Industrial Solutions Flatpanel Technology

DESIGN FOR TFT COLOR LCD MODULE

Design No.	dmh091_121
Revision	Rev. 1.0
Type	12,1“ 800 x 600
Specification	
Version	Internal Revision 1.1
Date	08.10.2012
Preliminary ☒	
Final ☐	
Approved	

This typical design can be used to manufacture dedicated products at i-sft according to the mentioned specification without additional NRE cost.
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!

Revision	Date	Description
1.0	08.10.2012	First Draft

1 DESCRIPTION

I-SFT dmh091_121 is a custom specific development based module and is not available on the open market.

I-SFT dmh091_121 is a TFT (thin film transistor) active matrix colour liquid crystal display (LCD) comprising amorphous silicon TFT attached to each signal electrode, a driving circuit.

I-SFT dmh091_121 is a **i-sft** GmbH specific design consisting out of a **i-sft** GmbH specific third party manufactured LCD-Glass-Matrix with backlight (which is NOT available in retail), a specific backlight to drive the panel to surface 1000 nit and an integrated e³ controller.

The 12.1 inch diagonal display area contains 800×600 pixels and can display 262,144 colours simultaneously.

2 FEATURES

12.1” SVGA for High bright Applications
High efficiency
Long life e^3 system
Colour temperature 9000K

3 APPLICATIONS

Industrial applications only

4 STRUCTURE AND FUNCTIONS

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

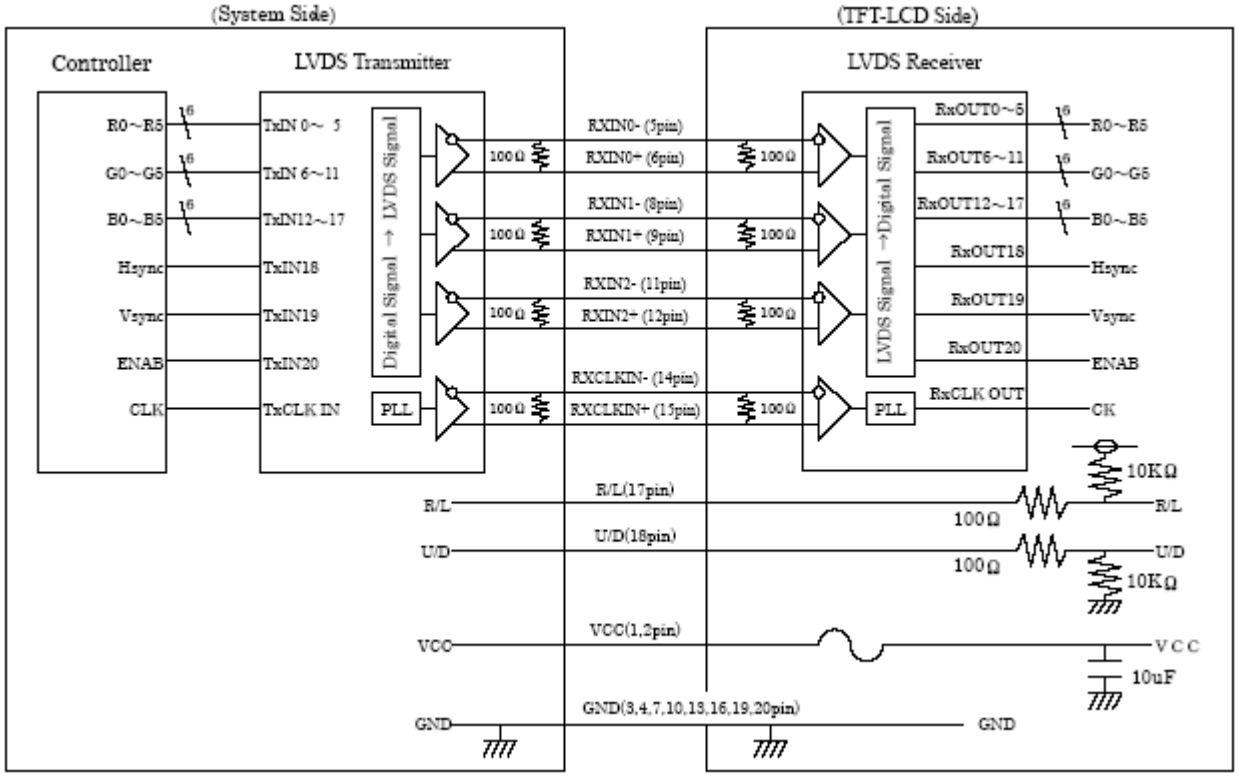
RGB (Red, Green, Blue) data signals are sent to LCD panel drivers after modulation into suitable forms for active matrix addressing through signal processor.

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

5 OUTLINE OF CHARACTERISTICS

ITEM	SPECIFICATION	UNIT	NOTE
Active display area	246.0 (H) x 184.5 (V) (12.1 inch diagonal)	mm	
Driver element	a – Si TFT active matrix		
Display colours	256k		
Number of pixels	800 x 600	pixel	
Luminance (typ.)	1000	cd/m²	
Dimming ratio	1 : 1000		
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.3075 (H) x 0.3075 (W)	mm	
Display mode	Normally White		
Surface treatment	Haze 25, Anti-glare & hard-coating (3H)		

6 BLOCK DIAGRAMM



7 SPECIFICATIONS

7-1 GENERAL SPECIFICATIONS

ITEM		TYP.	UNIT
Module size	Horizontal (H)	283.8	mm
	Vertical (V)	211.7	mm
	Depth (D)	22.15	mm
Weight		1560	g

7-2 ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Storage temperature	T_{nop}	-25	70	°C	(1)
Operating temperature	T_{op}	-10	65	°C	(1)
Shock (operating)	S_{op}	-	tbd	g	
Vibration (operating)	V_{op}	-	tbd	g	

Note
(1) measured at center of display area (front side); no condensation

7-3 ELECTRICAL CHARACTERISTICS

(1) Logic, LCD driving Ta = 25°C

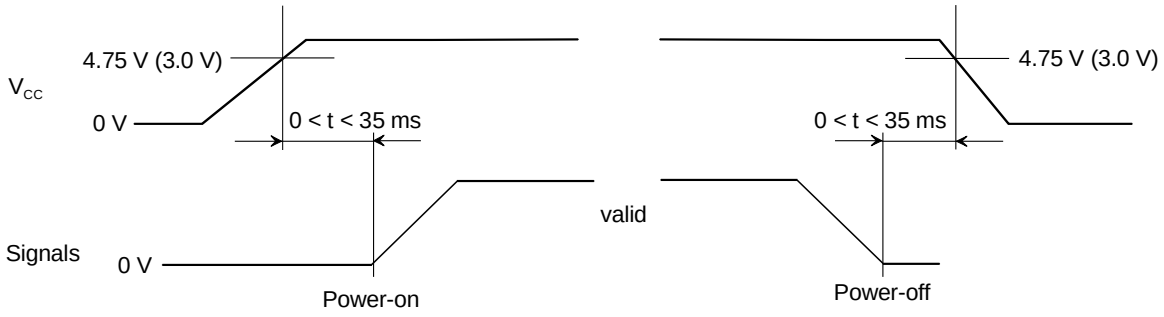
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	Vcc	4.75 (3.0)	5 (3.3)	5.25 (3.6)	V	-
Supply current	Icc	-	230 (380)	280 (480)	mA	Vcc=5.0V (Vcc=3,3V)
Logic input “L” voltage	V_{IL}	-	-	0.8	V	CMOS level note
Logic input “H” voltage	V_{IH}	2.1	-	-	V	

Note: V_{CCi} = 3.3V : is given by DC/DC converter in the LCD module

(2) Backlight, e³ controller driving Ta = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	V_{inv}	-	24	-	V	
Power consumption	P_{inv}	-	20	-	W	

SUPPLY VOLTAGE SEQUENCE



note 1: The supply voltage for input signals should be the same as V_{CC}.

note 2: Turn on the backlight within the LCD operation period. When the backlight turns on before LCD operation or the LCD operation turns off before the backlight turns off, the display becomes momentarily white.

note 3: When the power is off, please keep whole signals (Hsync, Vsync, CLK, DE, MODE and DATA) low level or high impedance.

7-4 INTERFACE PIN CONNECTION

(1) Interface signals, power supply

Module side connector Mating connector

CN30 : DF13-30DP-1.25 (HIROSE) DF13-30DS (HIROSE)

Pin NO.	Symbol	Function
1	V_{DD}	Power supply +3.3 V
2	V_{DD}	Power supply +3.3 V
3	NC	Not Connected
4	GND	Ground
5	GND	Ground
6	GND	Ground
7	GND	Ground
8	IN0+	LVDS Channel 0 Positive data signal (+)
9	IN0-	LVDS Channel 0 Negative data signal (-)
10	GND	Ground
11	IN1+	LVDS Channel 1 Positive data signal (+)
12	IN1-	LVDS Channel 1 Negative data signal (-)
13	IN2+	LVDS Channel 2 Positive data signal (+)
14	IN2-	LVDS Channel 2 Negative data signal (-)
15	CLK+	LVDS Positive clock signal (+)
16	CLK-	LVDS Negative clock signal (-)
17	R/L	Horizontal display mode select
18	U/D	Vertical display mode select
19-23	NC	Not Connected
24	GND	Ground
25-30	NC	Not Connected

(1) for best connection use pin 1 and 2 parallel and pin 4 – 7, 10 and 24 in parallel

7-5 DISPLAY COLORS vs. INPUT DATA SIGNALS

Display colors		Data signal(0: Low level, 1: High level)																	
		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
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	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
Red grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑																		
	↓																		
	bright	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	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 grayscale	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	0	0	0	0	0	1	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	↑																		
	↓																		
	bright	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
		0	0	0	0	0	0	1	1	1	1	1	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 grayscale	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	0	0	0	0	0	0	0	0	0	0	0	1
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	↑																		
	↓																		
	bright	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

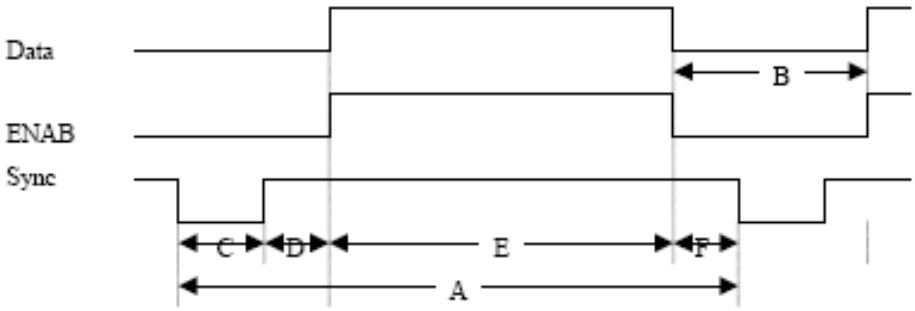
note: colors are developed in combination with 6 bit signals (64 steps in grayscale)
of each primary red, green, and blue color.
This process can result in up to 262,144 (64×64×64) colors.

7-6 INPUT SIGNAL TIMING

(1) INPUT SIGNAL SPECIFICATION

Parameter		Symbol	MIN.	TYP.	MAX.	Unit	Remarks
CLK	Frequency	1/Tc	35	40	42	MHz	-
Hsync	Period	Th	20.8	26.4	39.9	µs	-
	Display period	Thd	832	1056	1395	CLK	
	Front-porch	Thf	-	-	-	µs	
			800	800	800	CLK	
	Pulse width	Thp*)	-	-	-	µs	
			0	40	-	CLK	
	Back-porch	Thb *)	-	-	-	µs	
			2	128	200	CLK	
Vsync	Period	Tv	-	17.6	-	ms	
			628	666	798	H	
	Display period	Tvd	-	17.6	-	ms	
	Front-porch	Tvf	-	480	-	H	
	Pulse width	Tvp *)	-	0.381	-	ms	
			1	12	-	H	
	Back-porch	Tvb *)	-	0.063	-	ms	
			2	2	-	H	
	*) Tvp+Tvb	6	-	0.985	-	ms	
			4	31	-	H	
	Rise, Fall	Tvrf	33	-	H		
DATA R0-R5 G0-G5 B0-B5	CLK-DATA timing	Tds	-	-	10	ns	
			8	-	-	ns	
	DATA-CLK timing		Tdh	12	-	-	ns
	Rise, Fall	Tdrf	-	-	10	ns	
DE	DE-CLK timing	Tes	8	-	-	ns	
	CLK-DE timing	Teh	12	-	-	ns	
	Rise, Fall	Terf	-	-	10	ns	

(2) DEFINITION OF INPUT SIGNAL TIMING


Data
ENAB
Sync
B
C
D
E
F
A

7-7 DISPLAY POSITION at HRV: L and VRV: L

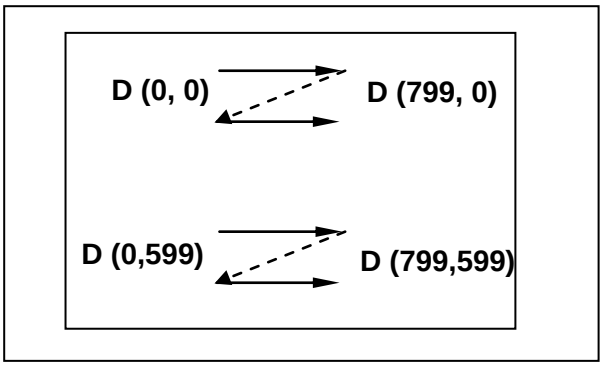
Normal scan: DPS = “L” (factory set)

D(0,0)	D(1,0)		D(X,0)		D(798,0)	D(799,0)
D(0,1)	D(1,1)		D(X,1)		D(638,1)	D(639,1)
D(0,Y)	D(1,Y)		D(X,Y)		D(638,Y)	D(639,Y)
D(0,598)	D(1,598)		D(X,598)		D(798,598)	D(799,598)
D(0,599)	D(1,599)		D(X,599)		D(798,599)	D(799,599)

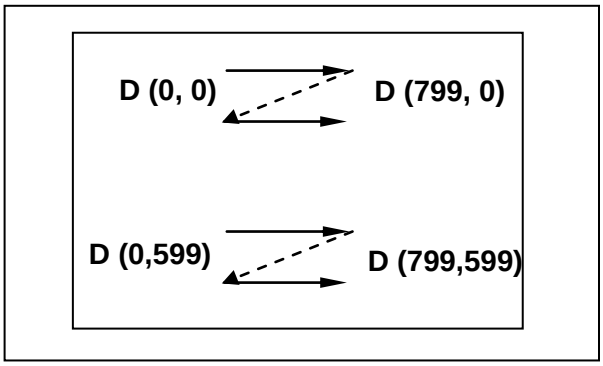
Note. Below drawings show relations between the scan direction and the viewing direction.

Front

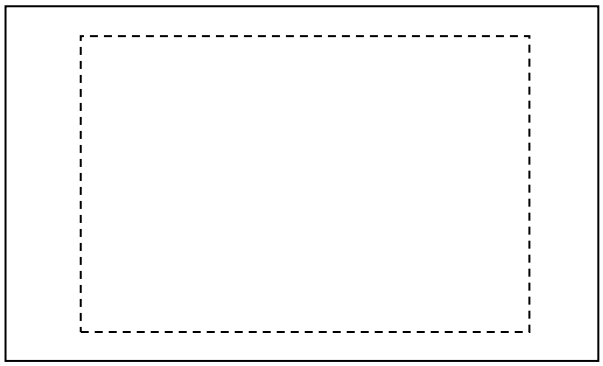
Normal scan (factory set)



Reverse scan (DPS = “H”, external signal)



Back

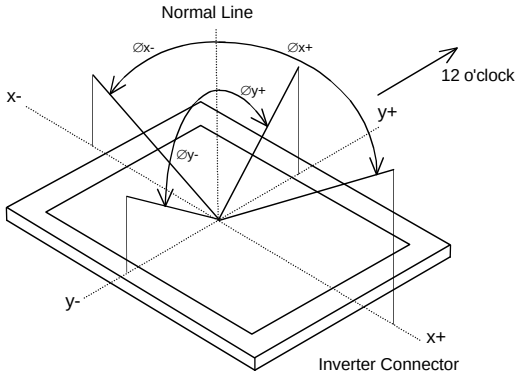


7-8 OPTICAL CHARACTERISTICS

Ta = 25°C ± 5°C

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Horizontal	∅x+	CR>10, ∅y = ±0°	-	65	-	deg.	note 1
		∅x-	CR>10, ∅y = ±0°	-	65	-	deg.	note 1
	Vertical	∅y+	CR>10, ∅x = ±0°	-	55	-	deg.	note 1
		∅y-	CR>10, ∅x = ±0°	-	65	-	deg.	note 1
Contrast ratio		CR	∅y=0°, ∅x=±0°	-	550:1	-	-	note 2
Response time		tpd	white to black black to white	- -	15 30	- -	ms	note 3
Luminance (center of screen)		Lw	at center Vabs at center V(λ)	- -	1000 850	- -	cd/m^2	note 4 note 5
Dimming range		DR			1000:1			

Note 1: Definitions of viewing angle are as follows. (Matrix facing up, connector on the right side)



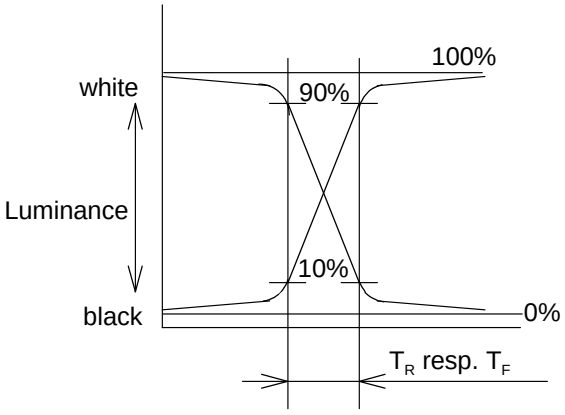
Note 2: The contrast ratio is calculated by using the following formula:

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

The brightness is measured in a darkroom.

Note 3: Definition of response time is as follows.

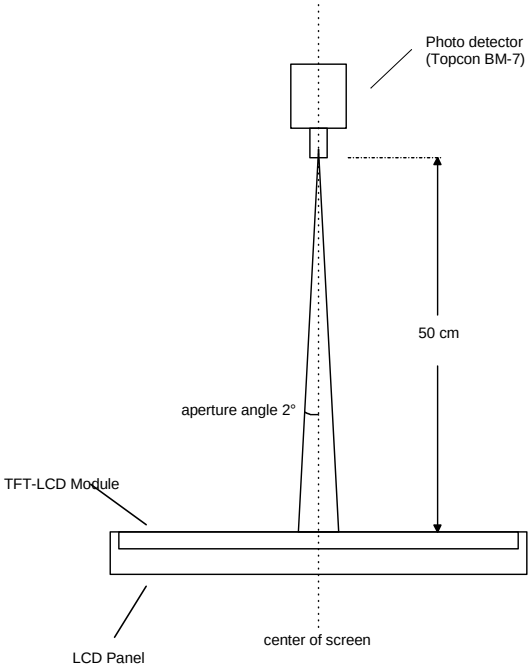
Photo detector output signal is measured when the brightness changes "white" to "black". Response time is the time between 10% and 90% of the photo detector output amplitude.



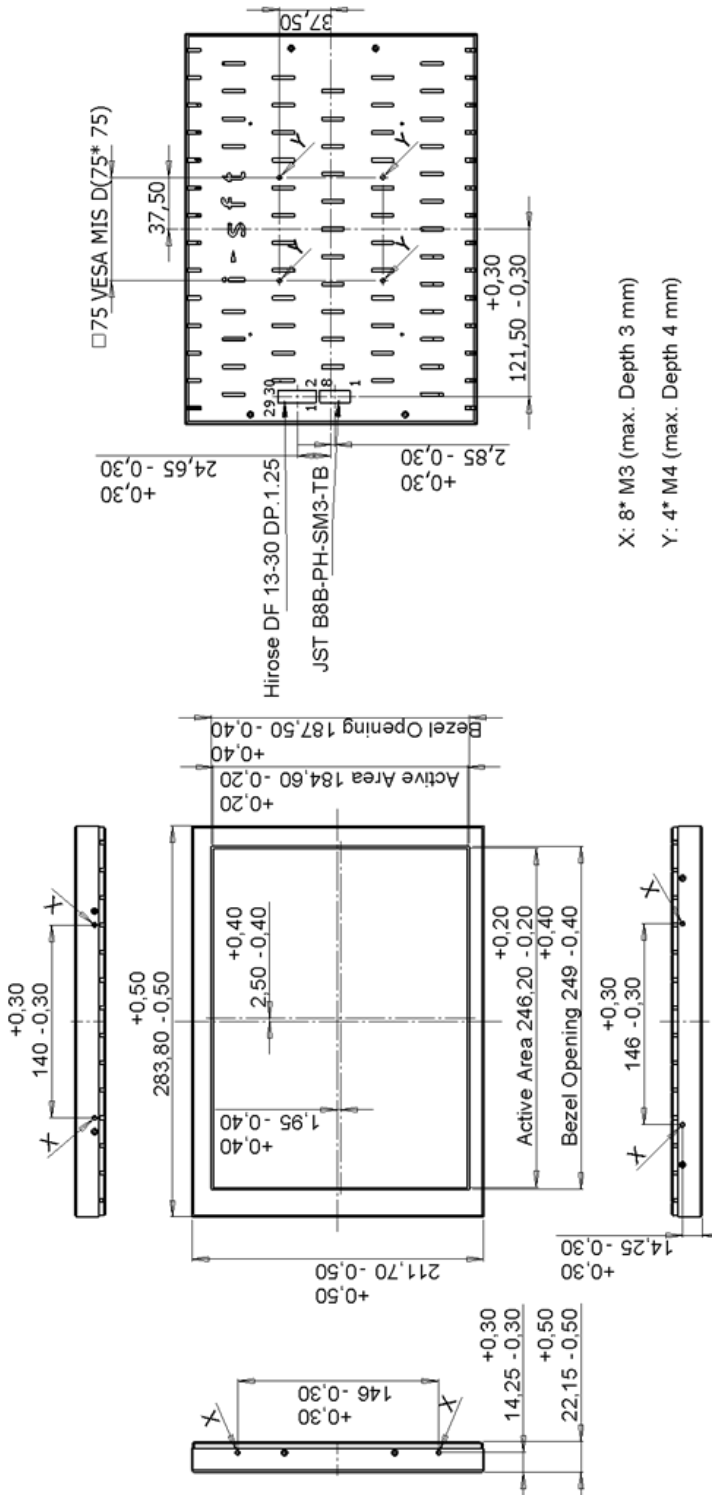
Note 4: Brightness measurements setup.

Measurement should be executed in a dark room 30 minutes
after lighting the backlight. Matrix: on state.
The brightness is measured at the centre of the screen surface.

Environmental conditions: Temperature should be 25 ± 2 °C. Ensure there is sufficient heat flow / air circulation is given



7-9 OUTLINE DIMENSIONS



tolerances in DIN ISO 2768 T1 class m

7-10 e³ CONTROLLER SPECIFICATIONS

a. PIN CONNECTION

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

Pin #	Description	value
1	Supply voltage for e³ controller	typ. 24 VDC *1
2	Supply voltage for e³ controller	typ. 24 VDC *1
3	N.C.	
4	Remote ON/OFF	+5VDC = ON GND = OFF
5	Reference voltage output	+5 VDC *3
6	Dimming input with variable resistor Analog dimming input Digital dimming input	1KΩ *3 0-5 VDC *3 PWM, TTL – Level
7	Ground	GND *1
8	Ground	GND *1

Attention: depending on source and temperature, when switching on, the e³ controller current can be much higher (see separate application note)

*1 for connection use both pin 1 and 2 parallel and pin 7 and 8 parallel

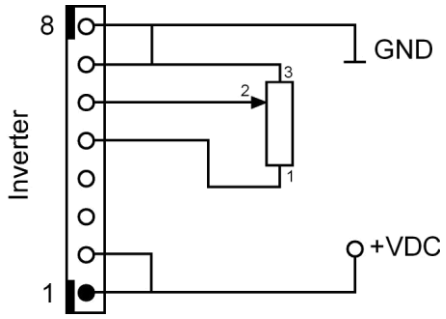
*2 n.c.: no connection (leave pin open)

*3 If no dimming is required, you have to short pin 6 and pin 5 for maximum brightness, 0 VDC= dark, 5 VDC= bright

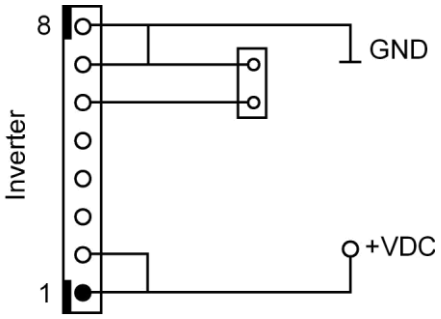
Note: e³ controller included soft start after power on 1minute.

b. e³ CONTROLLER CONNECTIONS

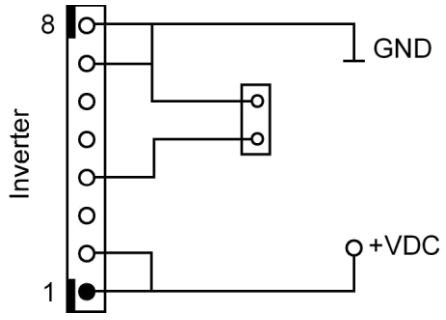
1. Dimming with variable Resistor (pin 7: 0 V)



2. Dimming with variable analog DC voltage. Variable voltage 0 to 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), recommended frequency 200Hz,



7-11 DEFECT SPECIFICATIONS

a)Inspection conditions

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

Illumination : 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 : $-20° \le \theta x \le +20°$, $0° \le \varnothing y \le +20°$

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

Measuring light conditions: Lamp: 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 ≤ 6
		F	-	R ≤ 6 , G ≤ 3
	Blue	F + H	-	≤ 6
		F	-	≤ 6
	Red, Green, Blue	F	≤ 6.5 mm *4	R, G, B ≤ 0
			Linked two or more dots *3	R, G, B ≤ 0
Dark dots *2	Color	Distance between dark dots		Quantity
	Black	-		R + G + B ≤ 16 R, G, B ≤ 7
		Linked two dots *3		≤ 1 pair
		Linked three or more dots *3		≤ 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.

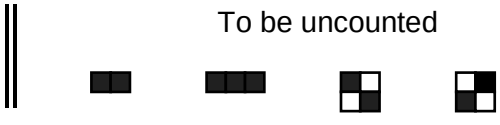
*2 Dark dots are measured while the screen is illuminated with Red, Green, or Blue.

*3 Linkage means linked two or more dots.

■(Luminous or Dark dot)

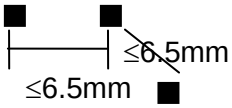
To be counted

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

*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 Stains Dust (dot shape)	Average diameter(∅) mm		Allowed value
	∅ ≤0.2		all allowed
	0.2< ∅ <0.3		≤10 points
	0.3< ∅ ≤0.5		≤ 3 points
	0.5< ∅ Linked other objects		0 point
Other objects Stains Dust (line shape)	Width(W) mm	Length(L) mm	
	W ≤ 0.05	-	all allowed
	0.05 ≤ W ≤ 0.1	L < 0.7	
		0.7 ≤ L ≤ 1.0	≤ 4 points
		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 a only valid under conditions described at 7-7 “a”.

8 GENERAL PRECAUTIONS

8-1 MOUNTING

(a) The module should be attached firmly to the system using every mounting hole. Be careful not to twist and bend the modules during mounting and operation.

(b) To avoid the local build-up of heat, there must be a sufficient heat flow / air circulation on the rear side of the display. We recommend a minimum gap of 6 to 15 mm between the rear side of the display module and the application - depending on display size and orientation of mounting. As higher the display as wider the gap.

(c) The length of fixation screws for the housing must not exceed 4 mm on the top, the bottom and on the sides. Length of fixation screws on the back plate must not exceed 6 mm

(d) Refrain from strong mechanical shock and / or any force to the module, this may cause improper operation or damage to the module and e^3 backlight.

8-2 HANDLING

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

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

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

(d) 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.

(e) If the liquid crystal material leaks from the panel (i.e. when broken), 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.

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

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

(h) Do not disassemble the module.

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

8-3 STORAGE

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

8-4 OPERATION

(a) Do not connect, or disconnect the module in the “Power On” mode.

(b) Power supply should always be turned on/off by following item 7.3 “ SUPPLY VOLTAGE SEQUENZE “.(see specification of your model)

(c) Module has high frequency circuits. Sufficient suppression of electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

8-5 OTHERS

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

(b) Avoid condensation. It may result in improper operation or permanent damage.

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

(d) If the module displays the same pattern continuously for a long period of time, image “sticking” can be seen on the screen. For proper operations avoid such conditions.

(e) This module has its circuitry PCB’s on the rear side. Please handle carefully in order to avoid any kind of stress.