Industrial Solutions Flatpanel Technology

DESIGN FOR TFT COLOR LCD MODULE

Design No.	doh274_170
Revision	Revision 0.1
Type	17" 1280 x 1024

SPECIFICATIONS	
Version	Internal Revision 0.1
Date	23.04.2007
Preliminary ☒	
Final ☐	

Buyer	

This typical design can be used to manufacture dedicated products at i-sft according to the mentioned specification. Please send us a RFQ for this design and stating the number of displays to be build. We will send a formal quote including a final specification. With your formal order please also send a written approval of the final specification. No further activities will start before formal order is processed and written approval of final specification is in!

Records of Revisions

Revision	Date	Description
0.1	23.04.07	pre series / prototype

1   DESCRIPTION

i-sft doh274_170 is a colour active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as switching devices.
This model is composed of a TFT LCD panel, a driver circuit and a backlight system.
The 17" display has a resolution of 1280 x 1024 pixels and can display up to 16.2 mio. colours. 6 o'clock direction is the optimum viewing angle.

2   FEATURES

- High brightness 1000 cd/m²
- Integrated inverter for driving backlight
- High contrast ratio, high aperture structure
- SXGA (1280 x 1024 pixels) resolution
- Low power consumption
- 6 CCFLs (Cold Cathode Fluorescent Lights)
- 2ch LVDS Interface

3   APPLICATIONS

- Point of Information / Point of Sales
- Monitors for industrial use

4   STRUCTURE AND FUNCTIONS

A TFT colour LCD module comprises a TFT LCD panel and LSIs for driving the liquid crystal. The TFT LCD panel is composed of a TFT array glass substrate superimposed on a colour filter glass substrate with liquid crystal filled in the narrow gap between two substrates.

RGB (Red, Green, Blue) data signals are sent trough a signal processor to the LCD panel drivers after modulation into suitable forms for active matrix addressing.

Each of the liquid crystal cells acts as an electro-optical switch that controls the incident light transmission. The liquid crystal cell is driven by a signal applied to the TFT switch.

5   OUTLINE OF CHARACTERISTICS

ITEM	SPECIFICATION	UNIT	NOTE
Active Display area	337,92 (H) x 270,336 (V) (17 inch diagonal)	mm	
Driver element	a – Si TFT active matrix		
Display colours	16.2M (6 Bit + FRC)		
Number of pixels	1280 x 1024	pixel	
Luminance (typ.)	1000	cd/m²	
Dimming ratio	tbd		
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.264 (H) x 0.264 (W)	mm	
Display Mode	Normally White		
Surface treatment	Anti - glare, hard - Coating (3H)		

6   BLOCK DIAGRAM
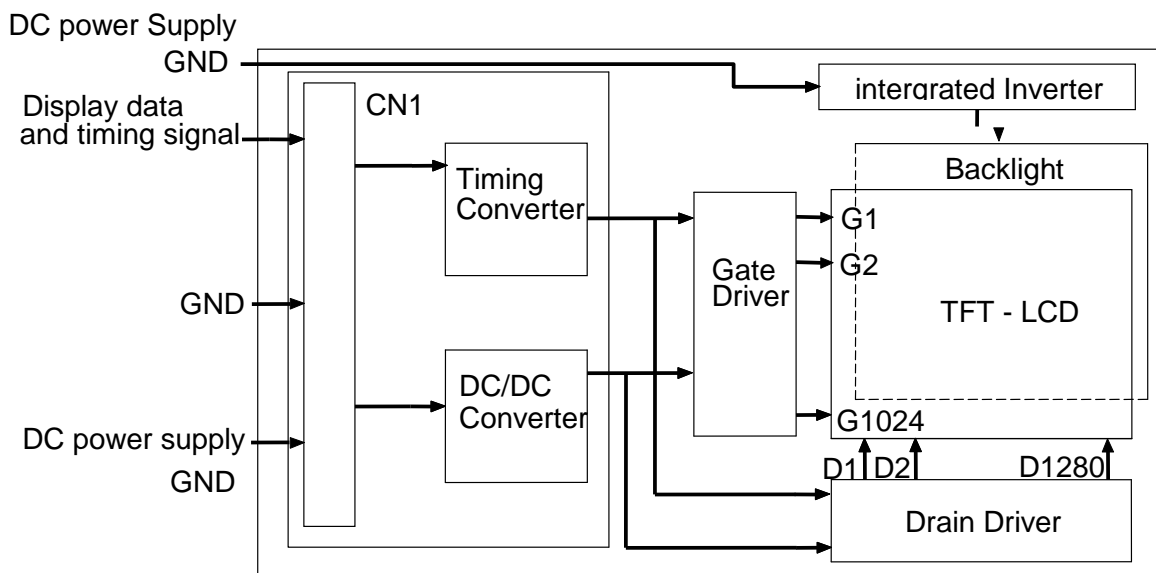
7   SPECIFICATIONS

7-1   GENERAL SPECIFICATIONS

ITEM		TYP.	UNIT
Module size	Horizontal (H)	368	mm
	Vertical (V)	303.2	mm
	Depth (D)	24.9	mm
Weight		tbd	g

7-2   ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Storage temperature	T_{STG}	-10	65	°C	
Operating temperature (Surface of Glass)	T_{OPR}	0	60	°C	
Shock (operating)	S_{nop}	tbd	tbd	g	
Vibration (operating)	V_{nop}	tbd	tbd	g	

7-3   ELECTRICAL ABSOLUTE RATINGS

TFT LCD MODULE

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Power Supply Voltage for logic	VDD	0	6.5	V	(1)
Input signal Voltage for logic	VI	-0.5	VDD +0.5	V	(1)

Notes
(1) Permanent damage may occur to the LCD module if beyond this specification. Functional operation should be restricted to the conditions described under Normal Operating Conditions.

7-4   ELECTRICAL CHARACTERISTIC

TFT LCD MODULE   Ta=25±2°C

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Power Supply Voltage	VDD	4.5	5	5.5	V	
Power Supply Current	IDD	-	700	950	mA	
VSYNC Frequency	fV	56.25	60	75	Hz	(1)
HSYNC Frequency	fH	-	63.19	75	kHz	
DCLK Frequency	fCLK	50	54	67.5	MHz	
Input rush current	IRUSH	-	-	3	A	(2)

Note
(1) When fV is too low, a flicker may be occurred on the display.
(2) Input Rush Current condition
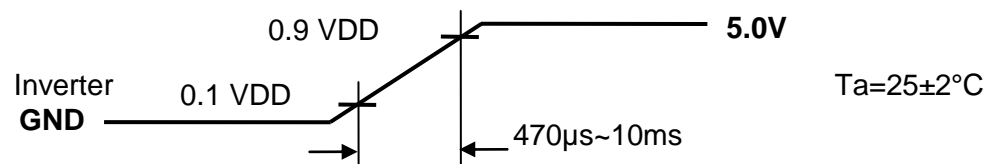
INVERTER

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Power Supply Voltage	Vinv	-	24	-	V	
Power consumption	Pinv	-		-	W	

7-5   INTERFACE PIN CONNENCTION

TFT LCD MODULE (Interface Signal & Power)
Connector: FHI-X30S-HF   Matching Socket:

Pin No.	Symbol	Description	Note
1	INO0-	Transmission data of pixels 0 odd (negative: -)	
2	INO0+	Transmission data of pixels 0 odd (positive: +)	
3	INO1-	Transmission data of pixels 1 odd (negative: -)	
4	INO1+	Transmission data of pixels 1 odd (positive: +)	
5	INO2-	Transmission data of pixels 2 odd (negative: -)	
6	INO2+	Transmission data of pixels 2 odd (positive: +)	
7	GND	Ground VSS	
8	INOC-	Sampling clock odd (negative: -)	
9	INOC+	Sampling clock odd (positive: +)	
10	INO3-	Transmission data of pixels 3 odd (negative: -)	
11	INO3+	Transmission data of pixels 3 odd (positive: +)	
12	INE0-	Transmission data of pixels 0 even (negative: -)	
13	INE0+	Transmission data of pixels 0 even (positive: +)	
14	GND	Ground VSS	
15	INE1-	Transmission data of pixels 1 even (negative: -)	
16	INE1+	Transmission data of pixels 1 even (positive: +)	
17	GND	Ground VSS	
18	INE2-	Transmission data of pixels 2 even (negative: -)	
19	INE2+	Transmission data of pixels 2 even (positive: +)	
20	INEC-	Sampling clock even (negative: -)	
21	INEC+	Sampling clock even (positive: +)	
22	INE3-	Transmission data of pixels 3 even (negative: -)	
23	INE3+	Transmission data of pixels 3 even (positive: +)	
24	GND	Ground VSS	
25	GND	Ground VSS	
26	NC		
27	GND	Ground VSS	
28	VDD+5V	Power supply +5 V	
29	VDD+5V	Power supply +5 V	
30	VDD+5V	Power supply +5 V	

7-6   DISPLAY COLOUR vs. INPUT DATA SIGNAL

Color	Input	Red Data								Green Data								Blue Data							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
		MSB							LSB	MSB							LSB	MSB							LSB
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenda	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	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	1	1	1	1	1	1
Red	Black	0	0	0	0	0	0	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	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red (254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green	Black	0	0	0	0	0	0	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	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green (254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Blue	Black	0	0	0	0	0	0	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	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	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue (254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Notes 1) Definition of gray scale:

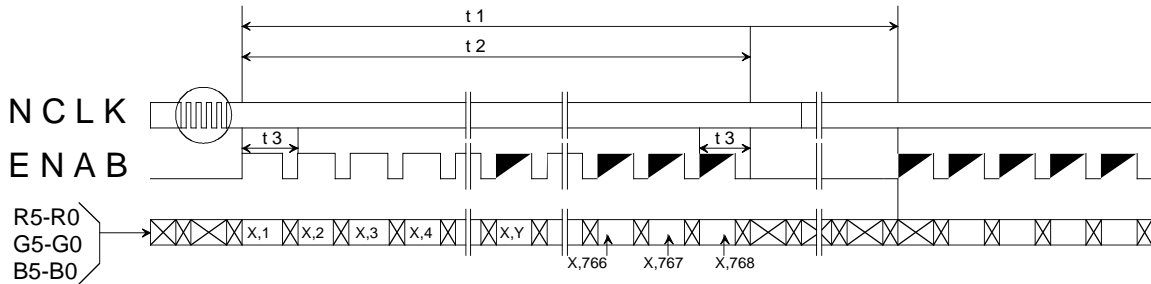Color(n) .... Number in paranthesis indicates gray scale level. Larger in corresponds to

brighter level.
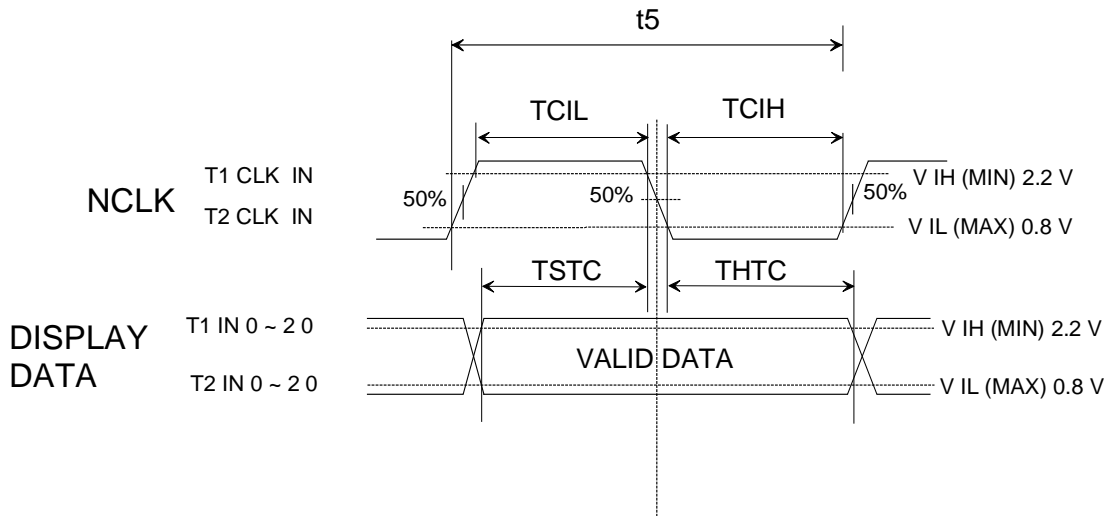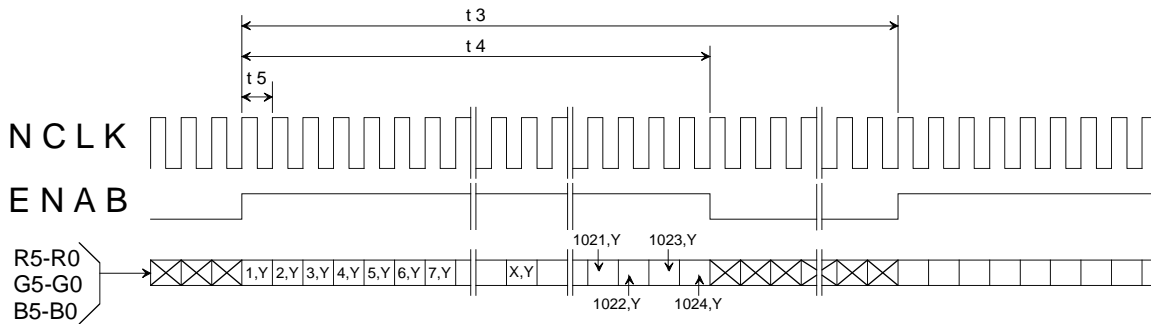
2) Data: 1:   0:

High,   Low

7-7   INPUT SIGNAL TIMING

Item	Symbol	MIN	TYP	MAX	Unit	Note
Frame Period	t1	1046 x t3	1066 x t3		-	
Vertical Display Term	t2	1024 x t3	1024 x t3	1024 x t3	-	
One Line Scanning	t3	710 x t5	844 x t5	-	-	
Horizontal Display Term	t4	640 x t5 163 x t5	640 x t5	640 x t5	- -	
Clock Period	t5	14.3	18.5	22.2	ns	

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(1) Vertical Timing

NCLK

ENAB

R5-R0
G5-G0
B5-B0

t 1
t 2
t 3
t 3

X,1 X,2 X,3 X,4   X,Y

X,766   X,767   X,768

(2) Horizontal Timing

NCLK

ENAB

R5-R0
G5-G0
B5-B0

t 3
t 4
t 5

1,Y 2,Y 3,Y 4,Y 5,Y 6,Y 7,Y   X,Y

1021,Y   1023,Y

1022,Y   1024,Y

t5

TCIL   TCIH

NCLK   T1 CLK IN
        T2 CLK IN

50%   50%   50%

V IH (MIN) 2.2 V
V IL (MAX) 0.8 V

TSTC   THTC

DISPLAY   T1 IN 0 ~ 2 0
DATA
        T2 IN 0 ~ 2 0

VALID DATA

V IH (MIN) 2.2 V
V IL (MAX) 0.8 V

7-8   SUPPLY VOLTAGE SEQUENZE

Power Supply Voltage VDD
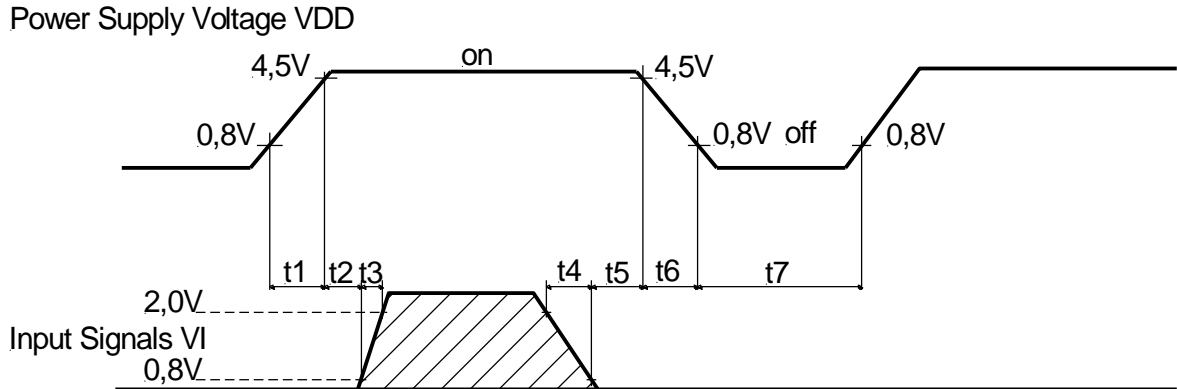
$$0 \text{ ms} < t4 \leq 3 \text{ ms}$$
$$0 \text{ ms} < t2 \leq 50 \text{ ms}$$
$$0 \text{ ms} < t3 \leq 3 \text{ ms}$$

$$t1 \leq 40 \text{ ms}$$
$$0 \text{ ms} < t5 \leq 50 \text{ ms}$$
$$0 \text{ ms} < t6 \leq 1 \text{ s}$$
$$t7 \geq 0.2 \text{ s}$$

Power ON OFF

Notes
(1) Set $0V \leq VI(t) \leq VDD(t)$
     Here, VI (t), VDD (t) indicate the transitive state of VI, VDD when power supply is
     turned ON or OFF.
(2) Do not keep interface signal high-impedance when power ON.

7-9   OPTICAL CHARACTERISTICS

Measuring equipment:
Luminance, Chromaticity: TOPCON BM-7
Viewing Angle, Contrast: ELDIM EZContrast 160D

TA = 25°C ± 2°CD, VDD = 5 V, fv = 60 Hz, f_{DCLK} = 54 Hz

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Remark
Viewing Angle	Horizontal	$\varnothing$x+	CR>10, $\varnothing$y = ±0°	-	70	-	deg.	(1), (4)
		$\varnothing$x-	CR>10, $\varnothing$y = ±0°	-	70	-	deg.	
	Vertical	$\varnothing$y+	CR>10, $\varnothing$x = ±0°	-	70	-	deg.	
		$\varnothing$y-	CR>10, $\varnothing$x = ±0°	-	60	-	deg.	
Contrast ratio		CR	$\varnothing$y=-5°, $\varnothing$x=±0°	-	Tbd	-	-	(1), (2), (4)
Response time		T_R T_F	rising falling	-	16	30	ms	(1), (3)
Luminance (center of screen)		Lw	at center	-	1000	-	cd/m^2	(1), (4)
Dimming range		DR			tbd		-	(1), (4)

Note
(1) Definition of viewing angle
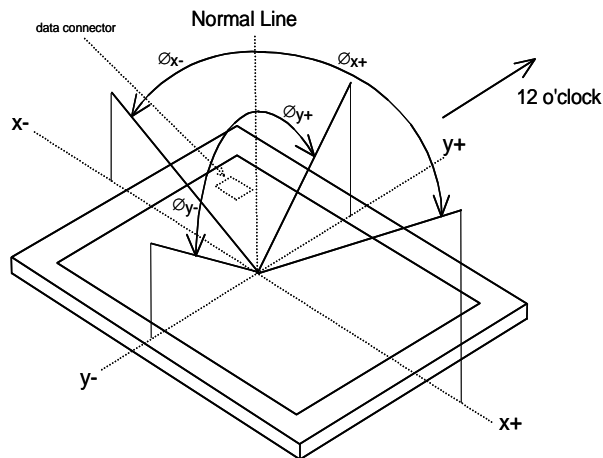
(2)   The contrast ratio is calculated by using the following formula:

$$\text{Contrast ratio} \; = \; \frac{\text{Brightness (Luminance) with all pixels in “White”}}{\text{Brightness (Luminance) with all pixels in “Black”}}$$

The brightness is measured in a darkroom.

(3) Definition of the response time:
Photodetector output signal is measured when the brightness changes from "white" to "black" or "black" to "white" respectively. The response time is the time between 10% and 90% of the photodetector output.
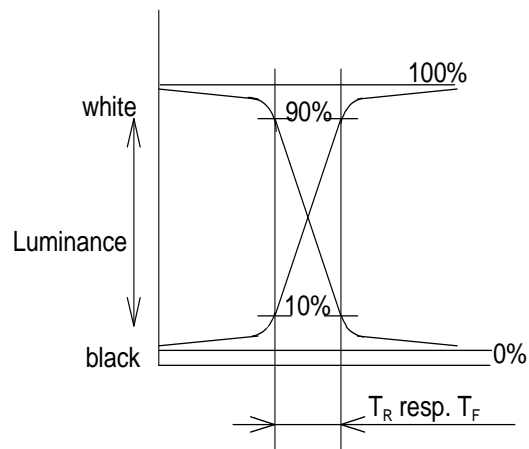
(4) Brightness measurements setup
The measurements should be executed in a dark room 30 min. after lightning the backlight. Matrix: off state. The brightness is measured in the centre of the screen. Environment condition: T = 25 ± 2 °C, it has to be assured that a sufficient heat flow / Air circulation is given

Photo detector
(Topcon BM-7)

50 cm

aperture angle 2°

TFT-LCD Module

LCD Panel

center of screen
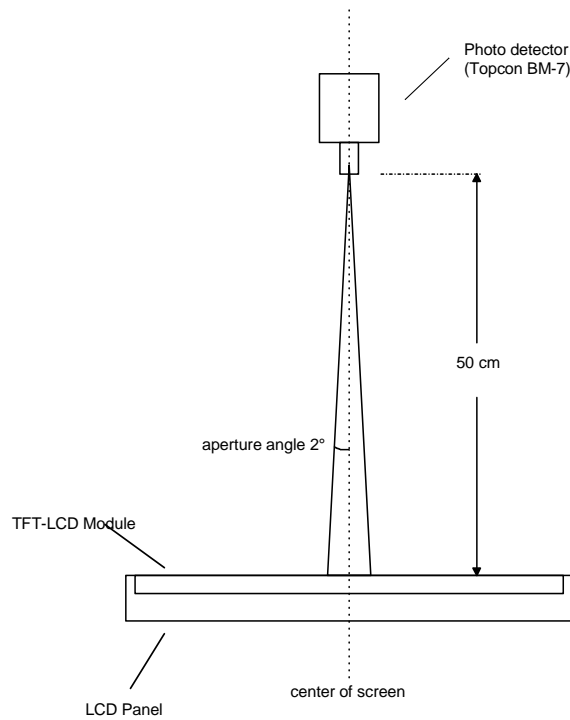
7-10   INVERTER SPECIFICATION

PIN CONNECTION

Connector: JST S8B-PH-SM3-TBc
Corresponding connector: housing JST PHR-8, contacts JST SPH-002T-P0.5S

Pin #	Description	value
1	Supply voltage for Inverter (1)	typ. 24 VDC
2	Supply voltage for Inverter (1)	typ. 24 VDC
3	Power limit signal (only control signal) **Do not connect an external signal!**	low -> limiter on high -> limiter off
4	Remote on / off	GND -> off not connected -> on
5	Reference current output for dimming with variable resistor (2)	typ. 2.5 mA
6	Analog Dimming input (2)	0 – 2.5 VDC
7	Ground (1)	GND
8	Ground (1)	GND

Note
(1) For connecting use both pin 1 and 2 parallel and pin 7 and 8 parallel
(2) For the dimming a 1KΩ variable resistor is required. The wires to use from the loose end of the connector are 5, 6 and 7.
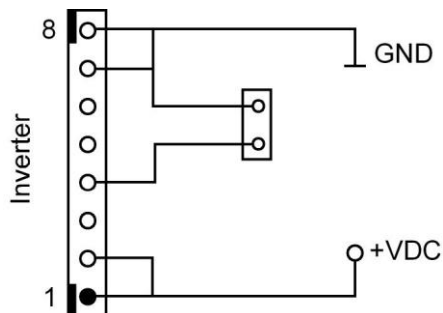
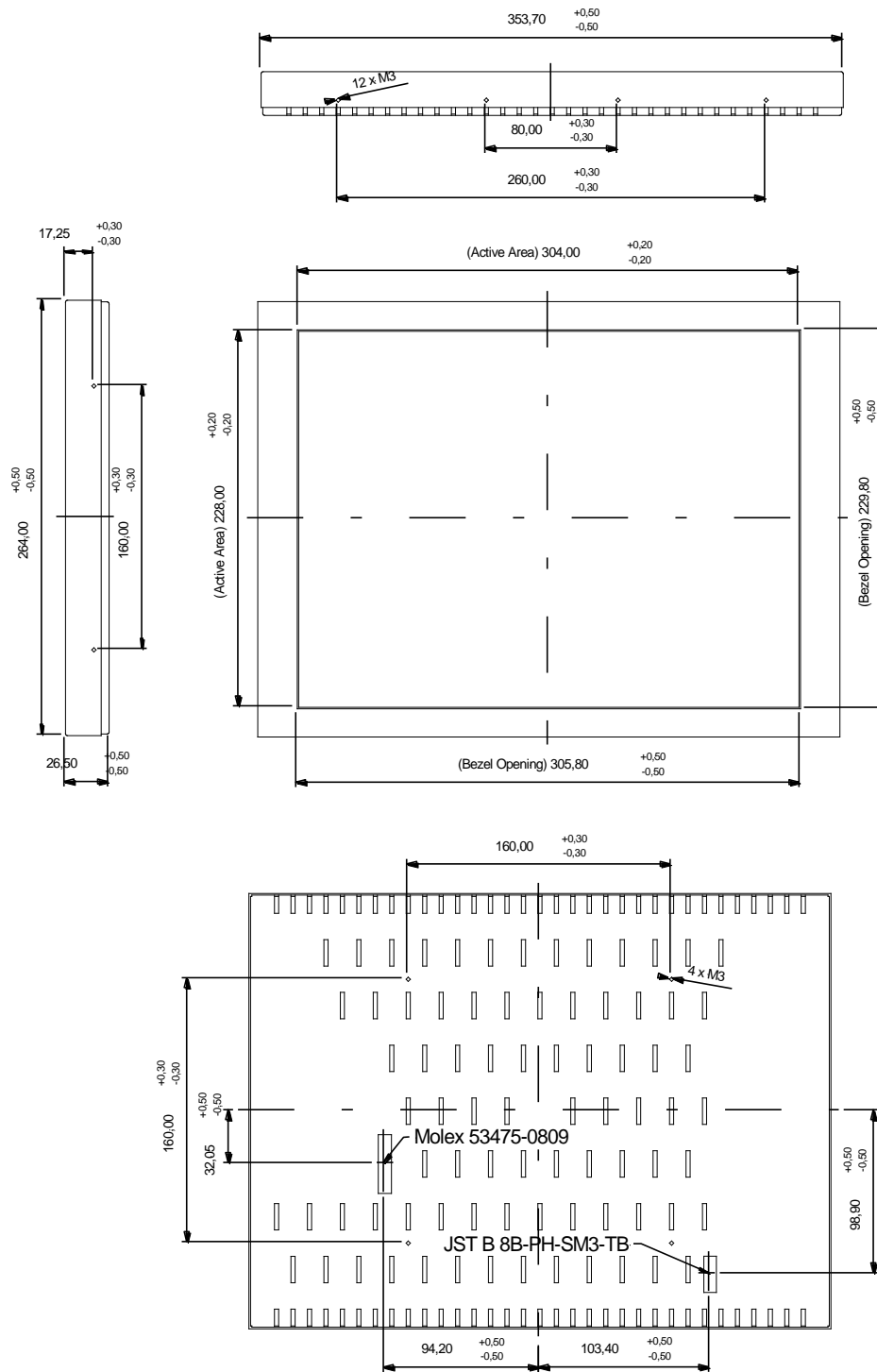1)   Dimming with variable Resistor (pin 7: 0 V)
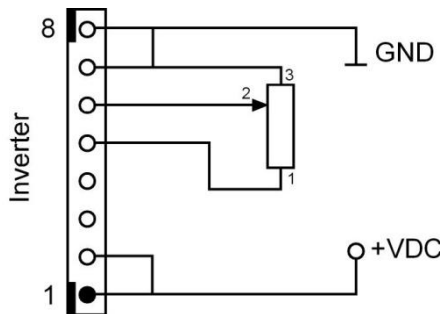
2)   Dimming with variable analog DC voltage. Variable voltage 0 to 2.5 VDC (pin 7: 0 V)
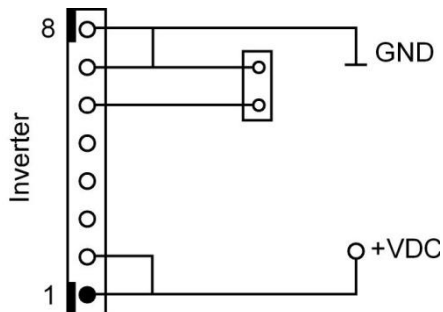
3)   Digital Dimming with PWM control 0 to 100% PWM, PWM 200 – 1000 Hz; TTL-Level
(pin 7: 0 V)

7-11   OUTLINE DIMENSION

7-12   DEFECT SPECIFICATIONS

a)Inspection conditions

Distance   : the distance between the inspector's eye and the LCD panel is 20cm.

Luminance : the distance between a 20-W fluorescent lamp and the LCD panel is 25-30 cm.

Temperature: Room temperature is 25C°±5C°.

Viewing angle:

Display specifications   : $-20° \leq \theta x \leq +20°$, $0° \leq \varnothing y \leq +20$

Appearance specifications: $-45° \leq \theta x \leq +45°$, $-45° \leq \varnothing y \leq +45°$

Measuring light conditions: for Cold Cathode Fluorescent Lamp

Chromaticity coordinates (x = 0.320, y = 0325) typ.

Luminance of backlight surface for inspection: 1200 cd/m²

b)Display specifications

Item	Specifications			
Line defect	Not allowed			
Luminous dots *1	Color	Brightness	Distance between same color dots	Quantity
	Red, Green	F + H	-	$R + G \leq 6$
		F	-	$R \leq 6$, $G \leq 3$
	Blue	F + H	-	≤ 6
		F	-	≤ 6
	Red, Green, Blue	F	≤ 6.5 mm *4	R, G, B ≤ 0
			Linked two or *3 more dots	R, G, B ≤ 0
Dark dots *2	Color	Distance between dark dots		Quantity
	Black	-		$R + G + B \leq 16$ R, G, B ≤ 7
		Linked two dots *3		≤ 1 pair
		Linked three or *3 more dots		≤ 0
		≤ 6.5 mm *4		≤ 0

*1 F: Full luminous dots (Bright point independent of viewing angle)

H: Half luminous dots (Bright point dependent on viewing angle)

Luminous dots are measured while the screen is black.

*2 Dark dots are measured while the screen is illuminated with Red, Green, or Blue.

*3 Linkage means linked two or more dots.
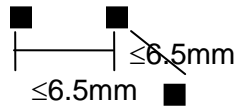
■(Luminous or Dark dot)

To be counted   To be uncounted

*4 ≤ 6.5 mm is considered with:

■ (:Luminous or Dark dot)

		To be counted	To be uncounted
	Luminous dots	Same color	Different color
	Dark dots	Same screen	Different screen

≤6.5mm

≤6.5mm

*5 The dot-amounts of linkage and <6.5 mm are counted when the dots are only full luminous.

c) Appearance specifications

Item	Specifications		
	Measurement criteria		Quantity
Other objects	Average diameter(∅) mm		Allowed value
Stains	∅ ≤0.2		all allowed
Dust	0.2< ∅ <0.3		≤10 points
(dot shape)	0.3< ∅ ≤0.5		≤ 3 points
	0.5< ∅		0 point
	Linked other objects		
	Width(W) mm	Length(L) mm	
Other objects	W ≤ 0.05	-	all allowed
Stains		L < 0.7	
Dust	0.05 ≤ W ≤ 0.1	0.7 ≤ L ≤ 1.0	≤ 4 points
(line shape)		1.0 < L	0 point
	0.1 < W	-	
Polarizer Bubbles	Average diameter(∅) mm		
Wrinkles Dent	∅ ≤ 0.5		< 2 points
Panel dent	∅ ≤ 0.5		< 2 points
Polarizer scratch	Remarkable scratches		0 point
Form	Specified labels and parts are put		

The relevant data for the values above are only valid under the conditions described in 7-9 "a".

8   GENERAL PRECAUTIONS

8-1   HANDLING

(a) When the module is assembled, it should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.

(b) Length of fixation screws for the housing should not exceed 5 mm on the top and the bottom. Length of fixation screws on the sides of the housing should not exceed 15 mm and the length of the screws for the back-plate max. 8 mm.

(c) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and CCFT backlight.

(d) Note that polarizer are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.

(e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining and discoloration may occur.

(f) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

(g) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane.
Do not use Ketone type materials (ex. Acetone) Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might produce a permanent damage to the polarizer due to chemical reaction.

(h) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.

(i) Protect the module from static, it may cause damage to the C-MOS Gate Array IC.

(j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(k) Do not disassemble the module!
      This will result in loss of guarantee when within the period.

(l) Pins of I/F connector shall not be touched directly with bare hands.

8-2   STORAGE

(a) Do not store the TFT-LCD module in direct sunlight.

(b) The module shall be stored in a dark place. It is prohibited to apply sunlight fluorescent light during the store.

8-3   OPERATION

(a) Do not connect; disconnect the module in the "Power On" mode.

(b) Power supply should always be turned on/off by following item 7.9 "SUPPLY VOLTAGE SEQUENZE".

(c) 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.

8-4   OTHERS

(a) Ultra-violet ray filter is necessary for outdoor operation.

(b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.

(c) Do not exceed the absolute maximum rating values (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, so on). Otherwise the module may be damaged.

(d) If the module displays the same pattern continuously for a long period of time, it can be the situation when the image "sticks" to the screen.

(e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.

9   COSMETIC SPECIFICATIONS

9-1   VISUAL INSPECTION

1) INSPECTED AREA

i)   The distance between inspector's eyes and the module is around 300 mm.
     Viewing angle for inspection is as follows:
     q ≤ 45° when non-operating inspection.
     q ≤ 5° when operating inspection.

ii) Inspection should be executed only from front side, and only for A-zone. The
     visual defects of B & C-zone are ignored (refer to 9.2 DEFINITION OF ZONE)

2) ENVIRONMENTAL

i)   Ambient temperature: 25°C

ii) Illumination for inspection should be around 2000 (lx) in the module operation and
     around 1000 (lx) in non-operation.

iii) Back-light is powered on in the inspection for module operation.

3) OPERATING INSPECTION

Number of display colors in the inspection is 8 only (Gray scale 0 and 255 for each
Red, Green, Blue and White).
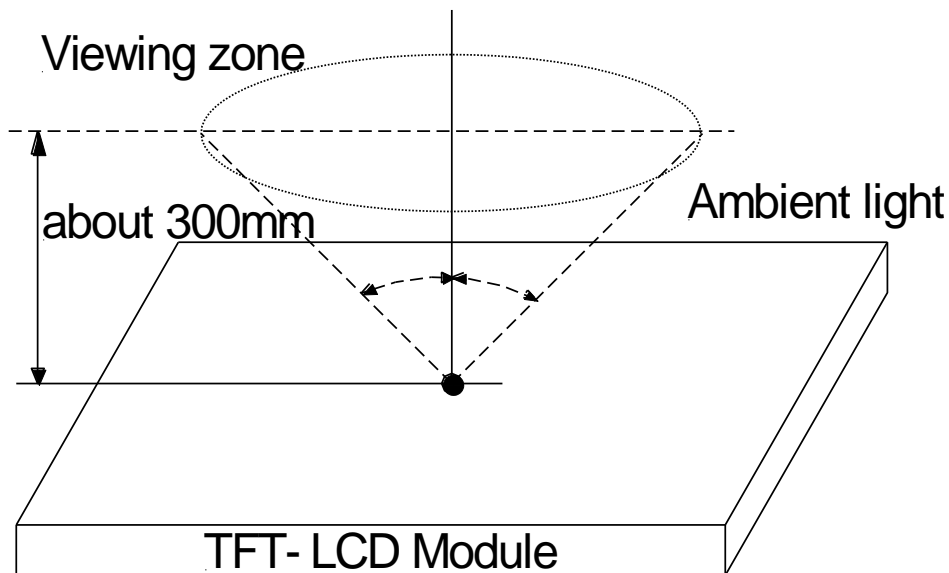
9-2   DEFINITION OF ZONE

Each zone is defined as follows. The visual defects are specified at A-zone and the
specification is not applicable to B & C-zone. (Defects in B & C-zone are disregarded.)

- A-zone: Display area (pixel area)
- B-zone: Area between A-zone and C-zone
- C-zone: Metallic bezel area (include I/F connector)

A-zone

B-zone

C-zone
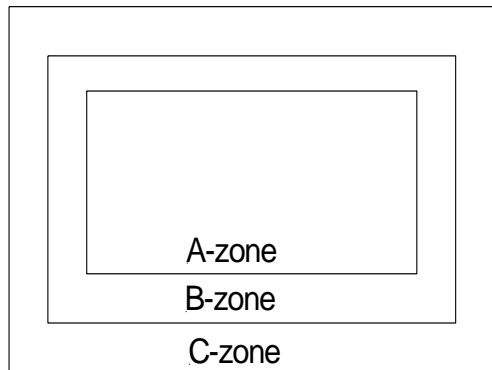
9-3   COSMETIC SPECIFICATION

The following are inspected at the module stable operation and defects appearing at powered on & off is disregard.

	No.	ITEM			Maximum Acceptable Number		Note
					A-zone	Unit	
Operating Inspection	1	Dot Defect	Sparkle Mode	1 dot	7	pcs	1),2),4)
				2 dot	3	Unit	1),2),5)
				3 dot	0		
				4 dot	0		
				Density	0	pcs/∅20mm	1),2),6)
				Total	7	pcs	1),2)
			Black Mode	1 dot	7	pcs	1),3),4)
				2 dot	3	Unit	1),3),5)
				3 dot	0		
				4 dot	0		
				Density	3	pcs/∅30mm	1),3),6)
				Total	7	pcs	1),3)
				Total	7	pcs	1)
	2	Line Defect			Serious one is Not allowed	-	-
	3	Uneven brightness					
	4	Stain Inclusion Line shape W: width(mm) L: length(mm)	W ≤ 0.02	L:Ignore	Ignore	pcs	7)
			W ≤ 0.04	L ≤ 2.0	10		
				L < 2.0	0		
			W ≤ 0.08	L ≤ 1.0	10		
				L > 1.0	0		
			W > 0.08	-	see Dot shape		
	5	Stain Inclusion Dot shape D: average dia.(mm)	D ≤ 0.24		Ignore	pcs	7)
			D ≤ 0.4		5		
			D > 0.4		0		
	6	Scratch on polarizer Line shape W: width(mm) L: length(mm)	W ≤ 0.01	L:ignore	Ignore	Pcs	8)
			W ≤ 0.02	L ≤ 40	10		
				L > 40	0		
			W ≤ 0.04	L ≤ 20	10		
				L > 20	0		
	7	Scratch on polarizer Dot shape D: average dia.(mm)	D ≤ 0.2		Ignore	pcs	8)
			D ≤ 0.4		10		
			D > 0.4		0		
	8	Bubbles, Peeling in Polarizer D: average dia.(mm)	D ≤ 0.3		Ignore	pcs	8)
			D ≤ 0.5		10		
			D ≤ 1.0		5		
			D > 1.0		0		
	9	Wrinkles on Polarizer			Serious one is Not allowed	-	-

Note

(1) Defect whose area per each dot is over 50% is regarded as Dot Defect.

(2) Defect whose brightness at all black screen is more than 30% is regarded as Bright Dot Defect.

(3) Defect whose brightness at all white screen is less than 70% is regarded as Dark Dot Defect.

(4) Defect dots which are not adjacent are regarded as Single Dot Defect each.

(5) Two or more Adjacent Defect dots is regarded as n (number)-Adjacent Dot Defect.

(6) Defect density is defined by the number of defects existing in the 20 mm Ø.

(7) Defect which can be easily wiped off is disregarded.

(8) The specification is applicable only to A-zone and if these defects are in B-zone, they are disregarded.

(9) In case of gray scale pattern, obvious defects are to be rejected.