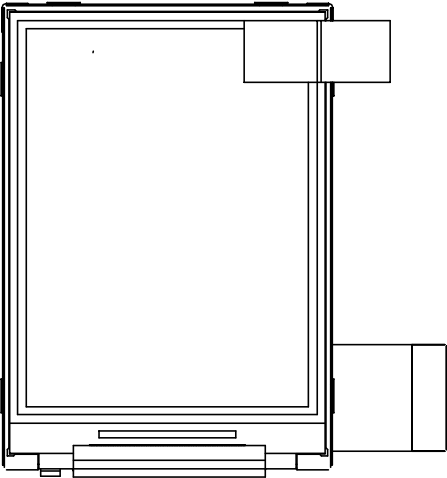




PRODUCT SPECIFICATION

**HDA240F**

2.4', QVGA TFT COLOR GRAPHICS  
LCD DISPLAY MODULE  
(Transflective)



HANTRONIX, INC. 10080 BUBB RD. CUPERTINO, CA 95014	Q.A.: Z.W.	REV.: 1.0	HDA240F	SHEET 1 OF 23 DATE: 6/1/11
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## 1. General Description and Features

HDA240F is a transfective type color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT-LCD module, a driver circuit and a back-light unit. Graphics and texts can be displayed on a QVGA 320 (H) x RGB x 240 (V) dots with 262,144 colors by supplying 18 bits data signal (6bits/each color).

### 1.1 Features

- Transfective and back-light with 4 LEDs(2S & 2P) are available.
- CPU/RGB/SPI Interface
- RoHS Compliance.

### 1.2 LCD Module

Item	Specification	Unit
Screen Size	2.41 inches	Diagonal
Display Resolution	240(H)×RGB×320(V)	Pixel
Active Area	36.72(V) × 48.96(H)	mm
Outline Dimension	60.26(V)× 42.92(H) × 2.48(T)	mm
Display Mode	Normally Black mode/ Transfective	--
Pixel Arrangement	R,G,B Vertical Stripe	--
Pixel pitch	0.153(H)×0.153(V)	mm
Surface Treatment	Anti-Glare and Hard Coating(3H)	
Display Color	262K	--
Viewing Direction	12	--
Input Interface	CPU/RGB/SPI Interface	--
Driver IC	ILI9325C	--

## 2. Mechanical Information

Item	Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	--	42.92	--	mm
	Vertical (V)	--	60.26	--	mm
	Thickness (T)	--	2.48	--	mm
Weight	--	12.4	--	g	--

Note (1) Not Include Component. Refer to the Outline Dimension Drawing as attached.

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### 3. Electrical Specifications

#### 3.1 Absolute Max. Ratings

##### 3.1.1 Absolute Ratings of Environment

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

( $T_a=25\pm 2^\circ\text{C}$ ,  $V_{SS}=\text{GND}=0$ )

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	$T_{STG}$	-30	+80	$^\circ\text{C}$	
Operating temperature	$T_{OPR}$	-10	+70	$^\circ\text{C}$	

##### 3.1.2 Electrical Absolute Maximum Ratings

###### 3.1.2.1 TFT-LCD Module

( $V_{SS}=\text{GND}=0$ )

Parameter	Symbol	Min.	Max.	Unit	Remark
Power supply logic voltage	VCI	-0.3	4.6	V	
Power supply logic voltage	VCC	-0.3	4.6	V	

### 3.1.3 DC Electrical Characteristics of the TFT LCD

(Ta=25±2°C, V<sub>SS</sub>=GND=0)

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply	VCI	2.3	2.8	3.3	V	
Power supply	VCC	1.65	1.8	3.3		
Input Voltage for logic	H Level	V <sub>IH</sub>	0.8xVCC	-	VCC	V
	L Level	V <sub>IL</sub>	-0.3	-	0.2xVCC	V
Power Supply current	ICC	-	7.2	-	mA	Note 1
Power Consumption	PLCD	-	20.16	-	mW	

Note1: f<sub>v</sub> =60Hz , Ta=25°C , Display pattern : Black pattern



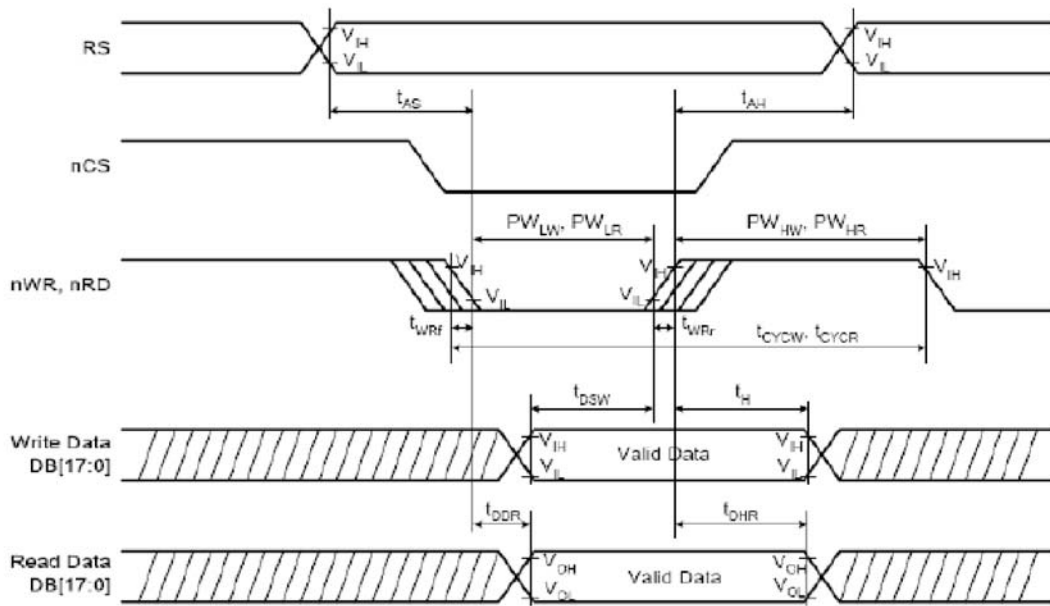
### 3.1.4 Backlight Units

(V<sub>SS</sub>=GND=0)

Parameter	Symbol	Min.	Typ.	Max.	Unit
LED Voltage	VL	-	6.6	7.2	V
LED Current	I <sub>f</sub>	-	40	-	mA
Power Consumption	PLED	-	(264)	-	mW

3.2 I80 System interface timing Characteristics (IOVCC=1.65 ~ 3.3V)

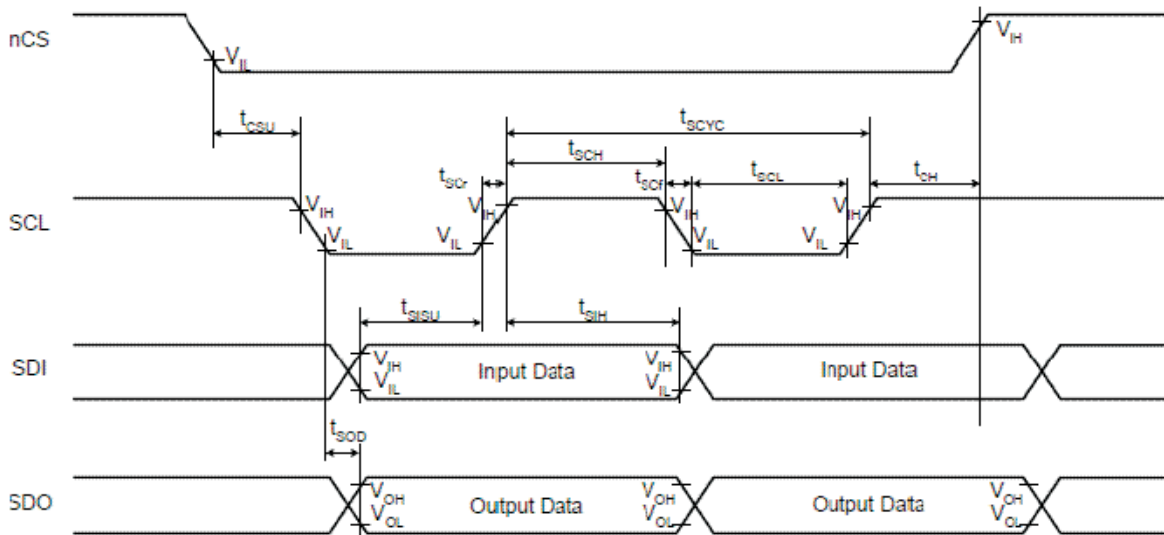
Item	Symbol	Values			Unit	Remark
		Min	Typ	Max.		
Bus cycle time	Write	$t_{CYCW}$	100	-	-	ns
	Read	$t_{CYCR}$	300	-	-	ns
Write low-level pulse width	$PW_{LW}$	50	-	-	ns	
Read low-level pulse width	$PW_{LR}$	150	-	-	ns	
Write high-level pulse width	$PW_{HW}$	50	-	-	ns	
Read high-level pulse width	$PW_{HR}$	150	-	-	ns	
Write/Read rise/fall time	$t_{WRr}, t_{WRf}$	-	-	25	ns	
RS, CS and WR Setup time	$t_{AS}$	10	-	-	ns	
Address hold time	$t_{AH}$	5	-	-	ns	
Write data setup time	$t_{DSW}$	10	-	-	ns	
Write data hold time	$t_{HWR}$	15	-	-	ns	
Read data delay time	$t_{DDR}$	-	-	100	ns	
Read data hold time	$t_{DHR}$	5	-	-	ns	



i80-System Bus Timing

3.3 Serial Data Transfer interface timing Characteristic. (IOVCC=1.65 ~ 3.3V,VCI=2.3~3.3V)

Item	Symbol	Values			Unit	Remark
		Min	Typ	Max.		
Serial clock cycle time	Write	tSCYC	100	-	-	ns
	Read	tSCYC	200	-	-	ns
Serial clock high – level pulse width	Write	tSCH	40	-	-	ns
	Read	tSCH	100	-	-	ns
Serial clock low – level pulse width	Write	tSCL	40	-	-	ns
	Read	tSCL	100	-	-	ns
Serial clock rise / fall time	tScr, tScf	-	-	-	-	ns
Chip select set up time	tCSU	10	-	-	-	ns
Chip select hold time	tCH	50	-	-	-	ns
Serial input data set up time	tSISU	20	-	-	-	ns
Serial input data hold time	tSIH	20	-	25	-	ns
Serial output data set up time	tSOD	-	-	-	-	ns
Serial output data hold time	tSOH	5	-	-	-	ns



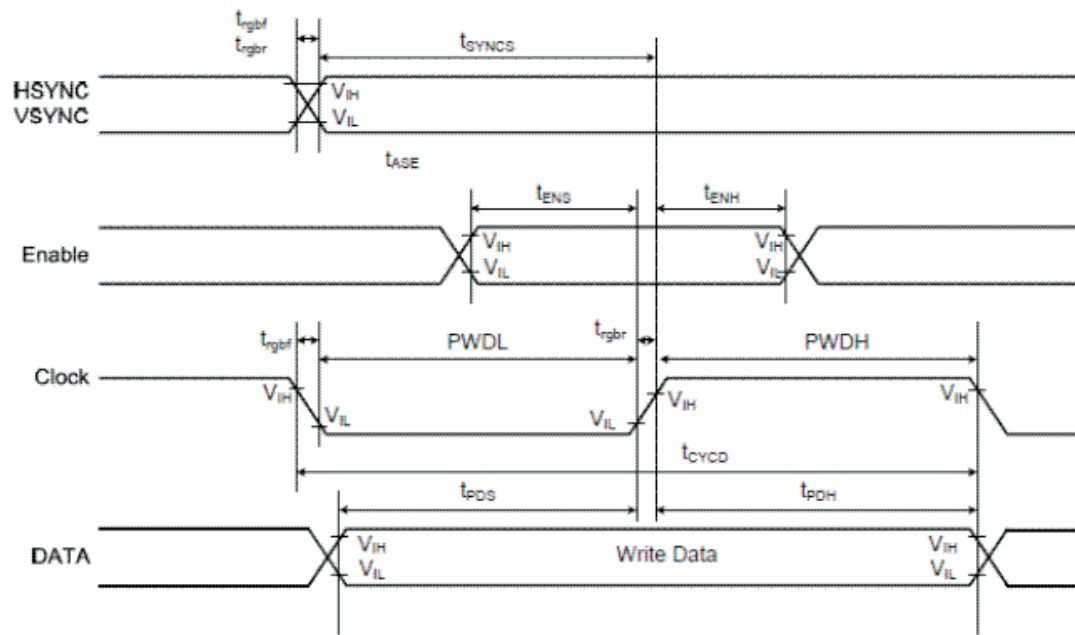
SPI System Bus Timing

3.4 18/16-bits Bus RGB interface Mode(IOVCC=1.65 ~ 3.3V)

Item	Symbol	Values			Unit	Remark
		Min	Typ	Max.		
VSYNC/HSYNC setup time	tSYNCS	0	-	-	ns	
ENABLE setup time	tENS	10	-	-	ns	
ENABLE hold time	tENH	10	-	-	ns	
PD Data setup time	tPDS	10	-	-	ns	
PD Data hold time	tPDH	40	-	-	ns	
DOTCLK high-level pulse width	PWDH	40	-	-	ns	
DOTCLK low-level pulse width	PWDL	40	-	-	ns	
DOTCLK cycle time	tCYCD	100	-	-	ns	
DOTCLK, VSYNC, HSYNC, rise/fall time	trghr,trght	-	-	25	ns	

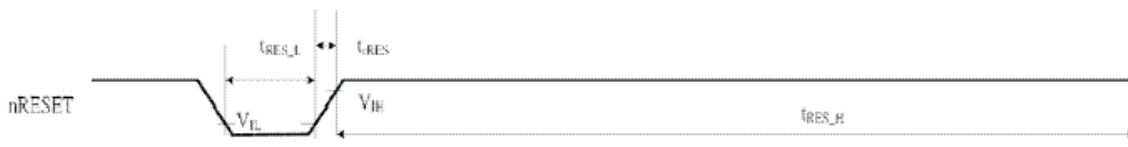
3.5 6-bits Bus RGB interface Mode(IOVCC=1.65 ~ 3.3V)

Item	Symbol	Values			Unit	Remark
		Min	Typ	Max.		
VSYNC/HSYNC setup time	tSYNCS	0	-	-	ns	
ENABLE setup time	tENS	10	-	-	ns	
ENABLE hold time	tENH	10	-	-	ns	
PD Data setup time	tPDS	10	-	-	ns	
PD Data hold time	tPDH	30	-	-	ns	
DOTCLK high-level pulse width	PWDH	30	-	-	ns	
DOTCLK low-level pulse width	PWDL	30	-	-	ns	
DOTCLK cycle time	tCYCD	80	-	-	ns	
DOTCLK, VSYNC, HSYNC, rise/fall time	trghr,trght	-	-	25	ns	



RGB Interface Timing

3.6 Rest timing



Item	Symbol	Unit	Min.	Typ.	Max.
Reset low-level width	$t_{RES\_L}$	ms	1	-	-
Reset rise time	$t_{RES}$	$\mu$ s	-	-	10
Reset high-level width	$t_{RES\_H}$	ms	50	-	-

3.7 Initial code

Normal operation (16Bit RGB Interface)

Step	Register	Value	Note
1	Reset		
2	Delay 70 ms		
3	0x00E3	0x3008	Set internal timing
4	0x00E7	0x0012	
5	0x00EF	0x1231	
6	0x00E5	0x78F0	
7	0x0001	0x0100	
8	0x0002	0x0700	
9	0x0003	0x1030	Entry Mode Setting
10	0x0004	0x0000	
11	0x0008	0x0202	
12	0x0009	0x0000	
13	0x000A	0x0000	
14	0x000C	0x0101	
15	0x000D	0x0000	
16	0x000F	0x0002	
17	Delay 10 ms		
18	0x0010	0x0000	Power Supply Setting VCOM Setting
19	0x0011	0x0007	
20	0x0012	0x0000	
21	0x0013	0x0000	
22	0x0007	0x0001	
23	Delay 200 ms		
24	0x0010	0x1690	
25	0x0011	0x0222	
26	Delay 50 ms		
27	0x0012	0x0087	
28	Delay 50 ms		
29	0x0013	0x1F00	

30	0x0029	0x0035	Gamma Setting
31	0x002B	0x000D	
32	Delay 50 ms		
33	0x0020	0x0000	
34	0x0021	0x0000	
35	0x0030	0x0000	
36	0x0031	0x0003	
37	0x0032	0x0400	
38	0x0035	0x0001	
39	0x0036	0x1C00	
40	0x0037	0x0703	
41	0x0038	0x0407	
42	0x0039	0x0707	
43	0x003C	0x0100	
44	0x003D	0x000F	
45	0x0050	0x0000	
46	0x0051	0x00EF	
47	0x0052	0x0000	
48	0x0053	0x013F	
49	0x0060	0xA700	
50	0x0061	0x0000	
51	0x006A	0x0000	
52	0x0090	0x0010	
53	0x0092	0x0600	
54	0x0007	0x0133	
55	Delay 30 ms		

**Sleep Mode Enter**

Step	Register	Value	Note
1	0x0007	0x0131	Display Off
2	Delay 10 ms		
3	0x0007	0x0130	
4	Delay 10 ms		
5	0x0007	0x0000	Power Off
6	0x0010	0x0080	
7	0x0011	0x0000	
8	0x0012	0x0000	
9	0x0013	0x0000	
10	Delay 200 ms		
11	0x0010	0x0082	

**Sleep Mode Exit**

Step	Register	Value	Note
1	0x0010	0x0080	Power Supply Setting
2	0x0011	0x0000	
3	0x0012	0x0000	
4	0x0013	0x0000	
5	0x0007	0x0001	
6	Delay 200 ms		
7	0x0010	0x1490	
8	0x0011	0x0227	
9	Delay 50 ms		
10	0x0012	0x001C	
11	Delay 50 ms		
12	0x0013	0x1A00	
13	0x0029	0x0025	
14	Delay 50 ms		
15	0x0007	0x0133	Display ON Setting

4. Optical Characteristics

4.1 Optical characteristic of the LCD

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods.

Measuring equipment: BM-7A

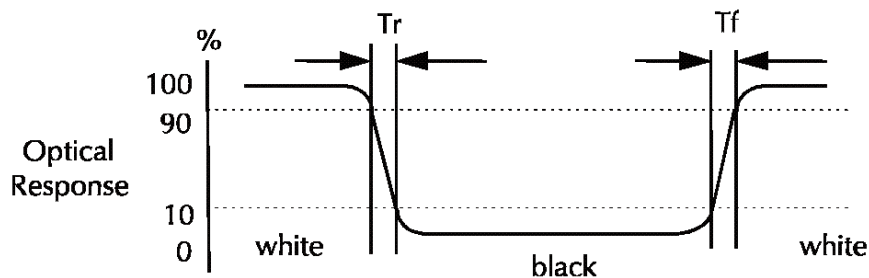
Item	Symbol	Condition	Min	Type	Max	Unit	Note	
Brightness	B		--	250	--	cd/m <sup>2</sup>		
Response time	T <sub>r+</sub> T <sub>f</sub>	θ=0°	-	25	35	ms	.	
Contrast ratio	CR	At optimized viewing angle	--	450	--	--		
Luminance Uniformity	ΔL		--	80	--	%		
Color Chromaticity (CIE 1931)	White	W <sub>x</sub>	θ=0° Normal Viewing Angle	(0.235)	(0.285)	(0.335)	--	BM-7A
		W <sub>y</sub>		(0.273)	(0.323)	(0.373)		
Viewing Angle (6H)	Hor.	θ <sub>R</sub>	CR≥10	70	--	--	Degree	
		θ <sub>L</sub>		70	--	--		
	Ver.	θ <sub>U</sub>		70	--	--		
		θ <sub>D</sub>		70	--	--		

a. Test equipment setup

After stabilizing and leaving the panel alone shall be warmed up for the stable operation of LCM, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7(fast) with a viewing angle of 2° at a distance of 50cm and normal direction.

b. Definition of response time: Tr and Tf

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



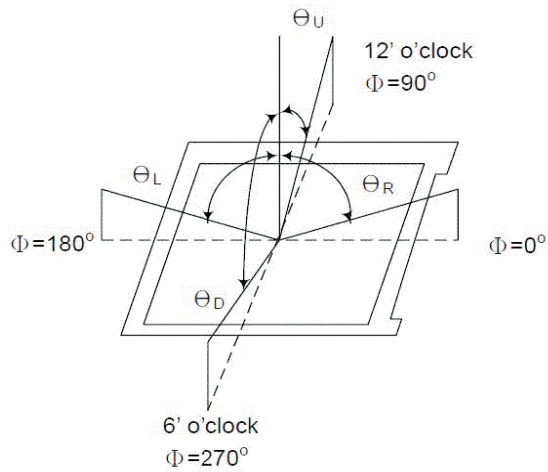
c. Definition of contrast ratio:

$$\text{Contrast Ratio (CR)} = \frac{\text{Brightness measured when LCD is at "white state"}}{\text{Brightness measured when LCD is at "black state"}}$$

d. Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

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e. View Angle



f. Definition of Luminance of White: Luminance of white at the center points

Light Source of Back-Light Unit	LED Type
---------------------------------	----------

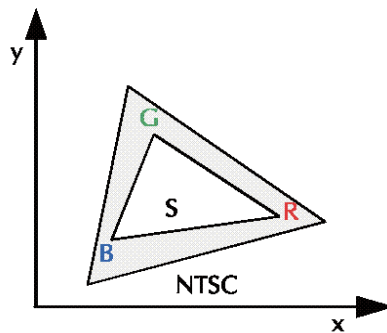
g. Definition of White Uniformity

$$\text{White Uniformity} = \frac{\text{Min. luminance of white among 9-points}}{\text{Max. luminance of white among 9-points}} \times 100\%$$

h. The definition of Color Gamut -Color Chromaticity CIE 1931

Color coordinate of white & red, green, blue at center point.

$$\text{Color Gamut : NTSC(\%)} = (\text{RGB Triangle Area} / \text{NTSC Triangle Area}) \times 100$$



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5. I/O Terminal

5.1 Pin Assignment (connector Part No: JAE FA5B040HP1 or equivalent.)

Pin No.	Symbol	I/O	Function	Remark
1	VCI	P	Power supply for logic and booster	
2	IOVCC	P	I/O Interface supply voltage	
3	IM0	I	MCU Interface select pin	
4	IM1	I	MCU Interface select pin	
5	IM2	I	MCU Interface select pin	
6	IM3	I	MCU Interface select pin	
7	RESET	I	Reset signal	
8	VSYNC	I	Vertical synchronous signal	
9	HSYNC	I	Horizontal synchronous signal	
10	Dotclk	I	Dot Clock signal in RGB I/F	
11	ENABLE	I	Data ENABLE signal for RGB interface operation	
12	DB17	I/O	Data Bus	
13	DB16	I/O	Data Bus	
14	DB15	I/O	Data Bus	
15	DB14	I/O	Data Bus	
16	DB13	I/O	Data Bus	
17	DB12	I/O	Data Bus	
18	DB11	I/O	Data Bus	
19	DB10	I/O	Data Bus	
20	DB9	I/O	Data Bus	
21	DB8	I/O	Data Bus	
22	DB7	I/O	Data Bus	
23	DB6	I/O	Data Bus	
24	DB5	I/O	Data Bus	
25	DB4	I/O	Data Bus	
26	DB3	I/O	Data Bus	
27	DB2	I/O	Data Bus	
28	DB1	I/O	Data Bus	
29	DB0	I/O	Data Bus	
30	SDO	O	Serial data output pin	

31	SDI	I	Serial data input pin	
32	RD	I	Read signal	
33	WR/SCL	I	Write signal or serial clock signal	
34	RS	I	register index or register command select	
35	CS	I	Chip select pin	
36	GND	P	Ground	
37	LEDA	P	Anode for LED	
38	LED K1	P	Cathode for LED	
39	LED K2	P	Cathode for LED	
40	DUMMY	--	NC	
41	DUMMY	--	NC	
42	DUMMY	--	NC	
43	DUMMY	--	NC	
44	DUMMY	--	NC	
45	DUMMY	--	NC	

IM3	IM2	IM1	IM0	MPU-Interface Mode	DB Pin in use
0	0	0	0	Setting invalid	
0	0	0	1	Setting invalid	
0	0	1	0	i80-system 16-bit interface	DB[17:10], DB[8:1]
0	0	1	1	i80-system 8-bit interface	DB[17:10]
0	1	0	ID	Serial Peripheral Interface (SPI)	SDI, SDO, SCL, nCS
0	1	1	0	9-bit 3 wires Serial Peripheral Interface	SDA, SCL, nCS
0	1	1	1	8-bit 4 wires Serial Peripheral Interface	SDA, SCL, nCS, RS (D/CX)
1	0	0	0	Setting invalid	
1	0	0	1	Setting invalid	
1	0	1	0	i80-system 18-bit interface	DB[17:0]
1	0	1	1	i80-system 9-bit interface	DB[17:9]
1	1	*	*	Setting invalid	

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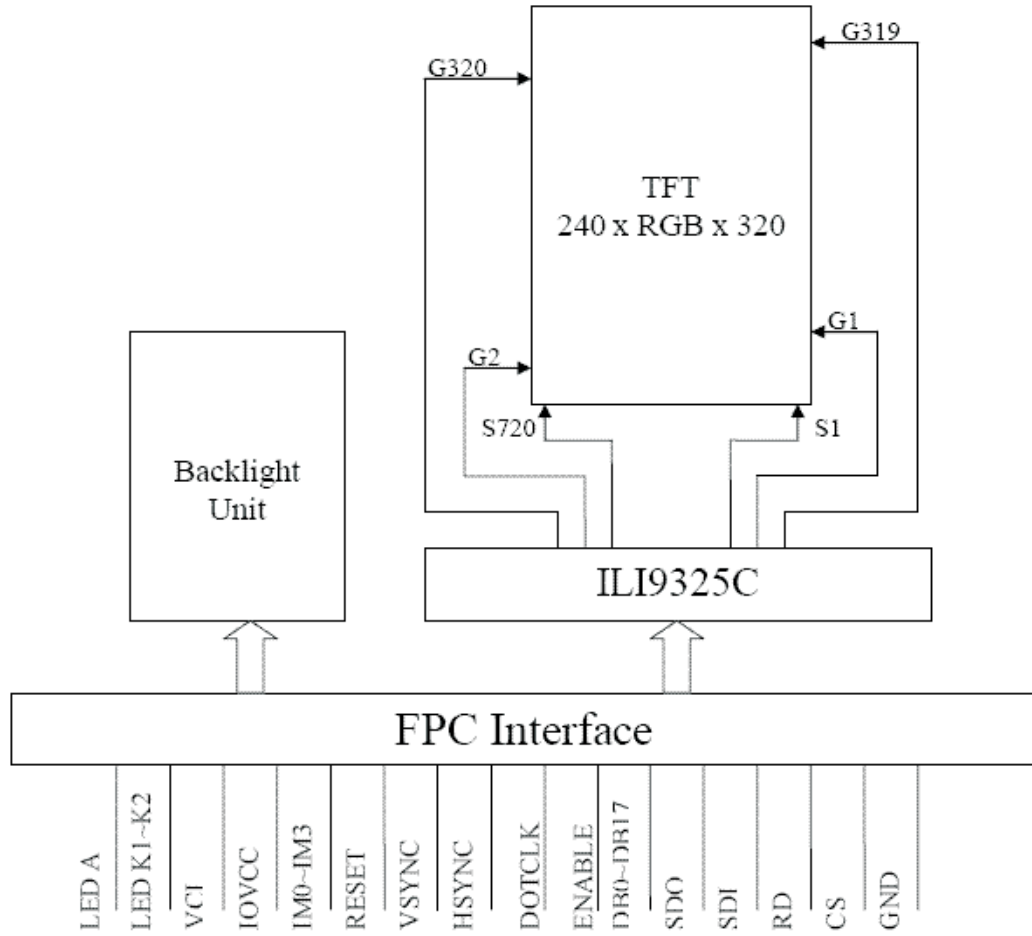
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5.2 Block Diagram



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6. Reliability Condition

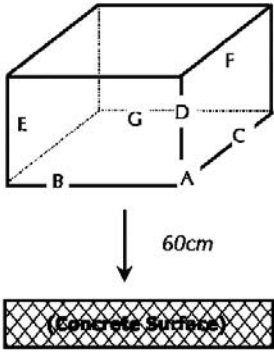
No change on display and in operation under the following test condition.

Condition: Unless otherwise specified, tests will be conducted under the following condition.

Temperature: 20±5°C.

Humidity: 65±5%RH.

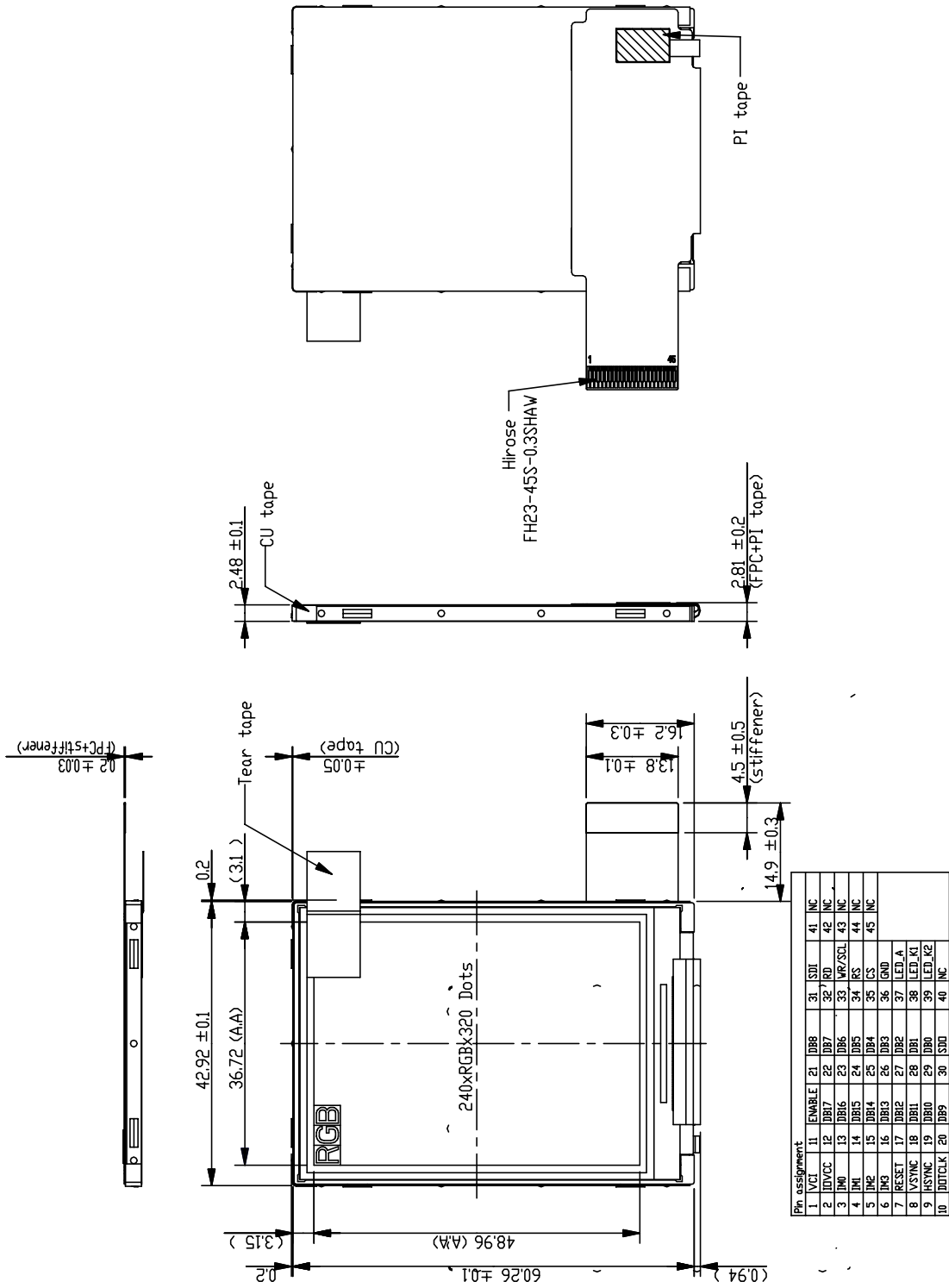
Tests will be not conducted under functioning state.

No.	Parameter	Condition	Notes
1	High Temperature Operating	70°C±2°C, 240hrs (Operation state).	
2	Low Temperature Operating	-10°C±2°C, 240hrs (Operation state).	1
3	High Temperature Storage	80°C±2°C, 240hrs.	2
4	Low Temperature Storage	-30°C±2°C, 240hrs.	1,2
5	High Temperature and High Humidity Operation Test	50°C±2°C, 80%, 240hrs.	1,2
6	Vibration Test	Total fixed amplitude: 1.5mm. Vibration Frequency: 10~55Hz. One cycle 60 seconds to 3 direction of X, Y, Z each 15 minutes.	3
7.	Drop Test	To be measured after dropping from 60cm high on the concrete surface in packing state.  <i>Dropping method corner dropping:</i> <i>A corner: Once edge dropping.</i> <i>B, C, D edge: Once face dropping.</i> <i>E, F, G face: Once.</i>	

- Notes:
1. No dew condensation to be observed.
  2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
  3. Vibration test will be conducted to the product itself without putting I in a container.

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7. Dimensional Outlines



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8. Incoming Inspection Standards

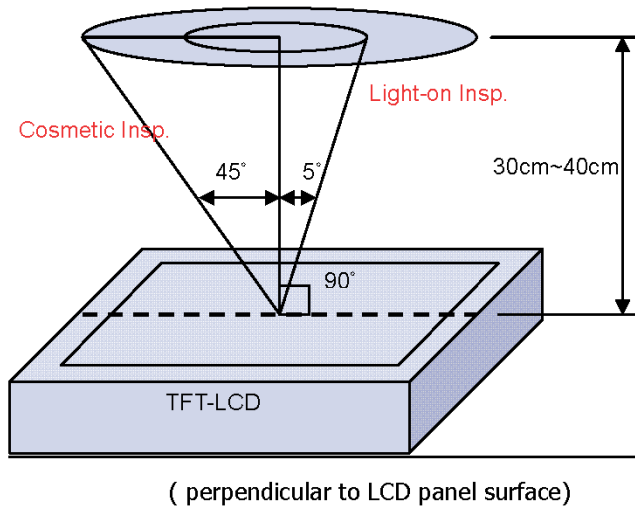
8.1 Inspection and Environment Conditions

8.1.1 Inspection Conditions:

(1) Inspection Distance: 35 cm±5cm

(2) View Angle : Light-on Inspection Angle : ±5°

Cosmetic Inspection Angle : ±45°



8.1.2 Environment Conditions:

Ambient Temperature		23°C±5°C
Ambient Humidity		55±10%RH
Ambient Illumination	Cosmetic Inspection	more than 600 Lux
	Functional Inspection	300~500 Lux

8.1.3 Sampling Conditions:

(1) Lot Size: Quantity of shipment lot per model

(2) Sampling Method:

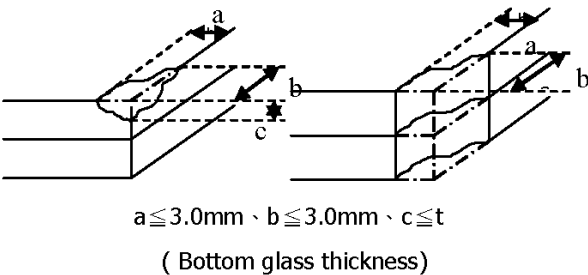

Sampling Plan		MIL-STD-105E
		Normal Inspection, Single Sampling
		Level II
AQL	Major Defect	1.0%
	Minor Defect	1.5%

(3) The classification of Major(MA) and Minor(MI) defects is shown as 3. Inspection Criteria.

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8.1.4 Inspection Criteria

8.1.4.1 Cosmetic Inspection(Panel):

Item	Judgment Criteria	Classification
Chipping on Panel	 <p><math>a \leq 3.0\text{mm} \cdot b \leq 3.0\text{mm} \cdot c \leq t</math> ( Bottom glass thickness)</p>	MA
Scratch on Panel *Note-2	<p><math>W \leq 0.05\text{mm}</math> or <math>L &lt; 5\text{mm}</math>: Ignored  <math>0.05\text{mm} &lt; W \leq 0.1\text{mm}</math> and <math>L \leq 5\text{mm}</math>: <math>N \leq 5</math>  <math>W &gt; 0.1\text{mm}</math> or <math>L &gt; 5\text{mm}</math>: Not allowed</p>	MI
Bubble or Dent on Panel *Note-3	<p><math>D \leq 0.2\text{mm}</math>: Ignored  <math>0.2\text{mm} &lt; D \leq 0.3\text{mm}</math>: <math>N \leq 5</math>  <math>D &gt; 0.3\text{mm}</math>: Not allowed</p>	MI
Panel Crack	 <p>Not Allowed crack</p>	MA
Bezel Deformation	Obvious deformation is not allowed.	MI
Bezel Oxidation	Not allowed if it rusts continuously over 1 cm (It is out of warranty with rusted tin plate)	MI
Bezel Scratch	$L \leq 20\text{mm}$ , $W \leq 0.2$ , $N \leq 3$	MI
Metal Squash Dent /Flange(Front Side)	$D(W) \leq 1, L \leq 3, N \leq 3;$	MI
B/L High Voltage Wire Denudation	Not allowed	MA
Polarizer flaw or leak out resin	Defect is defined as the active area.	MI
Outline Dimension	Must in Spec, refer to related product spec.	MI

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1.0

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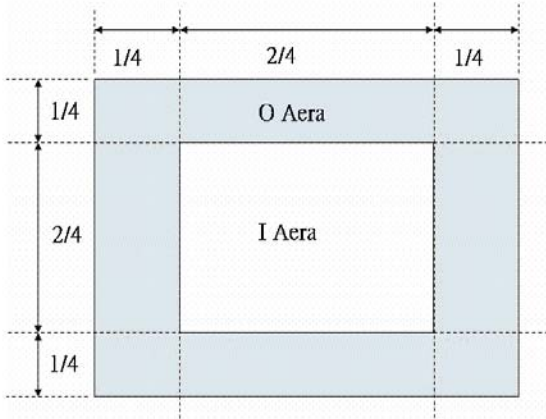
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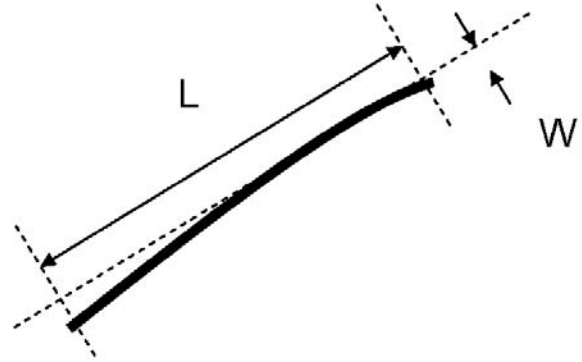
8.1.4.2 Functional Inspection:

Item	Judgment Criteria			Classification	
	Area(Note1)	I	O		
Point Defect	Bright dot	Random	0		MI
		2 dots adjacent	0	0	
		3 dots adjacent or more	0	0	
	Dark dot	Random	2		
		2 dots adjacent	0		
		3 dots adjacent or more	0	0	
	Total Dot Defect		2		
	Distance	Distance between Bright and Bright dot	$L \geq 5\text{mm}$		
		Distance between Bright and Dark dot	$L \geq 5\text{mm}$		
		Distance between Dark dot	$L \geq 5\text{mm}$		
(1) It is defined as Point Defect if defect area $> 0.5\text{dot}$ (2) It is ignored if defect area $\leq 0.5\text{dot}$ (3) Weak point defect will be defined as Bright Dot if it can be observed through ND filter 5%( Full Screen Black Inspection)					
Line Defect	Obvious vertical or horizontal line defect is not allowed.			MA	
Mura	Not allowed if it can be observed through ND Filter 5 %			MI	
Foreign Material in spot shape *Note-3	$D \leq 0.2\text{mm}$ : Ignored $0.2\text{mm} < D \leq 0.3\text{mm}$ : $N \leq 3$ $D > 0.3\text{mm}$ : Not allowed			MI	
Foreign Material in line or spiral shape *Note-4	$W \leq 0.05\text{mm}$ or $L \leq 3.0\text{mm}$ : Ignored $0.05\text{mm} < W \leq 0.1\text{mm}$ and $1.0\text{mm} < L \leq 2.0\text{mm}$ : $N \leq 4$ $W > 0.1\text{mm}$ or $L > 5\text{mm}$ : Not allowed			MI	
Display Function Abnormal	No Malfunction can be allowed			MA	

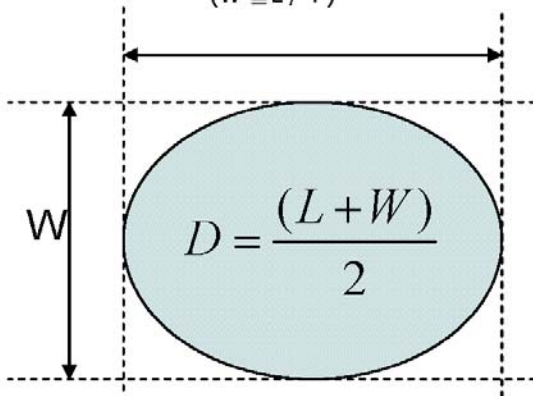
Note-1 : I/O Area Definition



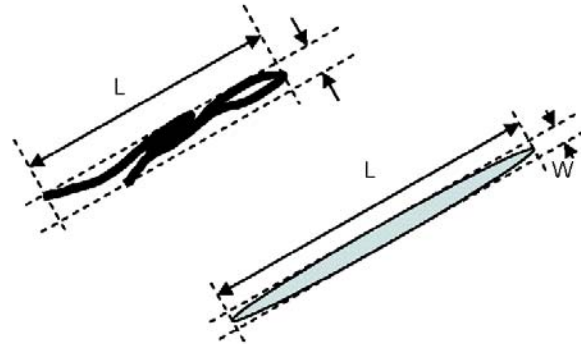
Note-2 : Polarizer Scratch



Note-3 : Spot Foreign Material  
( $W \geq L / 4$ )



Note-4 : Line or Spiral Foreign Material  
( $W < L / 4$ )



HANTRONIX, INC.  
10080 BUBB RD.  
CUPERTINO, CA 95014

Q.A.:  
Z.W.

REV.:  
1.0

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