

Industrial Solutions Flatpanel Technology

DESIGN FOR TFT COLOR LCD MODULE

Design No.	doh079_65
Version	Revision 1.0
Specification	
Version	Internal Revision 1.3
Date	28.03.2007
Preliminary <input checked="" type="checkbox"/>	
Final <input type="checkbox"/>	

Buyer	
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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!



Revision	Date	Description
1.0		First Draft

1	DESCRIPTION.....	4
2	FEATURES.....	4
3	APPLICATIONS.....	5
4	STRUCTURE AND FUNCTIONS.....	5
5	OUTLINE OF CHARACTERISTICS.....	6
6	BLOCK DIAGRAMM	7
7	SPECIFICATIONS	8
	7-1 GENERAL SPECIFICATIONS.....	8
	7-2 ABSOLUTE MAXIMUM RATINGS.....	8
	7-3 ELECTRICAL CHARACTERISTICS.....	9
	7-4 INTERFACE PIN CONNECTION.....	10
	7-5 DISPLAY COLORS vs. INPUT DATA SIGNALS.....	11
	7-6 INPUT SIGNAL TIMING	12
	7-7 DISPLAY POSITION at HRV: L and VRV: L	17
	7-8 OPTICAL CHARACTERISTICS.....	18
	7-9 OUTLINE DIMENSIONS.....	21
	7-10 MEASUREMENTS	22
	7-11 DEFECT SPECIFICATIONS.....	23
8	GENERAL PRECAUTIONS.....	25
	8-1 HANDLING.....	25
	8-2 STORAGE.....	26
	8-3 OPERATION	26
	8-4 OTHERS	26

1 DESCRIPTION

i-sft doh079_64 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 6.5" display has a resolution of 640 x 480 pixels and can display up to 256k colours.

6 o'clock direction is the optimum viewing angle.

i-sft doh079_65 is an **i-sft** GmbH in-house design consisting of:

- a. **i-sft** specific third party manufactured LCD-Glass-Matrix (NOT available in retail).
- b. **i-sft** customized backlight emitting a surface brightness of up to 1200 nits.
- c. **i-sft** custom made integrated inverter to drive the back-light.

2 FEATURES

6.5" VGA High-bright

Long life lamp system

Color temperature 9000K

High contrast ratio, wide viewing angle, wide color gamut

Wide viewing angle with anti-glare film

Wide temperature range

High shock and vibration levels

Interlocking connector

Integrated inverter for driving backlight

3 APPLICATIONS

Industrial application

POI / POS

4 STRUCTURE AND FUNCTIONS

A TFT color LCD module comprises of 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.

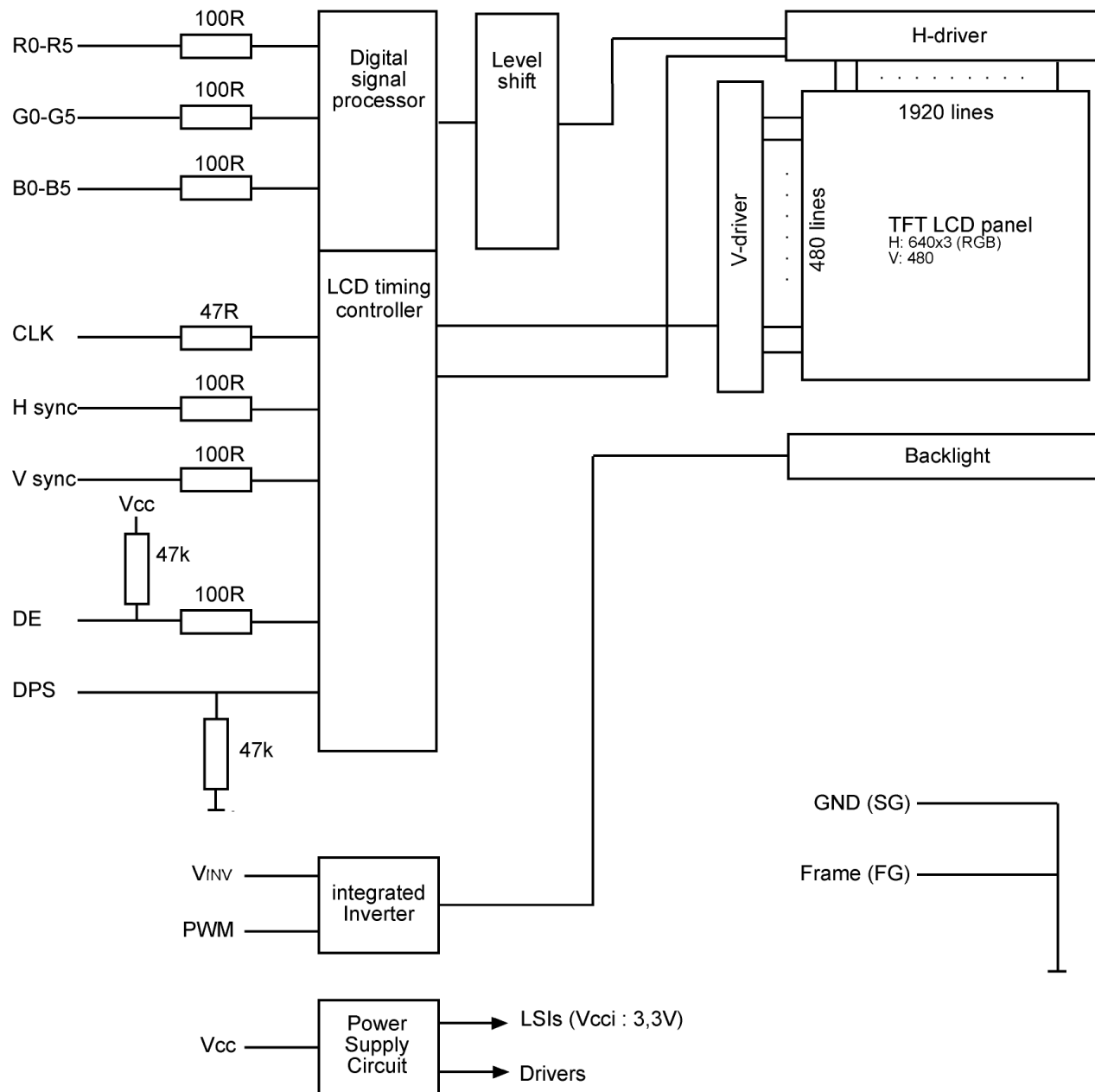
RGB (Red, Green, Blue) data signals are sent to LCD panel drivers after modulation into suitable forms for active matrix addressing through a signal processor.

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

Display area	132.5 mm (H) × 99.4 mm (V)
Drive system	a-Si TFT active matrix
Display colors	262,144 colors
Number of pixels	640 × 480
Pixel arrangement	RGB, vertical stripe
Pixel pitch	0.207 mm (H) × 0.207 mm (V)
Module size	185.8 mm (H) × 130.4 mm (V) × 23.5 mm (D)
Weight	680 g (typ.)
Luminance	1200 cd/m ² (typ.)
Dimming range	1000:1
Contrast ratio	600:1 (typ.)
Response time	13 ms (typ.), "white" to "black"
Signal system	6-bit digital signals for each of RGB primary colors, synchronous signals (hsync, vsync), Dot clock (CLK)
Supply voltage	5.0 V (3.3 V) (Logic, LCD driving), 12 VDC for integrated Inverter
Scanning direction	Vertical scanning is normal/reverse Horizontal scanning is normal/reverse

6 BLOCK DIAGRAMM



7 SPECIFICATIONS

7-1 GENERAL SPECIFICATIONS

Item	Specifications	Unit
Module size	185.8 (H) × 130.4 (V) × 23.5 (D)	mm
Display area	132.5 (H) × 99.4 (V)	mm
Number of pixels	640×3 (H) × 480 (V)	pixel
Dot pitch	0.0690 (H) × 0.2070 (V)	mm
Pixel pitch	0.2070 (H) × 0.2070 (V)	mm
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe	-
Display colors	262,144	color
Weight	680 (typ.)	g
Connector	HIROSE DF13-40DS-1.25C	

7-2 ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Ratings	Unit	Remarks
Supply voltage	V _{INV}	typ. 12	VDC	Ta = 25°C V _I -V _{CC} < 3.0
	V _{DD}	-0.3 to 6.5	V	
Input voltage	V _I	-0.3 to V _{CC} + 0.3	v	
Storage temp.	T _{ST}	-25 to +75 *1	°C	
Operation temp.	T _{OP}	-20 to +71 *1	°C	

*1: measured at centre of display area (Front side)

7-3 ELECTRICAL CHARACTERISTICS

(1) Logic, LCD driving

Ta = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	V _{CC}	4.75 (3.0)	5 (3.3)	5.25 (3.6)	V	-
Supply current	I _{CC}	-	200 (320)	450 (600)	mA	V _{CC} =5.0V (V _{CC} =3,3V)
Logic input "L" voltage	V _{IL}	0	-	V _{CCi} x 0.3	V	CMOS level note
Logic input "H" voltage	V _{IH}	V _{CCi} x 0.7	-	V _{CC}		

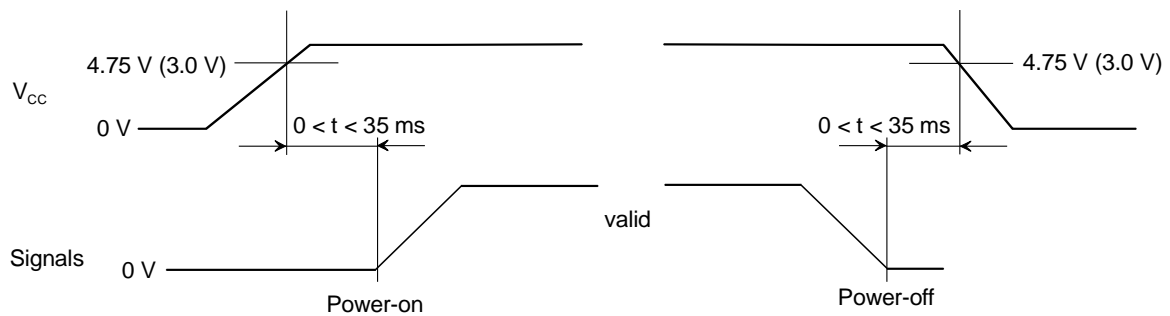
Note: V_{CCi} = 3.3V : is given by DC/DC converter in the LCD module

(2) Backlight, Inverter driving

Ta = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	V _{inv}	-	12	-	V	
Supply power	P _{inv}	-	11	-	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

CN40 : DF13-40DS-1.25C (HIROSE)

Mating connector

DF13-40DS (KAB-DF13-40DS-0500FK; ES&S)

Pin NO.	Symbol	Function	Pin NO.	Symbol	Function
1	CLK	Dot clock	21	B2	Blue data
2	GND	Ground	22	B1	Blue data
3	Vsync	Vertical sync	23	B4	Blue data
4	Hsync	Horizontal sync	24	B3	Blue data
5	R0	Red data (LSB)	25	GND	Ground
6	GND	Ground	26	B5	Blue data (MSB)
7	R2	Red data	27	Vcc	Power supply panel
8	R1	Red data	28	DE	Data enable
9	R4	Red data	29	N.C.	Non-connection (Open)
10	R3	Red data	30	Vcc	Power supply panel
11	GND	Ground	31	GND	Ground
12	R5	Red data (MSB)	32	DPS	Scan Direction select
13	G1	Green data	33	GND	Ground
14	G0	Green data (LSB)	34		N.C.
15	G3	Green data	35	PWM	
16	G2	Green data	36	V _{INV}	Power supply 12VDC
17	G5	Green data (MSB)	37	GND	Ground
18	G4	Green data	38	V _{INV}	Power supply 12VDC
19	B0	Blue data (LSB)	39	GND	Ground
20	GND	Ground	40	V _{INV}	Power supply 12VDC

LSB: Least Significant Bit

MSB: Most Significant Bit

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

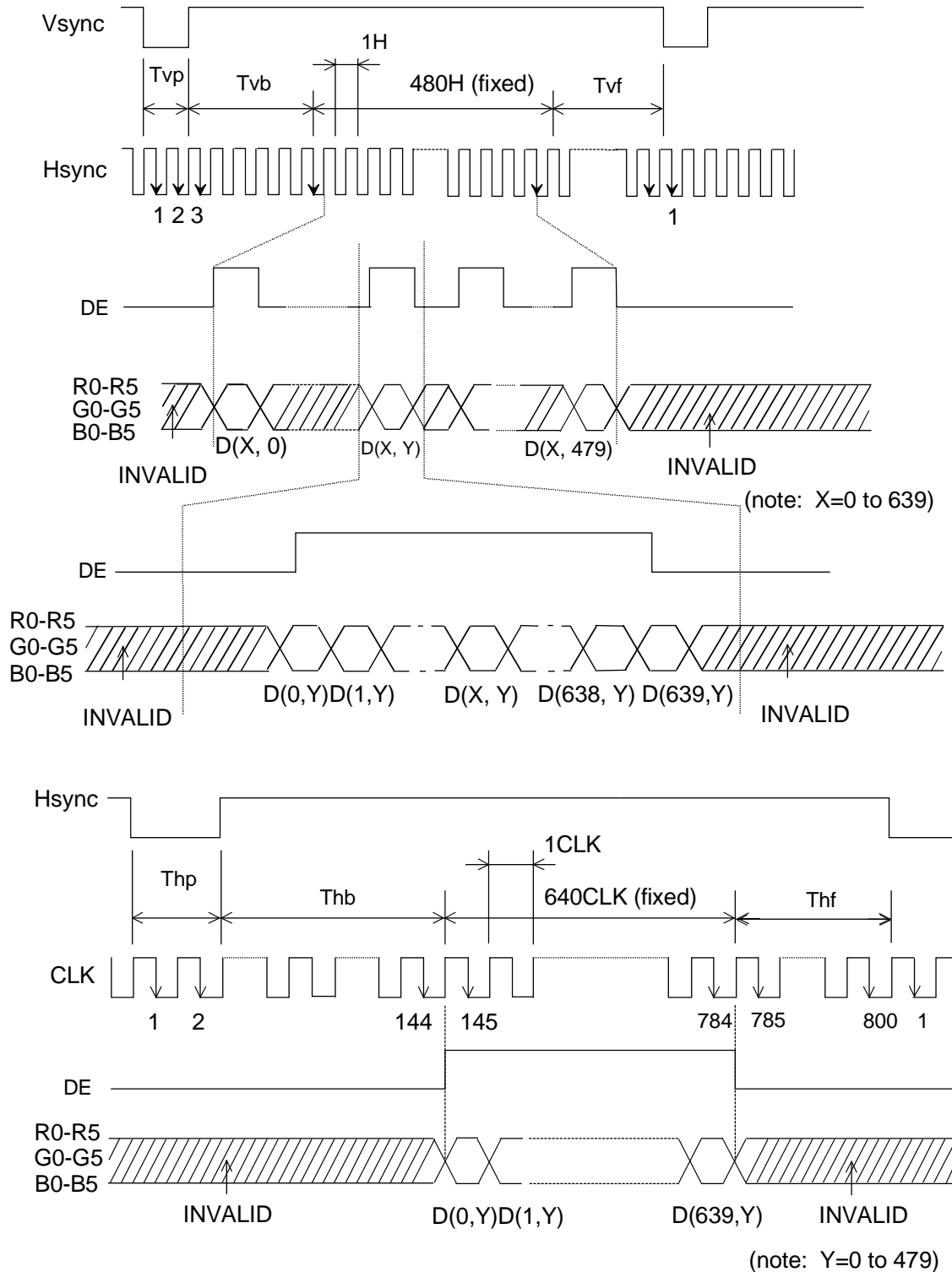
	Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Remarks	
CLK	Frequency	1/Tc	21.0	25.175	29.0	MHz	39.722 ns(TYP.)	
	Duty	Tch/Tc	0.4	0.5	0.6	-	-	
	Rise, Fall	Tcrf	-	-	10	ns	-	
Hsync	Period	Th	30.0	31.778	33.6	μ s	31.468 kHz(TYP.)	
			-	800	-	CLK		
	Display period	Thd	-	25.422	-	μ s		
			-	640	-	CLK		
	Front-porch	Thf	-	0.636	-	μ s		
			0	16	-	CLK		
	Pulse width	Thp*)	-	3.813	-	μ s		
			10	96	-	CLK		
	Back-porch	Thb *)	-	1.907	-	μ s		
			5	48	-	CLK		
	*) Thp+Thb			64	144	-	CLK	
	CLK-Hsync timing	Thch	12	-	-	ns		
	Hsync-CLK timing	Thcs	8	-	-	ns		
	Hsync-Vsync timing	Tvh	15	-	-	ns		
Vsync-Hsync timing	Tvs	15	-	-	ns			
Rise, Fall	Thrf	-	-	10	ns			
Vsync	Period	Tv	16.1	16.683	17.2	ms	59.94 Hz(TYP.)	
			-	525	-	H		
	Display period	Tvd	-	15.253	-	ms		
			-	480	-	H		
	Front-porch	Tvf	-	0.381	-	ms		
			1	12	-	H		
	Pulse width	Tvp *)	-	0.063	-	ms		
			2	2	-	H		
Back-porch	Tvb *)	-	0.985	-	ms			
		4	31	-	H			
*) Tvp+Tvb			6	33	-	H		
Rise, Fall	Tvrf	-	-	10	ns			
DATA R0-R5	CLK-DATA timing	Tds	8	-	-	ns		
G0-G5	DATA-CLK timing	Tdh	12	-	-	ns		

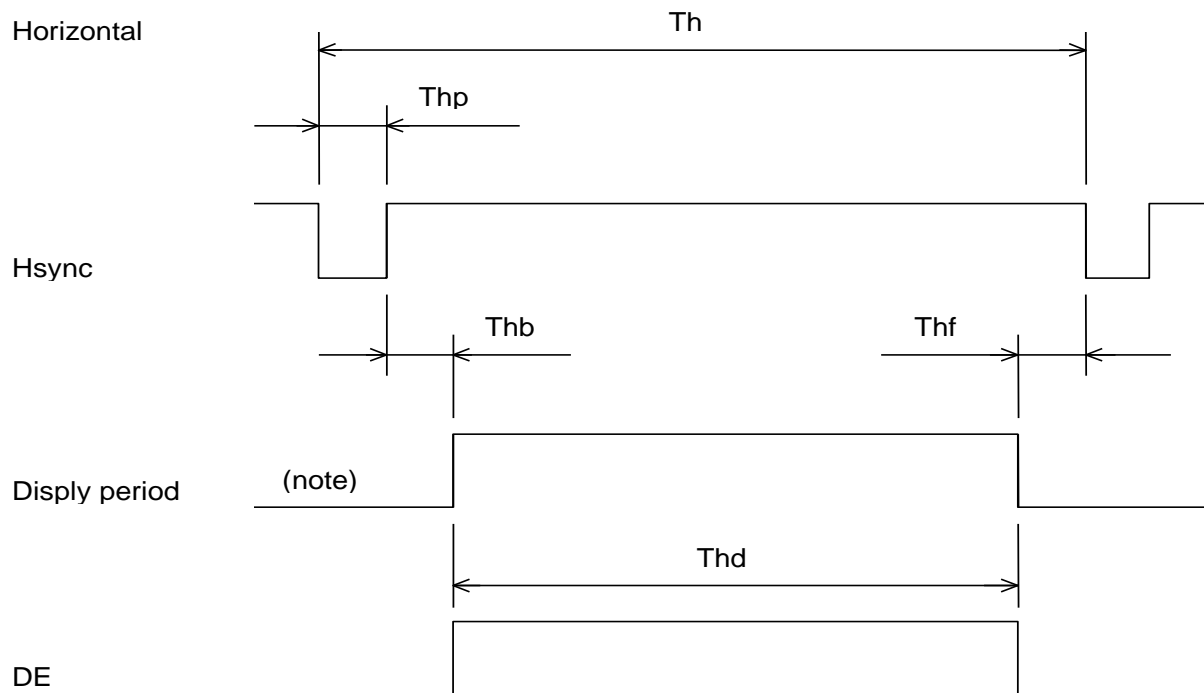
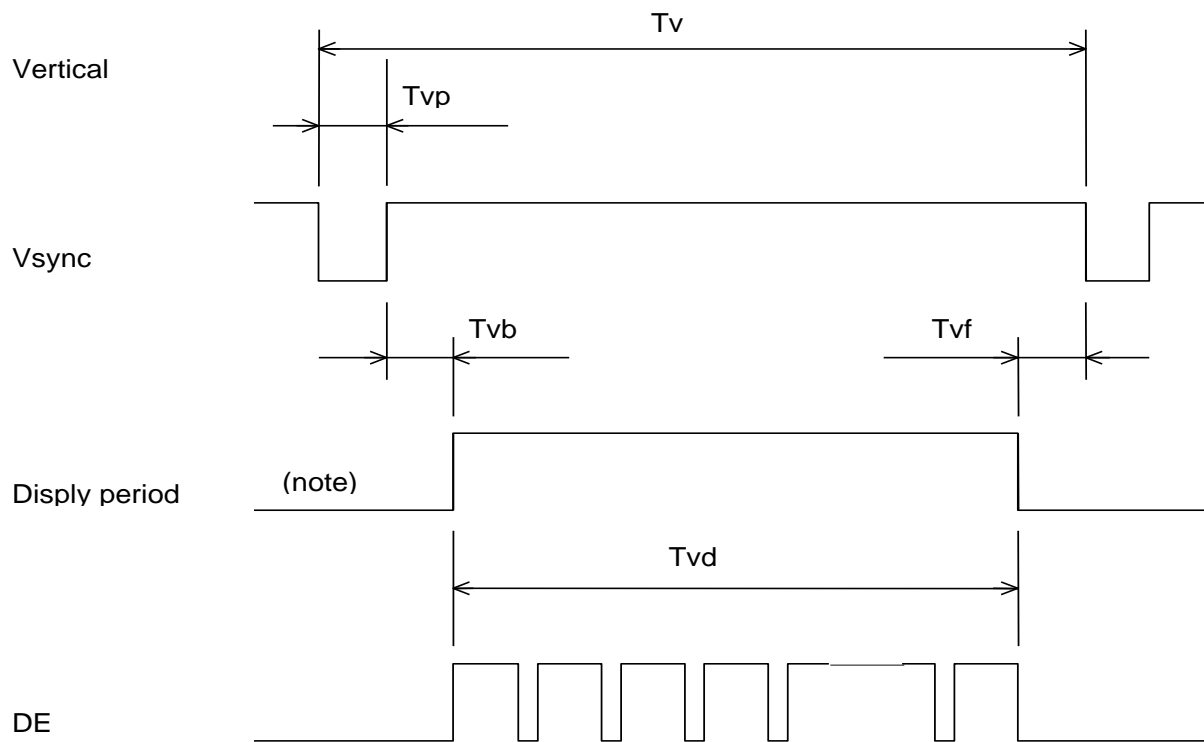


B0-B5	Rise, Fall	Tdrf	-	-	10	ns	
DE	DE-CLK timing	Tes	8	-	-	ns	
	CLK-DE timing	Teh	12	-	-	ns	
	Rise, Fall	Terf	-	-	10	ns	

note: All parameters should be kept within the specified range.

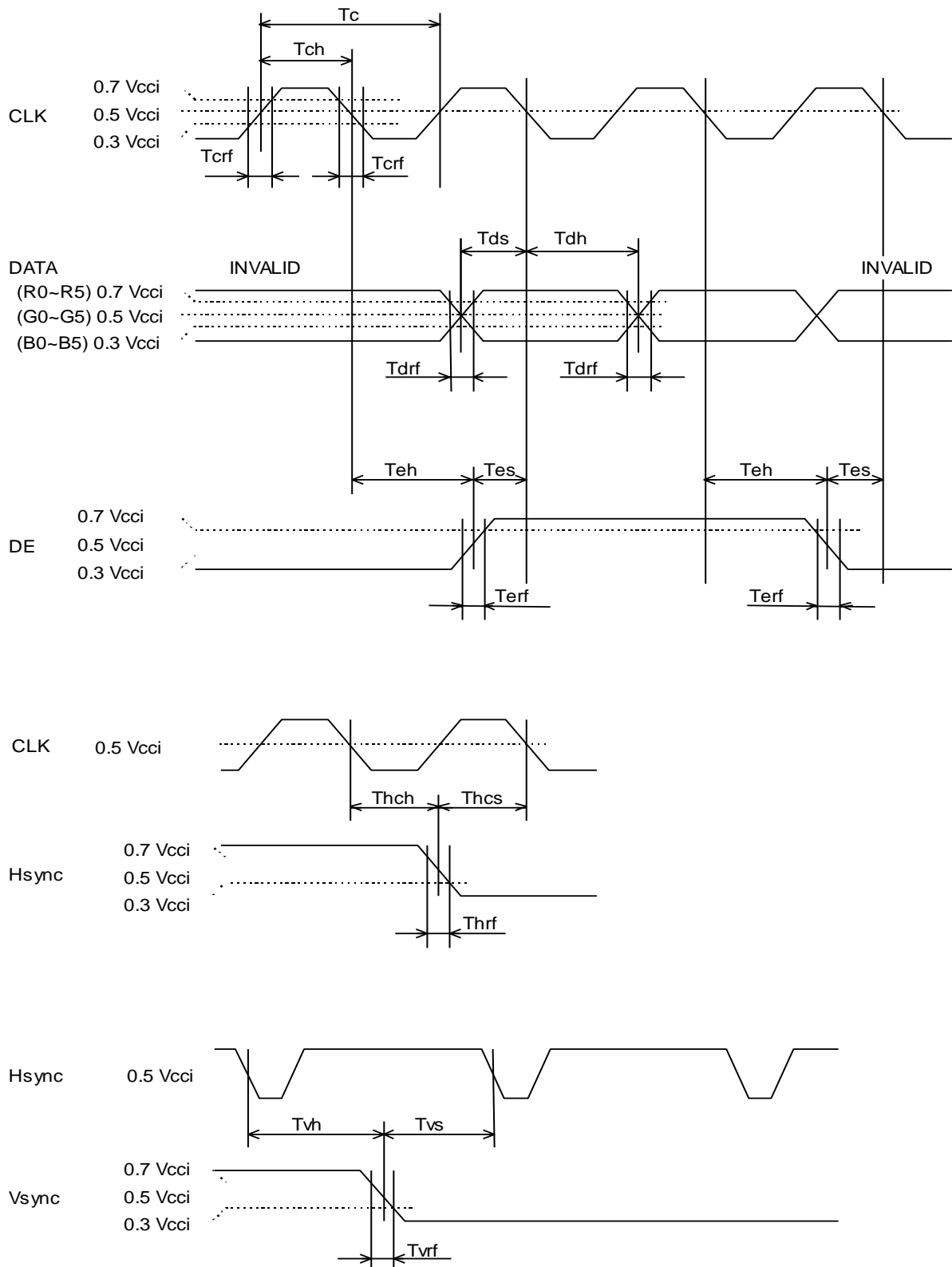
(2) DEFINITION OF INPUT SIGNAL TIMING





note: these signals do not exist

(3) INPUT SIGNAL TIMING CHART



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

Normal scan: DPS = "L" (factory set)

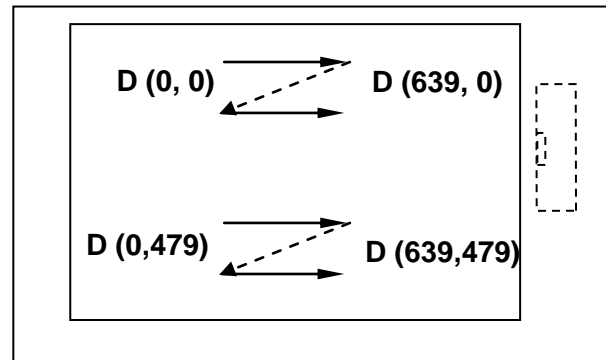
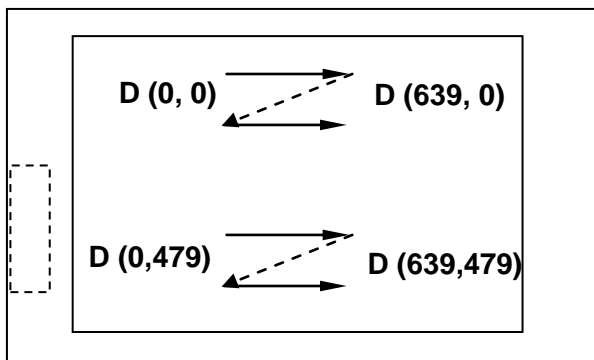
D(0,0)	D(1,0)		D(X,0)		D(638,0)	D(639,0)
D(0,1)	D(1,1)		D(X,1)		D(638,1)	D(639,1)
D(0,Y)	D(1,Y)		D(X,Y)		D(638,Y)	D(639,Y)
D(0,478)	D(1,478)		D(X,478)		D(638,478)	D(639,478)
D(0,479)	D(1,479)		D(X,479)		D(638,479)	D(639,479)

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

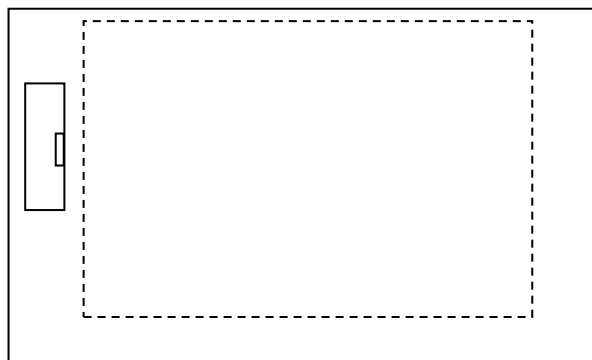
Front

Normal scan (factory set)

Reverse scan (DPS = "H", external signal)



Back

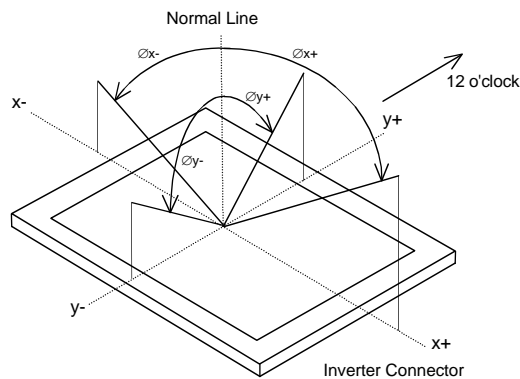


7-8 OPTICAL CHARACTERISTICS

Ta = 25°C ± 5°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	
Viewing angle range	Horizontal	$\varnothing x+$	CR>10, $\varnothing y = \pm 0^\circ$	-	60	-	deg.	note 1
		$\varnothing x-$	CR>10, $\varnothing y = \pm 0^\circ$	-	60	-	deg.	note 1
	Vertical	$\varnothing y+$	CR>10, $\varnothing x = \pm 0^\circ$	-	40	-	deg.	note 1
		$\varnothing y-$	CR>10, $\varnothing x = \pm 0^\circ$	-	80	-	deg.	note 1
Contrast ratio	CR	$\varnothing y=0^\circ, \varnothing x=\pm 0^\circ$	-	600	-	-	note 2	
Response time	t on t off	white to black	-	13	-	ms	note 3	
		black to white	-	36	-			
Luminance (center of screen)	Lw	at center	V_{abs}	-	1400	-	cd/m ²	note 4 note 5
		at center	$V(\lambda)$	1080	1200	-		
Dimming range	DR			1000:1				
Color gamut	C	at center, to PAL	50	-	-	%		

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



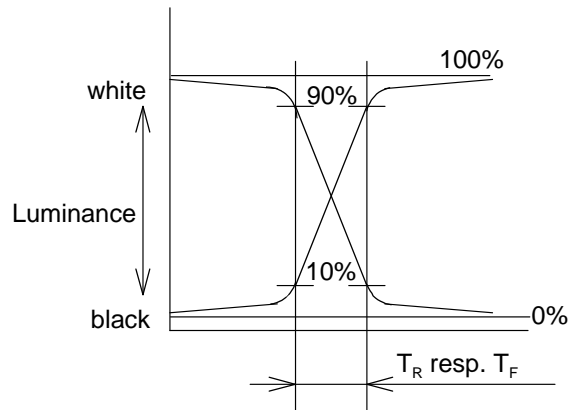
Note 2: The contrast ratio is calculated by using the following formula:

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

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.

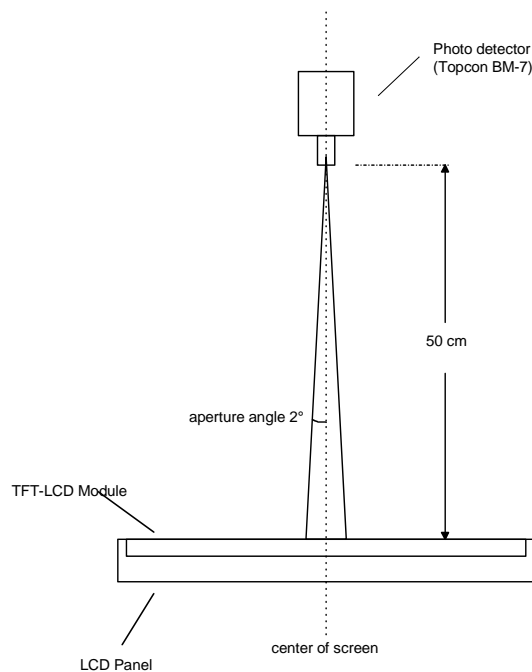


Note 4: Brightness measurements setup.

Measurement should be executed in a dark room 30 minutes after lighting the backlight. Matrix: off state.

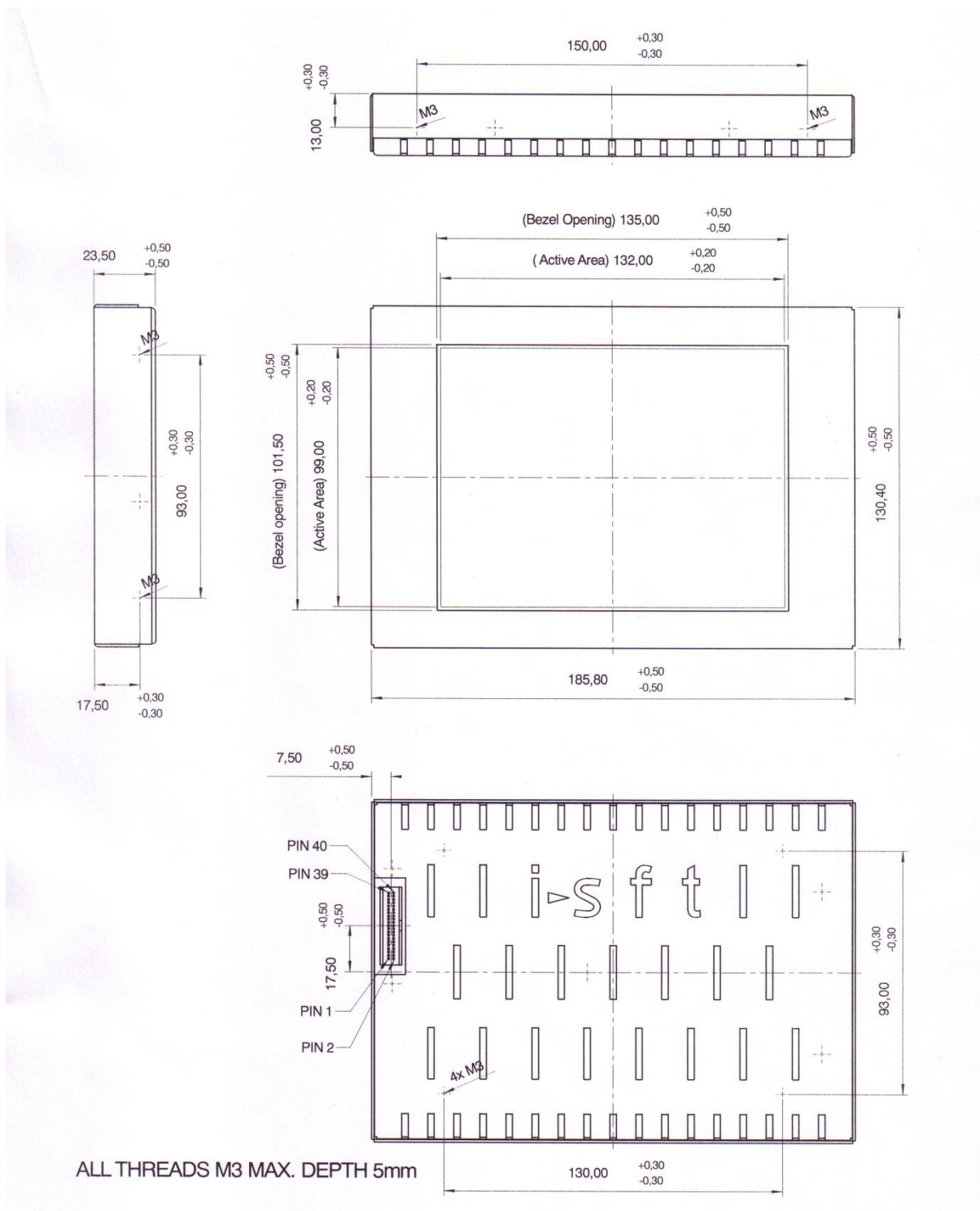
The brightness is measured at the center of the screen surface.

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



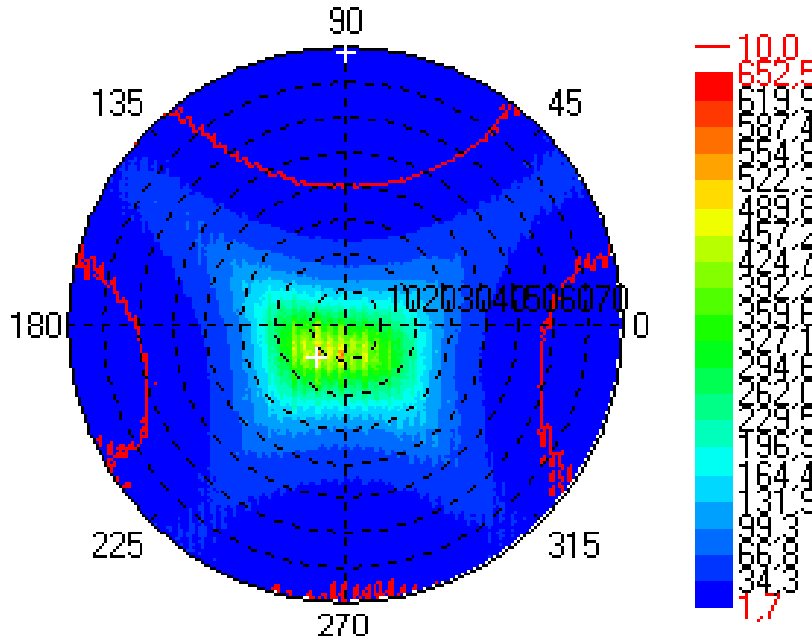
note 5: Brightness measurements setup.
measurement should be executed in a daylight room 30 min.
after lightning the backlight. Matrix: off state.
The brightness is measured in the center of the screen.
Environment condition: $T = 25 \pm 2 \text{ }^\circ\text{C}$, it has to be assured that a sufficient
heat flow / air circulation is given

7-9 OUTLINE DIMENSIONS



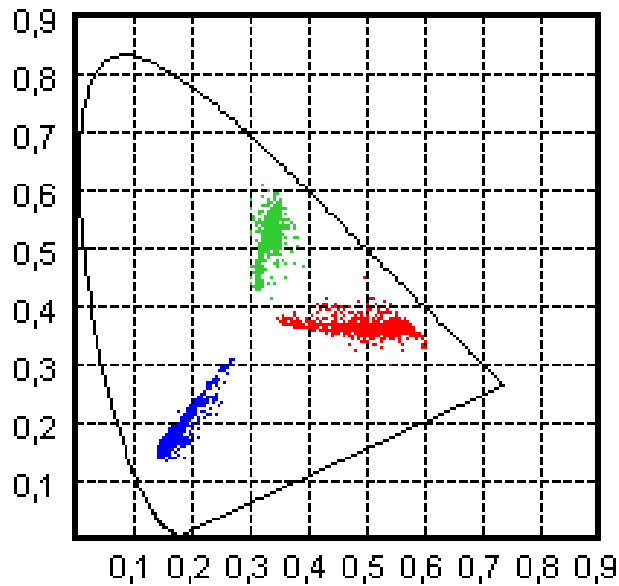
7-10 MEASUREMENTS

7-10-1 CONTRAST



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7-10-2 COLOR DISPERSION



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7-11 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 $25\text{C}^{\circ} \pm 5\text{C}^{\circ}$.

Viewing angle:

Display specifications : $-20^{\circ} \leq \theta x \leq +20^{\circ}$, $0^{\circ} \leq \theta y \leq +20^{\circ}$

Appearance specifications: $-45^{\circ} \leq \theta x \leq +45^{\circ}$, $-45^{\circ} \leq \theta y \leq +45^{\circ}$

Measuring light conditions: for Cold Cathode Fluorescent Lamp

Chromaticity coordinates (x = 0.320, y = 0.325) 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	$\leq 6.5 \text{ mm}$ *4	$R, G, B \leq 0$
Linked two or *3 more dots			$R, G, B \leq 0$	
Dark dots *2	Color	Distance between dark dots		Quantity
	Black	-		$R + G + B \leq 16$ $R, G, B \leq 7$
		Linked two dots	*3	$\leq 1 \text{ pair}$
		Linked three or more dots	*3	≤ 0
		$\leq 6.5 \text{ mm}$	*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

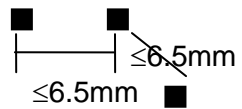


To be uncounted



*4 $\leq 6.5 \text{ mm}$ is considered with:

■ (:Luminous or Dark dot)



	To be counted	To be uncouncted
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		Quantity
	Measurement criteria		
Other objects Stains Dust (dot shape)	Average diameter(\varnothing) mm		Allowed value
	$\varnothing \leq 0.2$		all allowed
	$0.2 < \varnothing < 0.3$		≤ 10 points
	$0.3 < \varnothing \leq 0.5$		≤ 3 points
	$0.5 < \varnothing$		0 point
Other objects Stains Dust (line shape)	Linked other objects		
	Width(W) mm	Length(L) mm	all allowed
	$W \leq 0.05$	-	
	$0.05 \leq W \leq 0.1$	$L < 0.7$	≤ 4 points
		$0.7 \leq L \leq 1.0$	0 point
$0.1 < W$	-		
Polarizer Bubbles	Average diameter(\varnothing) mm		
Wrinkles Dent	$\varnothing \leq 0.5$		< 2 points
Panel dent	$\varnothing \leq 0.5$		< 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 hole. Be careful not to twist and bend the modules.
Keep at least 8 mm space on back of the display for air convection.
- (b) Length of fixation screws for the housing should not exceed 5mm on the top and on the bottom. The length of the fixation screws on the sides and the back-plate should not be more than 5mm.
- (c) Refrain from strong mechanical shock and / or any force to the module.
Improper operation or damage to the module and CCFT backlight could be the result.
- (d) Note that polarizer's are very fragile and could be easily damaged. Do not press or scratch the surface harder than like 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 anti-static gloves in order to keep display clean during the incoming inspection and assembly process.
- (k) Do not disassemble the module.
- (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 should be stored in a dark place. It is highly recommended not to impose sunlight or fluorescent light during the storage.

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 7-3 “ SUPPLY VOLTAGE SEQUENCE “.
- (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. It may result in improper operation or disconnection of electrodes.
- (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, it can be the situation when the image “sticks” to the screen.
- (e) This module has its circuitry PCB’s on the rear side. Please handle carefully in order to avoid unnecessary stress.