



Typical Design



# Industrial Solutions Flatpanel Technology

## DESIGN FOR TFT COLOR LCD MODULE

Design No.	dah072_104
Revision	Rev. 2.0
Type	10.4" 1024 x 768
Specification	
Version	Internal Revision 0.2
Date	06.09.2012
Preliminary <input checked="" type="checkbox"/>	
Final <input type="checkbox"/>	

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!



Typical Design

# Liquid Crystal Display Design

I-SFT dah072\_104



Revision	Date	Description
1.0	24.05.2011	First Draft
2.0	04.09.2012	Supply Voltage adaption <ul style="list-style-type: none"><li>Page 9: 7-1 Electrical characteristics</li></ul> Power consumption <ul style="list-style-type: none"><li>Page 9: 7-1 Electrical characteristics</li></ul> Luminance adaption <ul style="list-style-type: none"><li>Page 4: 1 Description</li><li>Page 6: 5 Outline of characteristics</li><li>Page 16: 7-9 Optical characteristics</li></ul>
	06.09.2012	Corrected interface system to LVDS <ul style="list-style-type: none"><li>Page 4: 4 Features</li></ul> Added D/A converter block <ul style="list-style-type: none"><li>Page 7: 6 Block diagramm</li></ul> Enlarged drawing <ul style="list-style-type: none"><li>Page 19: 7-10 Outline dimensions</li></ul>



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## 1 DESCRIPTION

**I-SFT dah072\_104** is a custom specific development based module and is not available on the open market.

**I-SFT dah072\_104** is a TFT (thin film transistor) active matrix color liquid crystal display (LCD) comprising of an amorphous silicon TFT attached to each signal electrode with circuit drivers.

**I-SFT dah072\_104** 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 display surface brightness typ. 1000 nits.
- c. **i-sft** custom made integrated e<sup>3</sup> driver to control the backlight.

The 10.4 inch diagonal display area contains 1024×768 pixels and can display 256k colors.

## 2 FEATURES

10.4" XGA High-bright  
open frame  
Low power consumption  
Long life e3-technology system  
BLU - Color temperature 9000K  
High contrast ratio, high aperture structure  
Wide temperature range  
High shock and vibration  
Interlocking connector  
Integrated e<sup>3</sup> driver for driving backlight  
LVDS interface

## 3 APPLICATIONS

Industrial application  
POI / POS



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## 4 STRUCTURE AND FUNCTIONS

A TFT color LCD module comprises of a TFT LCD panel and 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.



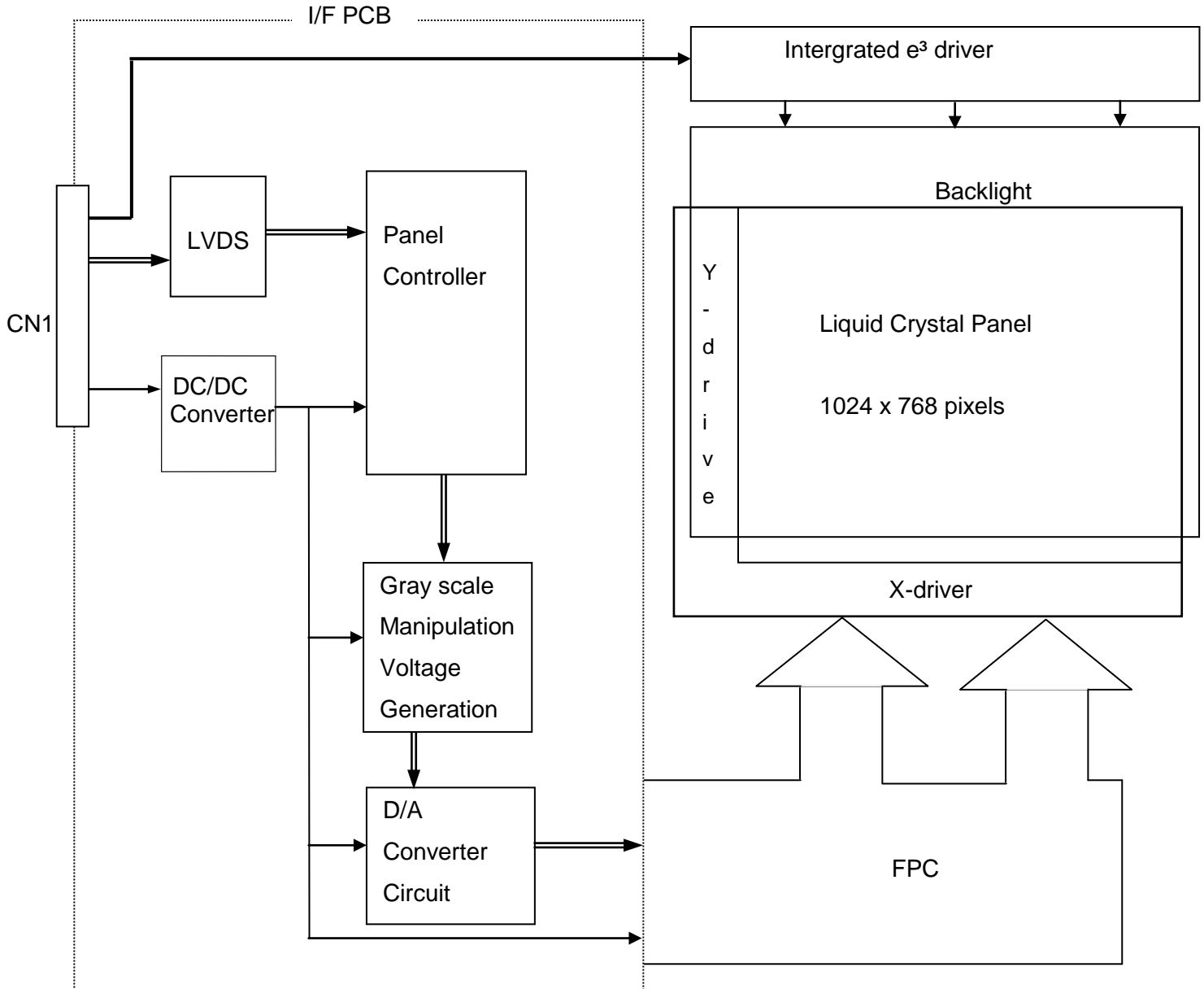
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## 5 OUTLINE OF CHARACTERISTICS

ITEM	SPECIFICATION	UNIT	NOTE
Active display area	210.432 (H) x 157.824 (V) (10.4 inch diagonal)	mm	
Driver element	a – Si TFT active matrix		
Display colours	256k		
Number of pixels	1024 x 768	pixel	
Luminance (typ.)	1000	cd/m <sup>2</sup>	
Dimming ratio	1 : 1000		
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.2055 (H) x 0.2055 (W)	mm	
Display mode	Normally Black		
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)	251.5	mm
	Vertical (V)	177.6	mm
	Depth (D)	23.55	mm
Weight		1280	g

### 7-2 ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Storage temperature	$T_{nop}$	-25	75	°C	(1)
Operating temperature	$T_{op}$	-10	60	°C	(1)
Shock (operating)	$S_{op}$	-	30	g	(2) (4)
Vibration (operating)	$V_{op}$	-	5	g	(3) (4)

Note

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

(2) 18ms

(3) 15 – 500Hz

(4) Customer tested with Eickhoff housing:

Shock: 30g / 18ms / Half-sinusoidal / 6 spatial directions 3 shocks per direction

Vibration: 5 .. 500Hz / 5.5mm amplitude for 5 ... 15Hz; 5g for 15 ... 500Hz /

Frequency change: 1 octave/min.; 5 cycles (5Hz..500Hz..5Hz)



### 7-3 ELECTRICAL CHARACTERISTICS

#### (1) Logic, LCD driving

 $T_a = 25^{\circ}\text{C}$ 

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	$V_{DD}$	3.0	3.3	3.6	V	-
Supply current	$I_{DD}$	-	210	-	mA	Note 1
Permissible Input Ripple voltage	$V_{RF}$	-	-	100	mV	$V_{DD} = 3.3\text{V}$
Logic input "L" voltage	$V_{IL}$	-100	-	-	mV	$V_{cm} = 1.2\text{V typ}$
Logic input "H" voltage	$V_{IH}$	-	-	+100	mV	

Note 1: The supply voltage is measured and specified at the interface connector of LCM.

The current draw and power consumption specified is for  $V_{DD} = 3.3\text{V}$ , Frame rate = 60Hz and Clock frequency = 65MHz.

Test Pattern of power supply current

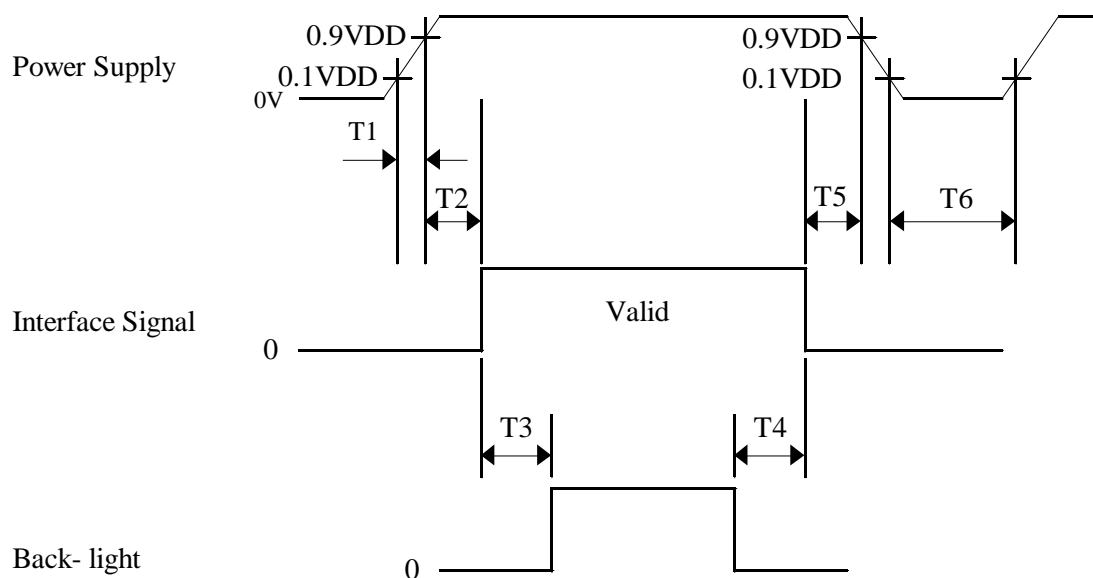
- a) Typ: Vertical color bar pattern
- b) Max: Gray 228 @ vertical 2 skip line pattern

#### (2) Backlight, e<sup>3</sup> driver driving

 $T_a = 25^{\circ}\text{C}$ 

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	$V_{inv}$	21,6	24	26,4	V	
Power consumption	$P_{inv}$	-	< 20W	-	W	$V_{inv} = 24\text{V}$

SUPPLY VOLTAGE SEQUENCE



- $0 < T1 \leq 10 \text{ ms}$
- $0 < T2 \leq 50 \text{ ms}$
- $100 \text{ ms} \leq T3, T4$
- $0 < T5 \leq 50 \text{ ms}$
- $1 \text{ s} < T6$

Notes:

1. When the power supply VDD is 0V, keep the level of input signals on the low or keep high impedance.
2. Do not keep the interface signal high impedance when power is on.
3. Backlight must be turned on after power for logic and interface signal are valid.





**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
Red	1	1	1	1	1	0	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
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
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.

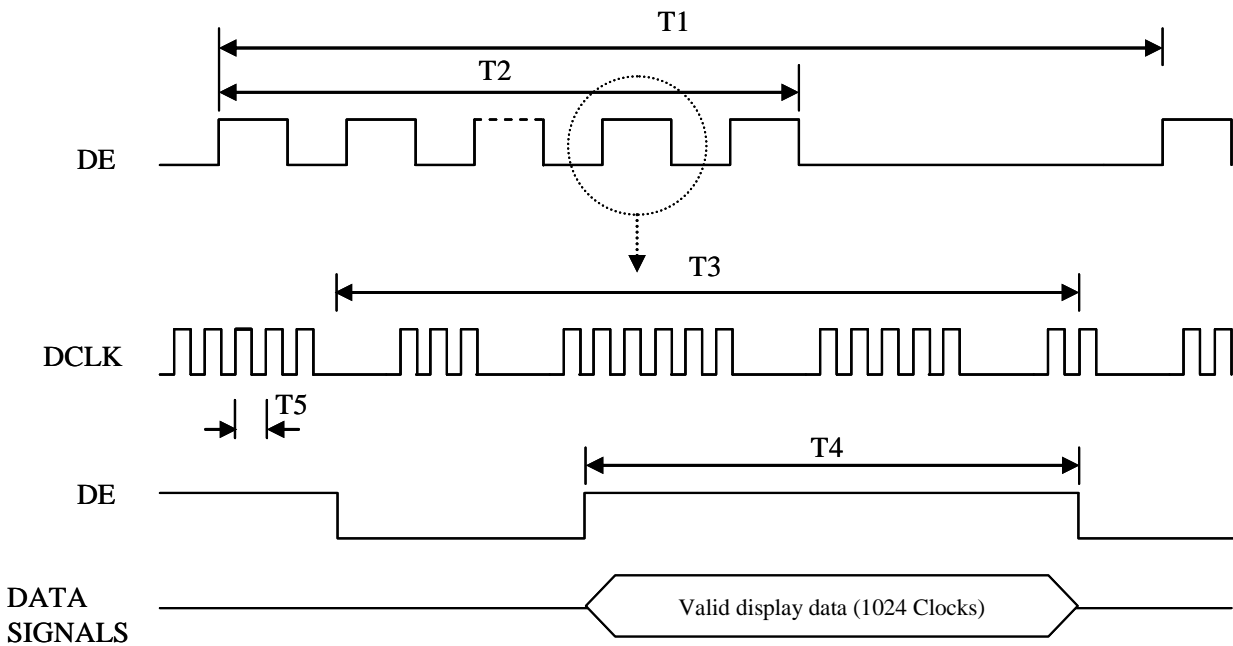
This process can result in up to 262,144 (64×64×64) colors.



7-6 INPUT SIGNAL TIMING

Item	Symbol	MIN	TYP	MAX	Unit	Note
Frame Period	T1	772	806	1022	lines	
Vertical Display Term	T2	768	768	768	lines	
One Line Scanning Time	T3	1100	1344	2046	clocks	
Horizontal Display Term	T4	1024	1024	1024	clocks	
Clock Period	1/T5	-	65	80	MHz	

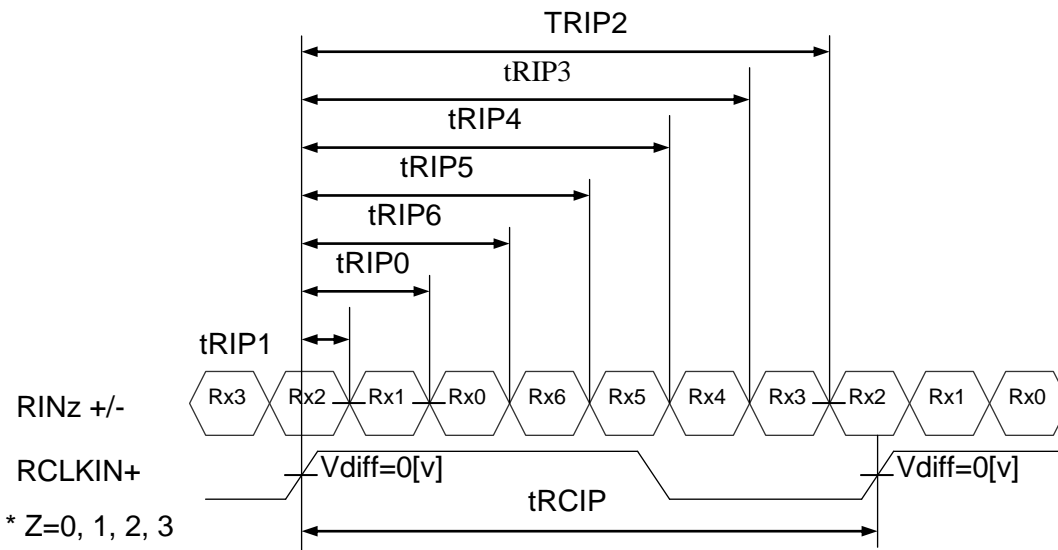
Note: The I-SFT **dah072\_104** is operated by the only DE (data enable) mode (LVDS Transmitter Input)



**7-7 LVDS Rx interface timing parameter**

specification of the LVDS Rx interface timing parameter  
<LVDS Rx Interface Timing Specification>

Item	Symbol	Min	Typ	Max	Unit	Remark
CLKIN Period	tRCIP	12.5	15.38	-	nsec	
Input Data 0	tRIP1	-0.4	0.0	+0.4	nsec	
Input Data 1	tRIP0	1*tRCIP/7 -0.4	1*tRCIP/7	1*tRCIP/7 +0.4	nsec	
Input Data 2	tRIP6	2*tRCIP/7 -0.4	2*tRCIP/7	2*tRCIP/7 +0.4	nsec	
Input Data 3	tRIP5	3*tRCIP/7 -0.4	3*tRCIP/7	3*tRCIP/7 +0.4	nsec	
Input Data 4	tRIP4	4*tRCIP/7 -0.4	4*tRCIP/7	4*tRCIP/7 +0.4	nsec	
Input Data 5	tRIP3	5*tRCIP/7 -0.4	5*tRCIP/7	5*tRCIP/7 +0.4	nsec	
Input Data 6	tRIP2	6*tRCIP/7 -0.4	6*tRCIP/7	6*tRCIP/7 +0.4	nsec	



\*  $V_{diff} = (RINz+) - (RINz-), (RCLKIN+) - (RCLKIN-)$

**7-8 PIXEL CO-ORDINATES**

Normal scan

D(1,1)	D(2,1)		D(X,1)		D(1023,1)	D(1024,1)
D(1,1)	D(1,1)		D(X,1)		D(1023,1)	D(1024,1)
D(1,Y)	D(1,Y)		D(X,Y)		D(1023,Y)	D(1024,Y)
D(1,767)	D(1,767)		D(X,767)		D(1023,767)	D(1024,767)
D(1,768)	D(1,768)		D(X,768)		D(1023,768)	D(1024,768)

**7-9 OPTICAL CHARACTERISTICS**

Measuring equipment:

Luminance: TOPCON BM-7

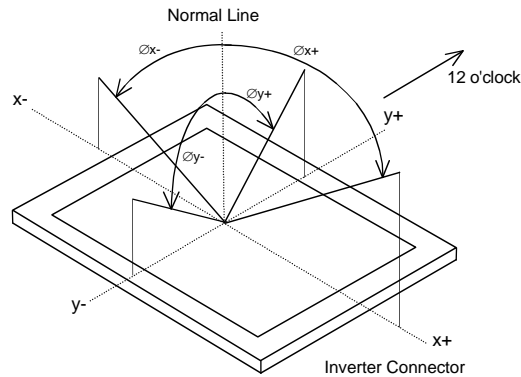
Viewing Angle, Contrast: ELDIM EZContrast 160D

Ta = 25°C ± 5°C

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Horizontal	∅x+	CR>10, ∅y = ±0°	-	80	-	deg.	note 1
		∅x-	CR>10, ∅y = ±0°	-	80	-	deg.	note 1
	Vertical	∅y+	CR>10, ∅x = ±0°	-	80	-	deg.	note 1
		∅y-	CR>10, ∅x = ±0°	-	80	-	deg.	note 1
Contrast ratio		CR	∅y=0°, ∅x=±0°	-	650:1	-	-	note 2
Response time		Ttotal	TR + TF	-	-	28	ms	note 3
Luminance (centre of screen)		Lw	at center v(abs) at center v(λ)	950	1200 1000		cd/m <sup>2</sup>	note 4
Dimming range		DR			1000:1			



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



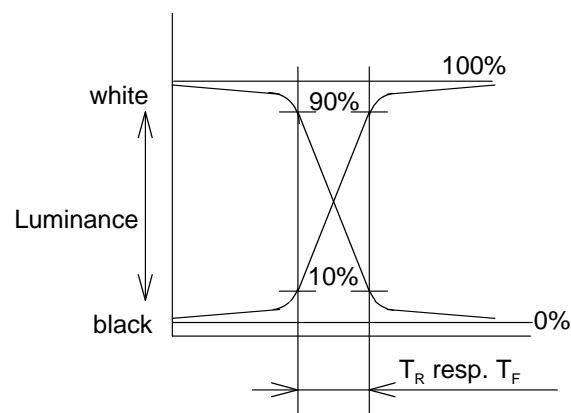
Note 2: The contrast ratio is calculated by using the following formula:

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

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.

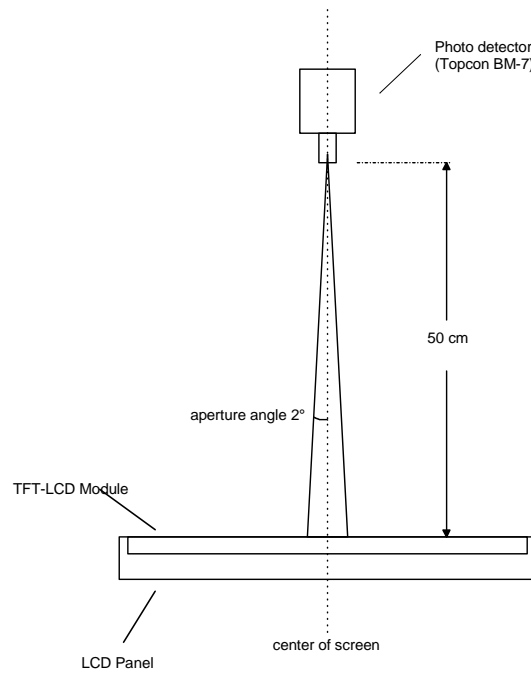


Note 4: Brightness measurements setup.

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  $25 \pm 2$  °C. Ensure there is sufficient heat flow / air circulation is given





**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 :  $-20^\circ \leq \theta_x \leq +20^\circ$ ,  $0^\circ \leq \theta_y \leq +20^\circ$

Appearance specifications:  $-45^\circ \leq \theta_x \leq +45^\circ$ ,  $-45^\circ \leq \theta_y \leq +45^\circ$

Measuring light conditions: Lamp: Cold Cathode Fluorescent Lamp

Chromaticity coordinates (x = 0.320, y = 0.325) typ.

Luminance of backlight surface for inspection: 1200 cd/m<sup>2</sup>

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 *3 more dots			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



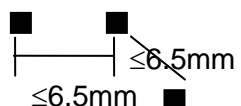
To be uncounted



\*4 ≤ 6.5 mm is considered with:

■ ( :Luminous or Dark dot)

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	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		Quantity
	Measurement criteria		
Other objects Stains Dust (dot shape)	Average diameter( $\varnothing$ ) mm		Allowed value
	$\varnothing \leq 0.2$		all allowed
	$0.2 < \varnothing < 0.3$		$\leq 10$ points
	$0.3 < \varnothing \leq 0.5$		$\leq 3$ points
	$0.5 < \varnothing$		0 point
Other objects Stains Dust (line shape)	Linked other objects		
	Width(W) mm	Length(L) mm	all allowed
	$W \leq 0.05$	-	
	$0.05 \leq W \leq 0.1$	$L < 0.7$	$\leq 4$ 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 a only valid under conditions described at 7-7 "a".



# 8 RELIABILITY TESTS

## 8-1 ENVIRONMENTAL TESTS

Test item	Condition	Judgement
High temperature (operating)	60 ± 2°C, 3 days	No display malfunctions
High temperature (non operating)	75 ± 2°C, 7 days	
Low temperature (operating)	-10 ± 2°C, 24 hours	
Low temperature (non operating)	-25 ± 2°C, 24 hours	
Vibration (operating)	5...500Hz / 5.5mm amplitude for 5...15Hz; 5g for 15...500Hz / Frequency change: 1 octave/min; 5 cycles (5Hz..500Hz..5Hz)	
Mechanical shock (operating)	30g/18ms/Half-sinusoidal 6 spatial directions 3 shocks per direction	
Altitude (operating)	10.000ft, 20 min	
Altitude (non operating)	40.000ft, 1 hour	

**8-2 EMI/EMC TESTS**

Test item	Test Method	Test Result	EUT Meets Criteria
Emissions Test (operating)	EN 55022:2006 Class A	No significant level of emission found in the frequency range of 30MHz through 1000MHz.	Yes
	EN 61000-3-2:2006	All even and odd harmonics current emissions were within stipulated limits.	Yes
	EN 61000-3-3:2005	The test results did not exceed the limits specified in the test criteria.	Yes
Immunity Test (operating)	IEC 61000-4-2:2001 (ESD)	Observation during and review after test showed no effect of the ESD test on the EUT.	A*
	IEC 6100-4-3:2006 (immunity to RF field)	The EUT continued to function normally during and after test.	A*
	IEC 61000-4-4:2004 (EFT)	Observation during and review after test showed no effect of the above tests on the EUT.	A*
	IEC 61000-4-5:2006 (voltage Surge)	The EUT continued to function normally in spite of the presence of surge currents on the input power of the host device of the EUT.	A*
	IEC 6100-4-6:2006 (Conducted Immunity)	The EUT continued to function normally in spite of the presence of conducted RF on the cables of the EUT.	A*
	IEC 61000-4-8:2001 (Magnetic Field Immunity)	The EUT continued to function normally in spite of being subjected to magnetic interference.	A*
	IEC 61000-4-11:2004 (Voltage Dips)	The EUT continued to function normally during and after test.	A*
	IEC 61000-4-11:2004 (Brownouts)	The EUT continued to function normally during and after test.	A*

\*No Degradation of Function



## 9 GENERAL PRECAUTIONS

### 9-1 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<sup>3</sup> backlight.

### 9-2 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.





### 9-3 STORAGE

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

### 9-4 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.

### 9-5 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.