
Note: Angle of optimized contrast with naked eye and viewing angle θ at Cmax above are not always the same.

7. LED Backlight Characteristics

VSS=0V, VDD=1.8V,VCI=2.80V

Item	Symbol	Condition	Min.	Typ.	Max.	unit
Brightness *1 *2 *3	Bp	Ta=25ºC±3ºC 30-80%RH	(260)	(350)	-	cd/m^2
Uniformity *1 *2 *4	Δ Bp		(70)	-	-	%

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



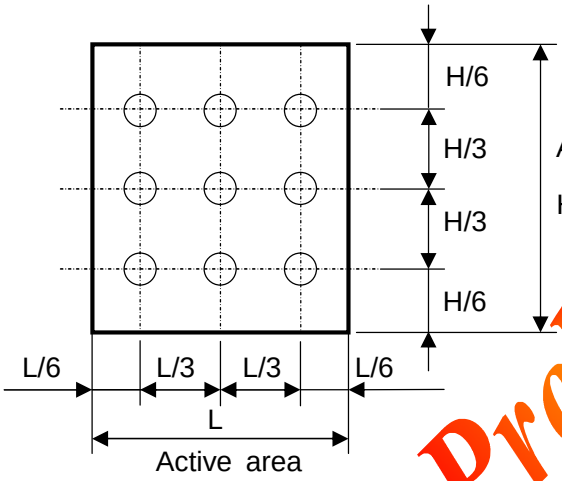
*1 The data is measured after LEDs are turned on for 5 minutes.

*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)
$\Delta B_P = B_P$ (Min.) / B_P (Max.) x 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).

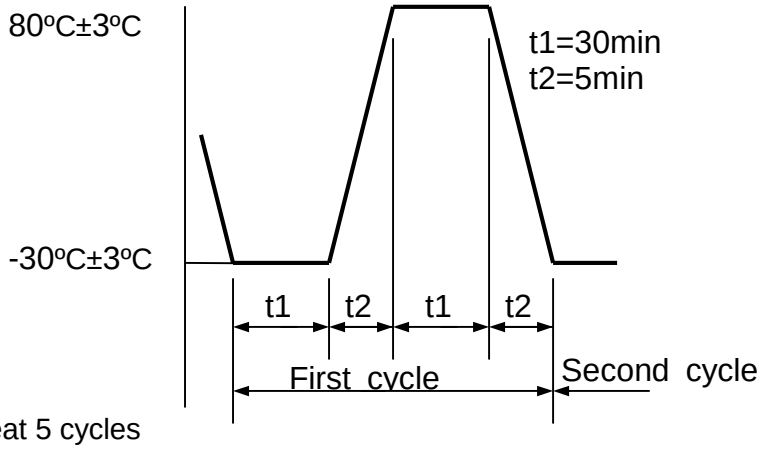
Measurement spots（9spots）



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	+80ºC±3ºC, for 240 hours *Measure after 12hours left at normal temperature and humidity.
Low temperature storage	-30ºC±3ºC for 240 hours *Measure after 12hours left at normal temperature and humidity.
Operation at high temperature	+70ºC±3ºC, 30%RH max for 240 hours *Measure after 12hours left at normal temperature and humidity.
Operation at low temperature	-20ºC±3ºC, for 240 hours *Measure after 12hours left at normal temperature and humidity.
Operation at high temperature and high humidity	+40ºC±3ºC, 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 malfunctining 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.

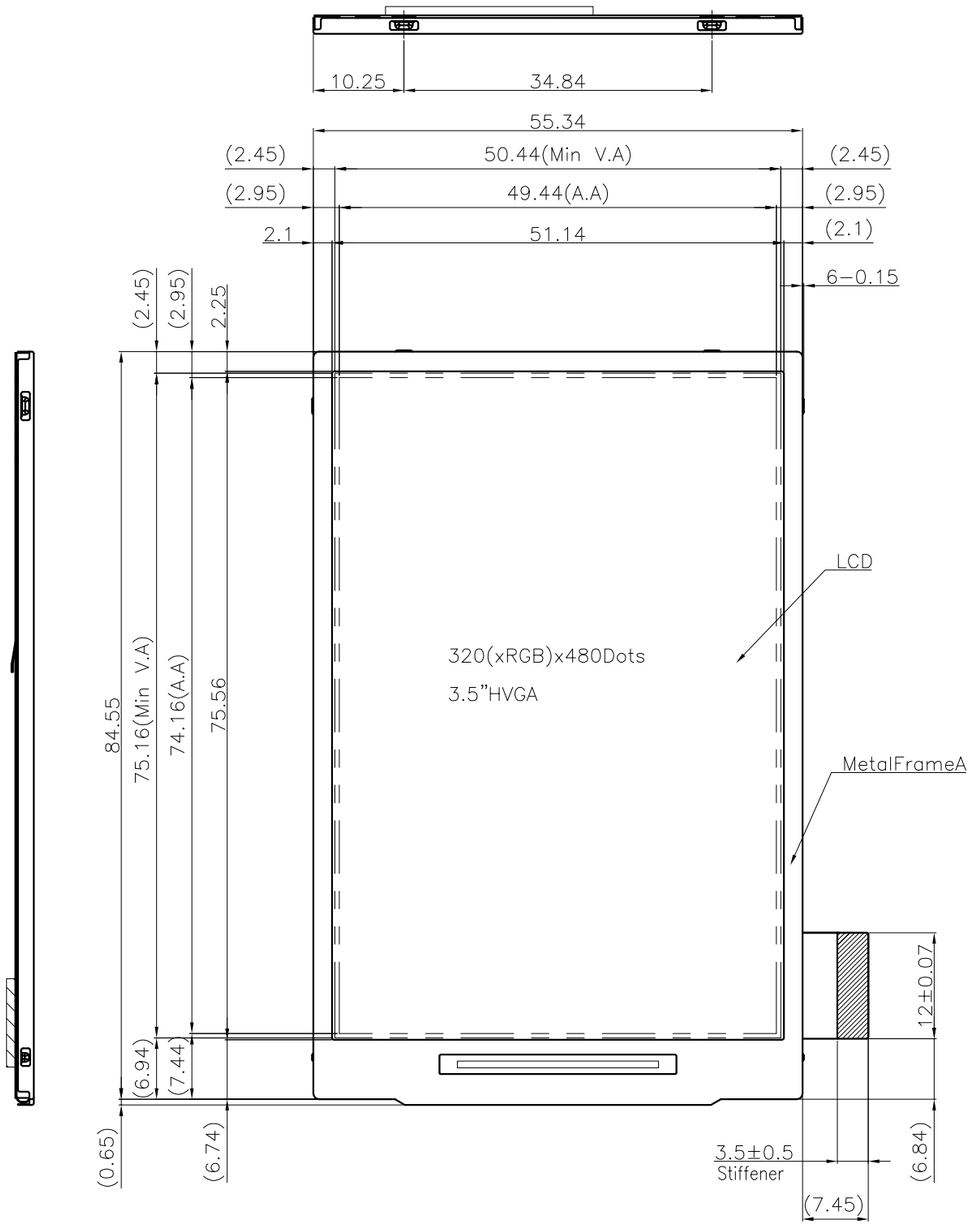
9-6 Cleaning

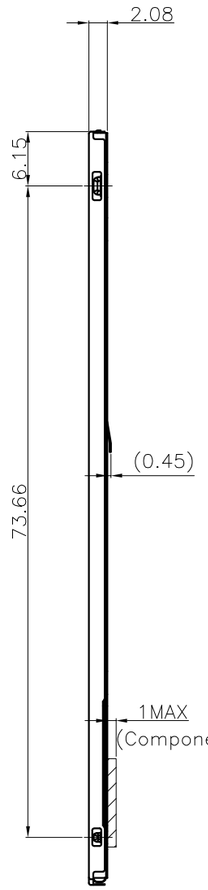
(1) **DO NOT** wipe the polarizer with dry cloth, as it might cause scratch.
(2) Wipe the polarizer with a soft cloth soaked with petroleum IPA, other chemical might damage.

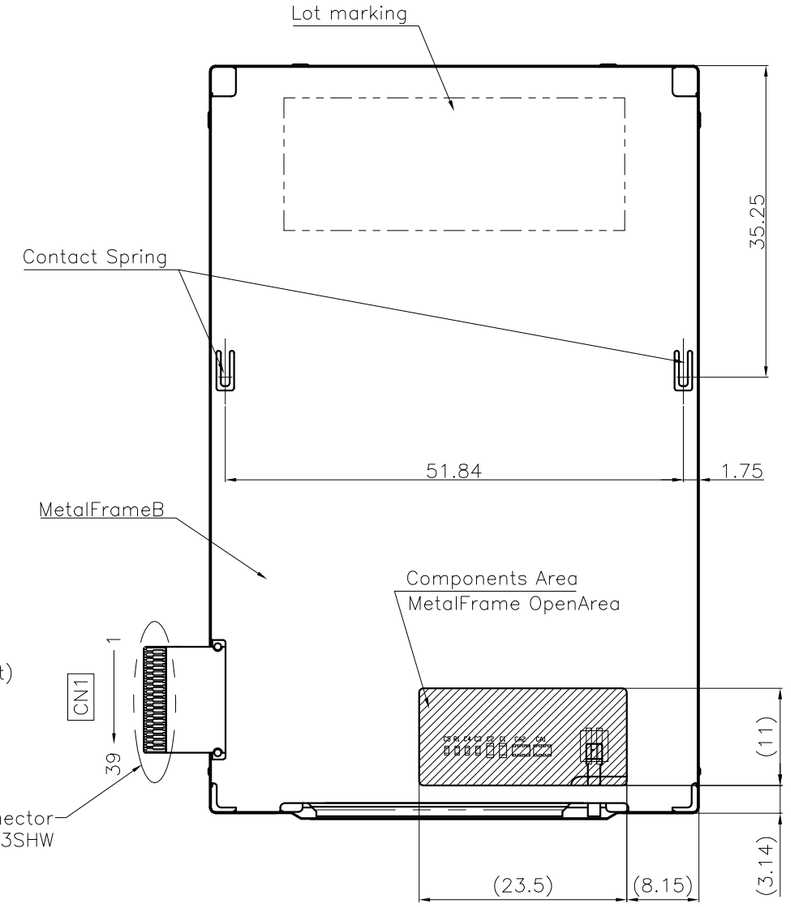
9-7 Waste

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

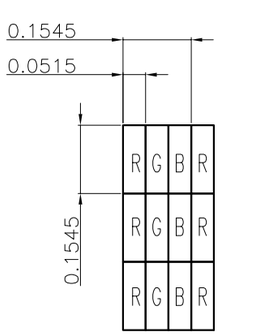
General tolerance ±0.2



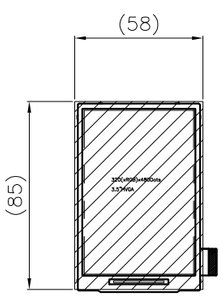




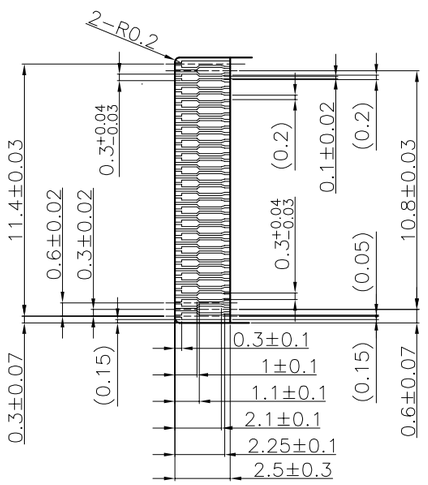
No.	Name
1	GND
2	LED−
3	GND
4	LED+
5	LDEPWM
6	GND
7	RESX
8	VCI
9	GND
10	IOVCC
11	GND
12	CSX
13	SCL
14	DIN
15	DOUT
16	DB0
17	DB1
18	DB2
19	DB3
20	DB4
21	DB5
22	DB6
23	DB7
24	DB8
25	DB9
26	DB10
27	DB11
28	DB12
29	DB13
30	DB14
31	DB15
32	DB16
33	DB17
34	DE
35	GND
36	PCLK
37	GND
38	HSYNC
39	VSYNC



Dots detail(100/1)



Protection Film
(SCL:Free)

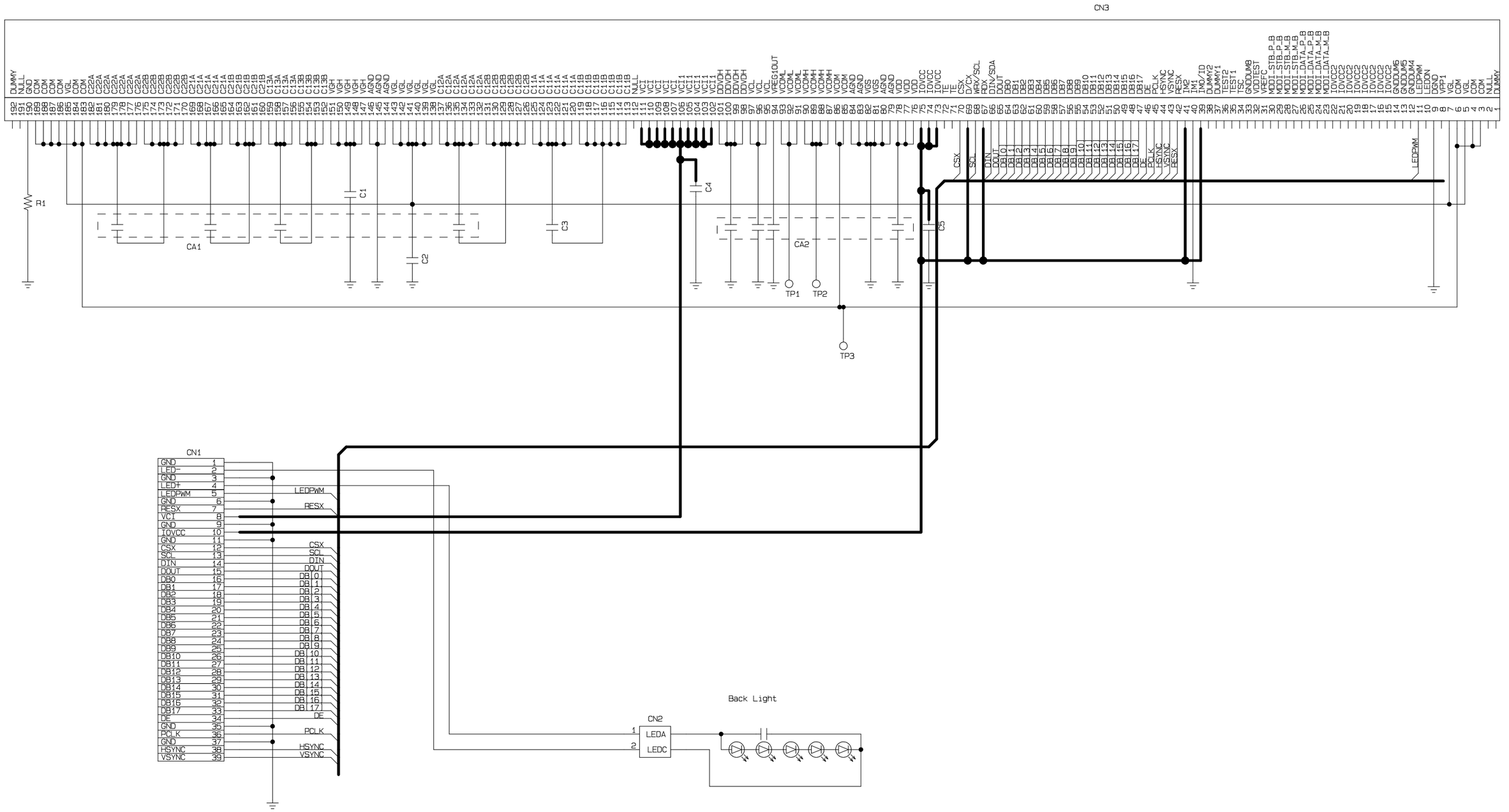


CN1 Detail(5/1)

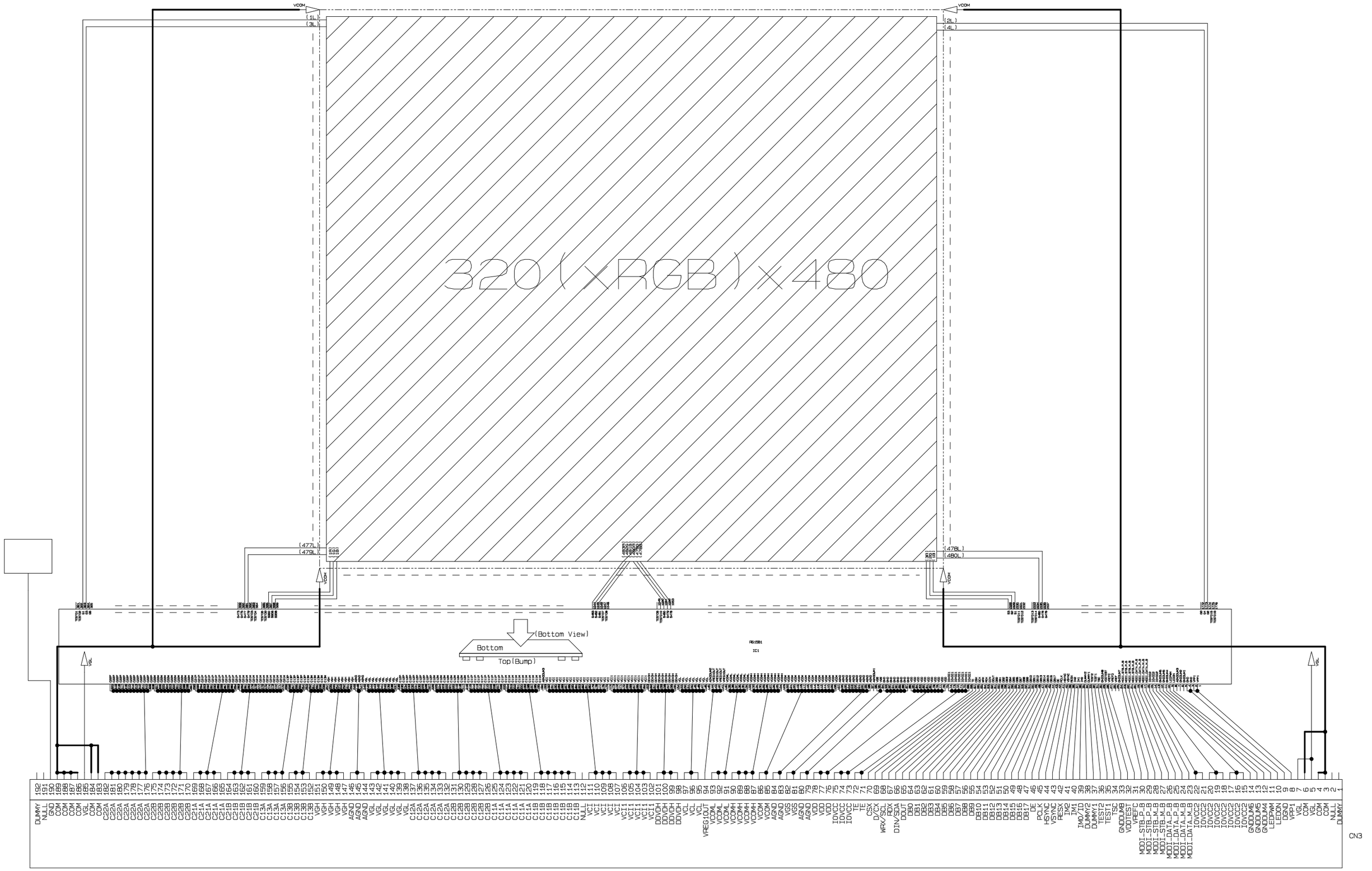
ST10−171	a	Setup for Sample				
CHIEF	LEADER	DESIGNED	DRAWN	CHECKED		
M.Seimiya	S.Sato	T.Hosokawa	T.Hosokawa	S.Sato		

MATERIAL				
TREATMENT				
PART NUMBER	SCALE	UNIT	DATE	
(1)	2/1	1=1mm	9.Jul,2010	
CAL.	35HVF0HZ2			
TITLE	Assembly drawing			REV. a
DRAWING No.	35HVF0HZ2 1A			PAGE 1

Seiko Instruments Inc.



						DATE 2010.05.7
						CAL. 35HVF0HZ0
2010.05.7	a	Idear Drawing				
CHIEF	LEADER	DESIGNED	DRAWIN	CHECKED	TITLE Circuit diagram(FPC)	REV. a
M.Seimiya	K.Tanigawa	K.Tanigawa	K.Tanigawa	M.Kuwahara	DRAWING NO. 35HVF0HZ0 6A	PAGE 4
					Seiko Instruments Inc.	



						DATE 2010.05.10
2010.05.7	a	Idear Drawing				CAL. 35HVFOHZ0
CHIEF	LEADER	DESIGNED	DRAWIN	CHECKED	TITLE Circuit diagram(LCD)	REV. a
M.Seimiya	K.Tanigawa	K.Tanigawa	K.Tanigawa	M.Kuwahara	DRAWING NO. 35HVFOHZ0 6B	PAGE 5
					Seiko Instruments Inc.	