

# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 1

## **HOSIDEN AND PHILIPS DISPLAY CORPORATION**

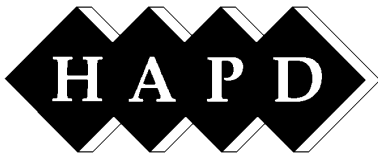
**HLD 1509 - 010130**

**15,1 INCH**

**ACTIVE MATRIX COLOR  
2 TUBE HIGH BRIGHTNESS TFT DISPLAY**

**1024 x 768 DOTS**





# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 2

## **CONTENTS**

### **1. OUTLINE**

- 1-1 Scope
- 1-2 Features
- 1-3 Block Diagram

### **2. ABSOLUTE MAXIMUM RATINGS**

### **3. DISPLAY CHARACTERISTICS**

- 3-1 Physical Dimensions
- 3-2 Electro-Optical Characteristics
- 3-3 Electrical Characteristics

### **4. DEFINITION AND MEASURING METHOD**

- 4-1 Viewing Angle
- 4-2 Optical Measurement
- 4-3 Contrast Ratio
- 4-4 Response Time
- 4-5 Reflectance
- 4-6 Brightness and Brightness Uniformity
- 4-7 Supply Current
- 4-8 Crosstalk

### **5. RELIABILITY**

- 5-1 Test Item and Condition
- 5-2 Evaluation Criteria
- 5-3 Cosmetic Anomalies
- 5-4 Functional Defects

### **6. APPLICABLE OTHER DOCUMENTS**

### **7. CAUTION AND HANDLING PRECAUTION**

- 7-1 Handling
- 7-2 Storage
- 7-3 Operation
- 7-4 Others

### **8. WARRANTY**

- 8-1 Incoming Inspection
- 8-2 Warranty Period

### **9. OTHERS**

### **10. DRAWING**



# SPECIFICATIONS

## 1. OUTLINE

### 1-1 Scope

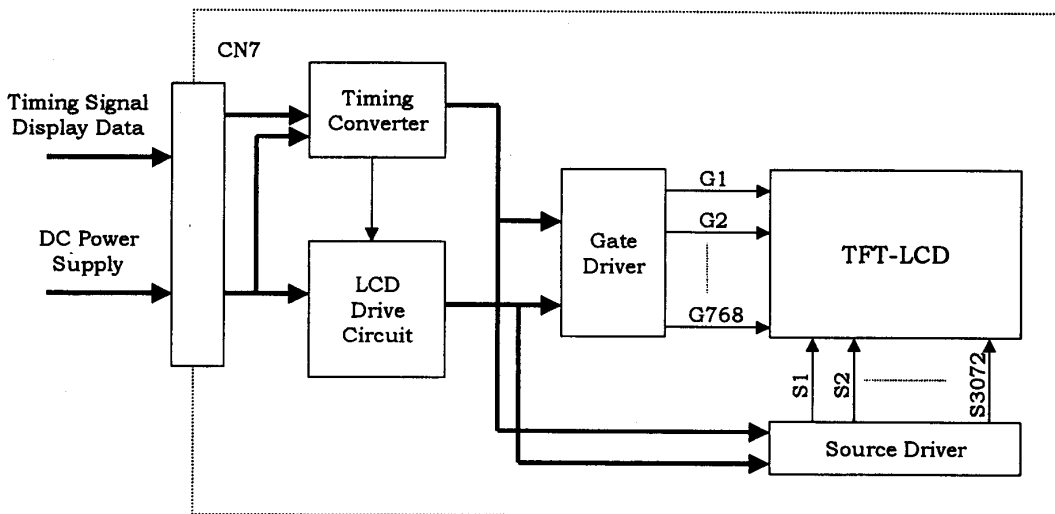
This specification shall be applied to HOSIDEN AND PHILIPS Color Active Dot Matrix Liquid Crystal Display (ALCD) with CCFL backlight

### 1-2 Features

Display Mode	Transmissive type normally white mode
Display Format	1024 (x3) x 768 Dots
Screen Active Area	307,2 x 230,4 mm
Display Outline	360 x 260 x 14.9 mm (typ.)
Contrast Ratio	300:1 (typ.)
Brightness	250 cd/m <sup>2</sup> (typ)
Response Time	Tr = 15 ms (typ) / Tf = 25 ms (typ)
Color Pixel Arrangement	RGB vertical stripes
Display Surface	Low reflection type, antiglare with hard coating
Number of Colors	262.144 colors (6 bits/subpixel) / 16 Mio colors (8 bits with FRC)
Viewing Direction	6:00 o' clock (Maximum contrast direction)
Interface	5 V CMOS logic
Backlight	2 CCFL edgelight system

### 1-3 Block Diagram

#### 1-3-1 Display



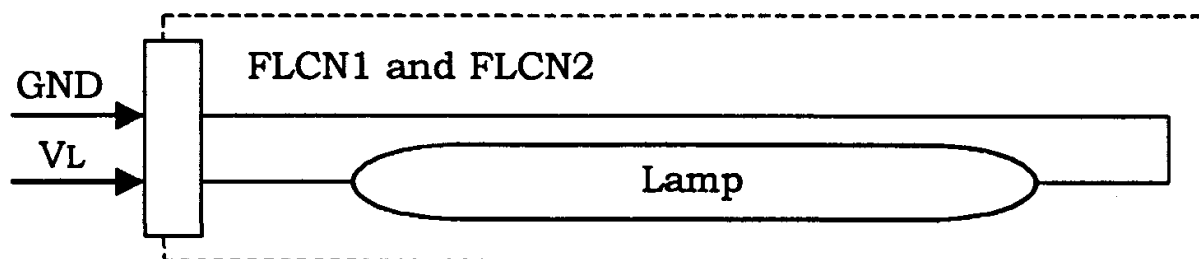


# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 4

## 1-3-2 Backlight Unit



## 2. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Specification	Unit	Remark
Storage Temperature	T <sub>st</sub>	-20 ... 60	°C	
Humidity *	RH	95 max	%	≤ 40°C
Operating Temperature	T <sub>op</sub>	0 ... 50	°C	
Humidity *	RH	95 max	%	≤ 40°C
5V Supply Voltage	V <sub>DD</sub>	-0,3 ... +6		T <sub>a</sub> =25°C
Input Voltage	V <sub>I</sub>	-0,3 ... V <sub>DD</sub> +0,3	V	
Ambient Light		103,8	klx	
Driving Lamp current	I <sub>fl</sub>	2...8	mA	Depending on inverter capacity for low current

\* Note :

40°C , 95% RH , 120 h : Module will keep specified contrast ratio

40°C , 95% RH , 200 h : No damage to the module for practical use

See section "5 Reliability" for other conditions

## 3. DISPLAY CHARACTERISTICS

### 3-1 Physical Dimensions

Item	Standard Value	Unit
Display Pixels	1024 (x3RGB) x 768	dots
Pixel Pitch	0,300 (0,100x3) x 0,300	mm
Active Area	307,2 x 230,4 (15,1" diagonal)	mm
Display Outline	360 x 266 x 14,9 (max)	mm
Weight	1300 (typ)	grams



# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 5

## 3-2 Electro-Optical Characteristics

Item	Condition	Symbol	Min	Typ	Max	Unit	
Contrast Ratio	$\theta=0^\circ, \phi=0^\circ$	CR	200	300	-	-	
Viewing Angle	Vertical up	$\phi=0^\circ$ (CR $\geq$ 10)	$\theta$	- 35	- 45	-	deg
	Vertical down	$\phi=0^\circ$ (CR $\geq$ 10)	$\theta$	45	55	-	deg
	Horiz. left	$\theta=0^\circ$ (CR $\geq$ 10)	$\phi$	- 50	-60	-	deg
	Horiz. right	$\theta=0^\circ$ (CR $\geq$ 10)	$\phi$	50	60	-	deg
Viewing Angle	Vertical up	$\phi=0^\circ$ (CR $\geq$ 5)	$\theta$	-	- 60	-	deg
	Vertical down	$\phi=0^\circ$ (CR $\geq$ 5)	$\theta$	-	75	-	deg
	Horiz. left	$\theta=0^\circ$ (CR $\geq$ 5)	$\phi$	-	-80	-	deg
	Horiz. right	$\theta=0^\circ$ (CR $\geq$ 5)	$\phi$	-	80	-	deg
Response Time	Rise	$25^\circ\text{C} \pm 2,5^\circ\text{C}$	$T_r$	-	15	30	ms
	Fall	$\theta=0^\circ, \phi=0^\circ$	$T_f$	-	25	40	ms
Frame Frequency			50	60	75	Hz	
Crosstalk	$\theta=0^\circ, \phi=0^\circ$				1.5	%	
Front Surface Hardness (Pencil)	JIS K5400		3	-	-	H	
Front Antiglare Coating (Haze)	JIS K6714		20	25	30	%	
Front Surface Reflectance		R	-	-	5.0	%	
Brightness (5 point average)	$I_f = 5 \text{ mA}$		200	250	-	$\text{cd/m}^2$	
Brightness Uniformity	$I_f = 5 \text{ mA}$		-10		+10	%	
Chromaticity (CIE 1931)	$\theta=0^\circ, \phi=0^\circ$	x	0.285	0.315	0.345	-	
	White	y	0.315	0.345	0.375	-	
	$\theta=0^\circ, \phi=0^\circ$	x	-	0.62	-	-	
	Red	y	-	0.33	-	-	
	$\theta=0^\circ, \phi=0^\circ$	x	-	0.30	-	-	
	Green	y	-	0.61	-	-	
	$\theta=0^\circ, \phi=0^\circ$	x	-	0.14	-	-	
	Blue	y	-	0.11	-	-	
Viewing Direction				6:00		o'clock	

Note :

- a) If not specially mentioned, CCFL supply current ( $I_f$ ) shall be referred to section 3-3-2
- b) Refer to section 4 for definitions and other information
- c) If not specially mentioned, condition of temperature is RT ( $20^\circ\text{C} \dots 30^\circ\text{C}$ )
- d) If not specially mentioned, condition of frame frequency is 60 Hz, line frequency is 48 kHz



# SPECIFICATIONS

## 3-3 Electrical Characteristics

### 3-3-1 Display

Item	Symbol	Min	Typ	Max	Unit	Remark
Supply Voltage	V <sub>DD</sub>	4,75	5,0	5,25	V	V <sub>DD</sub> ± 5%
"High" Input Voltage	V <sub>ih</sub>	2,3	-	-	V	Input signals are: DE,VS,HS,DCLK, R,G,B 0...5, FRCC
"Low" Input Voltage	V <sub>il</sub>	-	-	1,0	V	
Input Leakage Current	I <sub>CL,I</sub> CH	-20	-	20	µA	
Supply Current	I <sub>DD</sub>	-	190	300	mA	V <sub>DD</sub> =5V, VS=60Hz HS=49kHz DCLK=32,5 MHz

Note :

A 1.5 A fuse

### 3-3-2 CCFL Backlight

Item	Symbol	Min	Typ	Max	Unit	Remark
Lamp Current	I <sub>f</sub>	-	7	-	mA	for 1 CCFL
Lamp Voltage	V <sub>L</sub>	-	620	-	V <sub>rms</sub>	for 1 CCFL
Power Consumption		-	4,34	-	W <sub>rms</sub>	for 1 CCFL
Power Consumption		-	8,68	-	W <sub>rms</sub>	for 2 CCFLs
Starting Voltage		1300 1700	-	-	V <sub>rms</sub>	25°C ± 2°C 0°C ± 2°C
Driving Frequency		45	50	55	kHz	* 1,2
Life (half brightness time)		50.000	-	-	h	* 3

Note :

\*1 : Operating with out of range of specified frequency as above can affect brightness and uniformity of the product. Therefore, please contact with us before you can operate with such frequency.

\*2 : Interference between Horizontal Sync (HS) frequency and CCFL driving frequency may feasibly cause beat on the display. Therefore please set up CCFL driving frequency suitable to avoid beat on the display.

\*3 : Criteria of Lamp Life shall be more than 50% of initial brightness

**Recommended Inverter : Built-In Type : HLS1509-020301-INVERTER**



# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 7

## 3-3-3-1 Interface Description Display (8 Bit Mode)

Connector (CN1) for display Manufacturer : HIROSE Part Number : FX8-80S-SV

Recommended Interface : IF183-01 (dual LVDS) / IF183-02 (digital) available

Pin	Signal Name	Function	Pin	Signal Name	Function
1	GND	Ground	41	GND	Ground
2	RA0	Red Data 0 Odd	42	GB0	Green Data 0 Even
3	RA1	Red Data 1 Odd	43	GB1	Green Data 1 Even
4	RA2	Red Data 2 Odd	44	GB2	Green Data 2 Even
5	RA3	Red Data 3 Odd	45	GB3	Green Data 3 Even
6	GND	Ground	46	GND	Ground
7	RA4	Red Data 4 Odd	47	GB4	Green Data 4 Even
8	RA5	Red Data 5 Odd	48	GB5	Green Data 5 Even
9	RA6	Red Data 6 Odd	49	GB6	Green Data 6 Even
10	RA7	Red Data 7 Odd	50	GB7	Green Data 7 Even
11	GND	Ground	51	GND	Ground
12	GA0	Green Data 0 Odd	52	BB0	Blue Data 0 Even
13	GA1	Green Data 1 Odd	53	BB1	Blue Data 1 Even
14	GA2	Green Data 2 Odd	54	BB2	Blue Data 2 Even
15	GA3	Green Data 3 Odd	55	BB3	Blue Data 3 Even
16	GND	Ground	56	GND	Ground
17	GA4	Green Data 4 Odd	57	BB4	Blue Data 4 Even
18	GA5	Green Data 5 Odd	58	BB5	Blue Data 5 Even
19	GA6	Green Data 6 Odd	59	BB6	Blue Data 6 Even
20	GA7	Green Data 7 Odd	60	BB7	Blue Data 7 Even
21	GND	Ground	61	GND	Ground
22	BA0	Blue Data 0 Odd	62	GND	Ground
23	BA1	Blue Data 1 Odd	63	CLK	Clock
24	BA2	Blue Data 2 Odd	64	GND	Ground
25	BA3	Blue Data 3 Odd	65	GND	Ground
26	GND	Ground	66	HS	Horizontal Sync
27	BA4	Blue Data 4 Odd	67	GND	Ground
28	BA5	Blue Data 5 Odd	68	GND	Ground
29	BA6	Blue Data 6 Odd	69	DE	Display Data Enable
30	BA7	Blue Data 7 Odd	70	VS	Vertical Sync
31	GND	Ground	71	V <sub>DD</sub>	Power Supply +5V
32	RB0	Red Data 0 Even	72	V <sub>DD</sub>	Power Supply +5V
33	RB1	Red Data 1 Even	73	V <sub>DD</sub>	Power Supply +5V
34	RB2	Red Data 2 Even	74	V <sub>DD</sub>	Power Supply +5V
35	RB3	Red Data 3 Even	75	V <sub>DD</sub>	Power Supply +5V
36	GND	Ground	76	TEST1	Do not connect
37	RB4	Red Data 4 Even	77	FRCC	FRC ON=1 / OFF=0
38	RB5	Red Data 5 Even	78	TEST2	Do not connect
39	RB6	Red Data 6 Even	79	TEST3	Do not connect
40	RB7	Red Data 7 Even	80	GND	Ground



# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 8

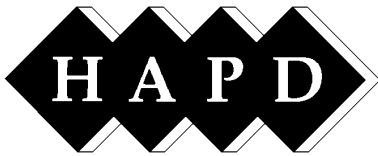
## 3-3-3-2 Interface Description Display (6 Bit Mode)

Connector (CN1) for display Manufacturer : HIROSE Part Number : FX8-80S-SV

Recommended Interface : IF183-01 (dual LVDS) / IF183-02 (digital) available

Pin	Signal Name	Function	Pin	Signal Name	Function
1	GND	Ground	41	GND	Ground
2	GND	Ground	42	GND	Ground
3	GND	Ground	43	GND	Ground
4	RA0	Red Data 0 Odd	44	GB0	Green Data 0 Even
5	RA1	Red Data 1 Odd	45	GB1	Green Data 1 Even
6	GND	Ground	46	GND	Ground
7	RA2	Red Data 2 Odd	47	GB2	Green Data 2 Even
8	RA3	Red Data 3 Odd	48	GB3	Green Data 3 Even
9	RA4	Red Data 4 Odd	49	GB4	Green Data 4 Even
10	RA5	Red Data 5 Odd	50	GB5	Green Data 5 Even
11	GND	Ground	51	GND	Ground
12	GND	Ground	52	GND	Ground
13	GND	Ground	53	GND	Ground
14	GA0	Green Data 0 Odd	54	BB0	Blue Data 0 Even
15	GA1	Green Data 1 Odd	55	BB1	Blue Data 1 Even
16	GND	Ground	56	GND	Ground
17	GA2	Green Data 2 Odd	57	BB2	Blue Data 2 Even
18	GA3	Green Data 3 Odd	58	BB3	Blue Data 3 Even
19	GA4	Green Data 4 Odd	59	BB4	Blue Data 4 Even
20	GA5	Green Data 5 Odd	60	BB5	Blue Data 5 Even
21	GND	Ground	61	GND	Ground
22	GND	Ground	62	GND	Ground
23	GND	Ground	63	CLK	Clock
24	BA0	Blue Data 0 Odd	64	GND	Ground
25	BA1	Blue Data 1 Odd	65	GND	Ground
26	GND	Ground	66	HS	Horizontal Sync
27	BA2	Blue Data 2 Odd	67	GND	Ground
28	BA3	Blue Data 3 Odd	68	GND	Ground
29	BA4	Blue Data 4 Odd	69	DE	Display Data Enable
30	BA5	Blue Data 5 Odd	70	VS	Vertical Sync
31	GND	Ground	71	V <sub>DD</sub>	Power Supply +5V
32	GND	Ground	72	V <sub>DD</sub>	Power Supply +5V
33	GND	Ground	73	V <sub>DD</sub>	Power Supply +5V
34	RB0	Red Data 0 Even	74	V <sub>DD</sub>	Power Supply +5V
35	RB1	Red Data 1 Even	75	V <sub>DD</sub>	Power Supply +5V
36	GND	Ground	76	TEST1	Do not connect
37	RB2	Red Data 2 Even	77	FRCC	FRC ON=1 / OFF=0
38	RB3	Red Data 3 Even	78	TEST2	Do not connect
39	RB4	Red Data 4 Even	79	TEST3	Do not connect
40	RB5	Red Data 5 Even	80	GND	Ground





# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 9

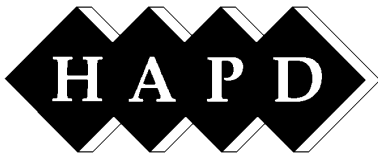
## **3-3-3-3 Interface Extended Functions Description**

### **TEST 1,2,3 (Pin 76,78,79) [RESERVED]**

Please leave this terminal not connected (N.C.) for normal operation  
(This pin is preset "LOW" internally)

### **FRCC (Pin 77) [FRAME RATE CONTROL SWITCH]**

Please leave this terminal not connected (N.C.) for normal operation  
(This pin is preset "HIGH" internally)



# SPECIFICATIONS

### 3-3-4 Interface Description Backlight

Connector (FLCN1 and FLCN2) for backlight

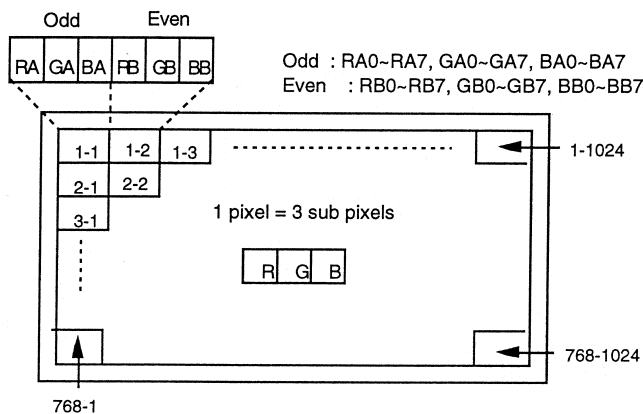
Manufacturer : JAPAN SOLDERLESS TERMINAL CO., LTD

Part Number : BHR-03VS-1    Preferable Connector : SM02 (8.0) B-BHS-1

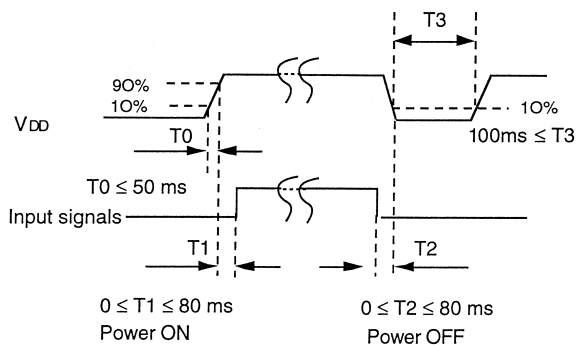
Pin No.	Signal Name	Function
1	VL	Power Supply
2	NC	No Connection
3	GND	Ground (0V)

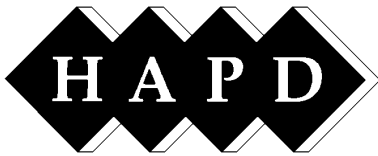
### 3-3-5 Data Input Format

Display Position of Input Data (W-H)



### 3-3-6 Power ON/OFF Sequential Timing





# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 11

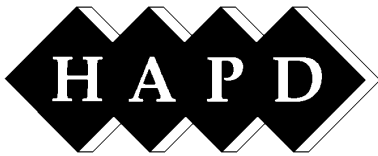
## 3-3-7 Data Signal, Basic Color and Gray Scale of each Color for 8 Bit Operation

Basic Color	Data Signal																
	Odd	RA7	RA6	RA5	RA4	RA3	RA2	RA1	RA0	GA7	GA6	GA5	GA4	GA3	GA2	GA1	GA0
	Even	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0	GB7	GB6	GB5	GB4	GB3	GB2	GB1	GB0
Black	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	0	0	0	0	0
Green	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	0	1	1	1	1	1	1	1	1
Red	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Magenta	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Basic Color	Data Signal								
	Odd	BA7	BA6	BA5	BA4	BA3	BA2	BA1	BA0
	Even	BB7	BB6	BB5	BB4	BB3	BB2	BB1	BB0
Black	0	0	0	0	0	0	0	0	0
Blue	1	1	1	1	1	1	1	1	1
Green	0	0	0	0	0	0	0	0	0
Cyan	1	1	1	1	1	1	1	1	1
Red	0	0	0	0	0	0	0	0	0
Magenta	1	1	1	1	1	1	1	1	1
Yellow	0	0	0	0	0	0	0	0	0
White	1	1	1	1	1	1	1	1	1

Gray Scale of Red / Green / Blue	Data Signal									Gray Level (decimal)							
	RGB	RGB	RGB	RGB	RGB	RGB	RGB	RGB	RGB								
	A7	A6	A5	A4	A3	A2	A1	A0	B7		B6	B5	B4	B3	B2	B1	B0
Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	= 0
Darker	0	0	0	0	0	0	1	0	1								= 1
↑	0	0	0	0	1	0	1	0									= 2
:	0	0	0	0	1	1	1	1									= 3
:	:	:	:	:	:	:	:	:									:
:	:	:	:	:	:	:	:	:									:
:	:	:	:	:	:	:	:	:									:
↓	1	1	1	1	1	1	0	1									= 253
Brighter	1	1	1	1	1	1	1	1									= 254
Red / Green / Blue	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	= 255

0 = Low Level Voltage  
1 = High Level Voltage



# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 12

## 3-3-8 Data Signal, Basic Color and Gray Scale of each Color for 6 Bit Operation

Basic Color	Data Signal												
	Odd	RA5	RA4	RA3	RA2	RA1	RA0	GA5	GA4	GA3	GA2	GA1	GA0
	Even	RB5	RB4	RB3	RB2	RB1	RB0	GB7	GB6	GB5	GB4	GB3	GB2
Black	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	0
Green	0	0	0	0	0	0	0	1	1	1	1	1	1
Cyan	0	0	0	0	0	0	0	1	1	1	1	1	1
Red	1	1	1	1	1	1	1	0	0	0	0	0	0
Magenta	1	1	1	1	1	1	1	0	0	0	0	0	0
Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1
White	1	1	1	1	1	1	1	1	1	1	1	1	1

Basic Color	Data Signal						
	Odd	BA5	BA4	BA3	BA2	BA1	BA0
	Even	BB5	BB4	BB3	BB2	BB1	BB0
Black	0	0	0	0	0	0	0
Blue	1	1	1	1	1	1	1
Green	0	0	0	0	0	0	0
Cyan	1	1	1	1	1	1	1
Red	0	0	0	0	0	0	0
Magenta	1	1	1	1	1	1	1
Yellow	0	0	0	0	0	0	0
White	1	1	1	1	1	1	1

Gray Scale of Red / Green / Blue	Data Signal						Gray Level (decimal)
	RGB	RGB	RGB	RGB	RGB	RGB	
	A5	A4	A3	A2	A1	A0	
Black	B5	B4	B3	B2	B1	B0	= 0
Darker	0	0	0	1	0	1	= 1
↑	0	0	1	0	1	0	= 2
:	0	0	1	1	1	1	= 3
:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:
↓	1	1	1	1	0	1	= 61
Brighter	1	1	1	1	1	0	= 62
Red / Green / Blue	1	1	1	1	1	1	= 63

0 = Low Level Voltage  
1 = High Level Voltage



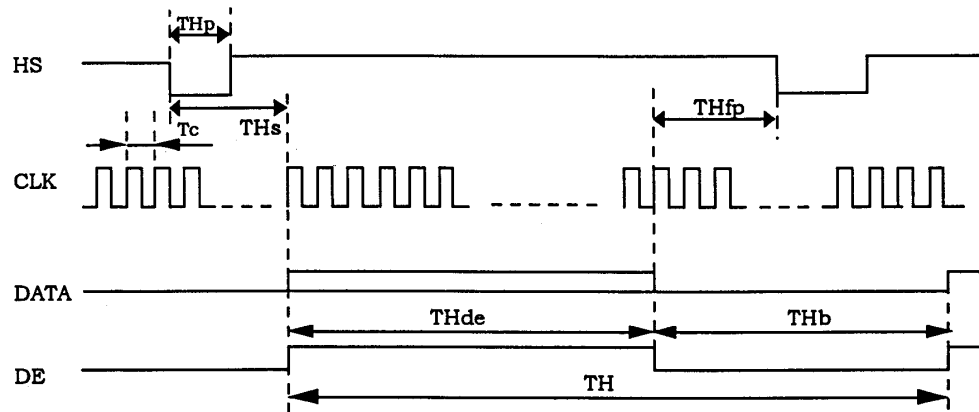
# SPECIFICATIONS

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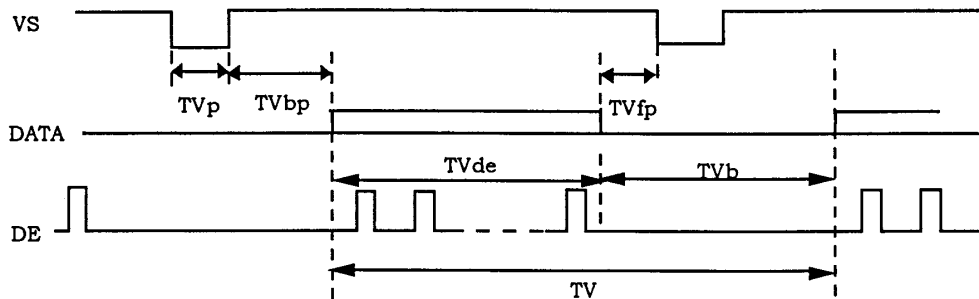
NUMBER : HLD 1509-010130 SE REV.A PAGE 13

## 3-3-9 Interface Timing Diagram

Horizontal

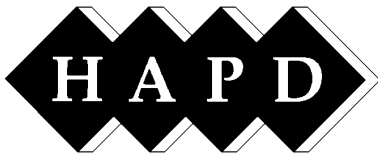


Vertical



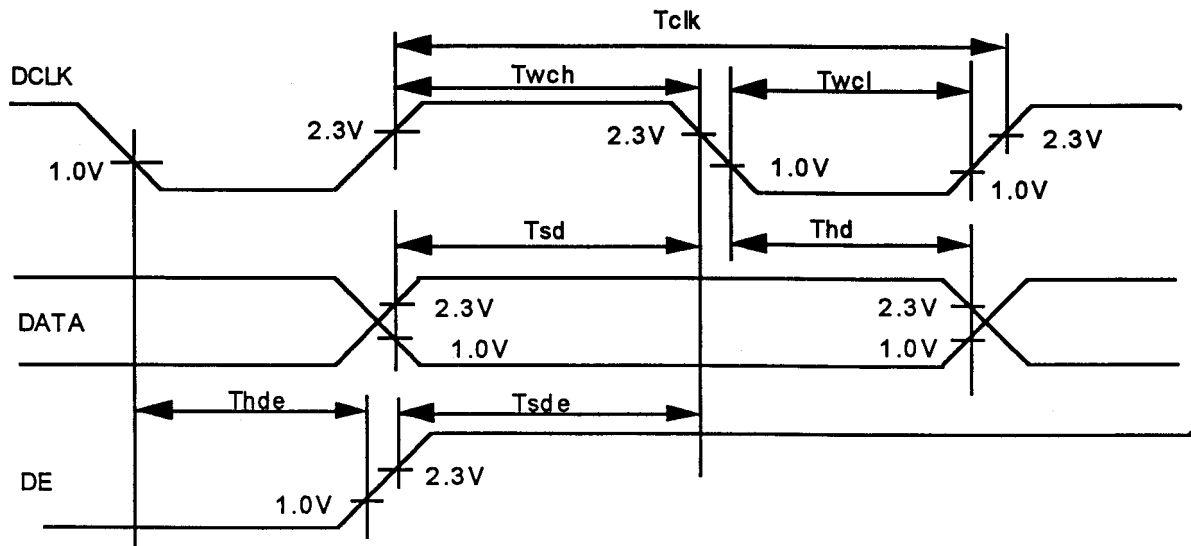
	Symbol	Min	Typ	Max	Unit
CLK Frequency	1/Tc	-	32,5	40	MHz
Line frequency	1/TH	-	48	-	kHz
HS Pulse Width	THp	2	-	-	CLK
Horizontal Start	THs	8	-	224	CLK
Horizontal Frontporch	THfp	0	-	-	CLK
Horizontal Period	THde	512			CLK
Horizontal Blank	THb	8	-	400	CLK
Frame Frequency	1/TV	50	60	75	Hz
VS Pulse Width	TVp	1	-	-	TH
Vertical Backporch	TVbp	2	-	-	TH
Vertical Frontporch	TVfp	2	-	-	TH
Vertical Period	TVde	768			TH
Pulse Width	THb	8	-	100	TH

1. CLK is equal to 1/2 clock of the dotclock
2. DE requires blank term over vertical blank time
3. HS should keep continuously even if the term of vertical blank time



# SPECIFICATIONS

## 3-3-10 Detailed Horizontal Timing Diagram

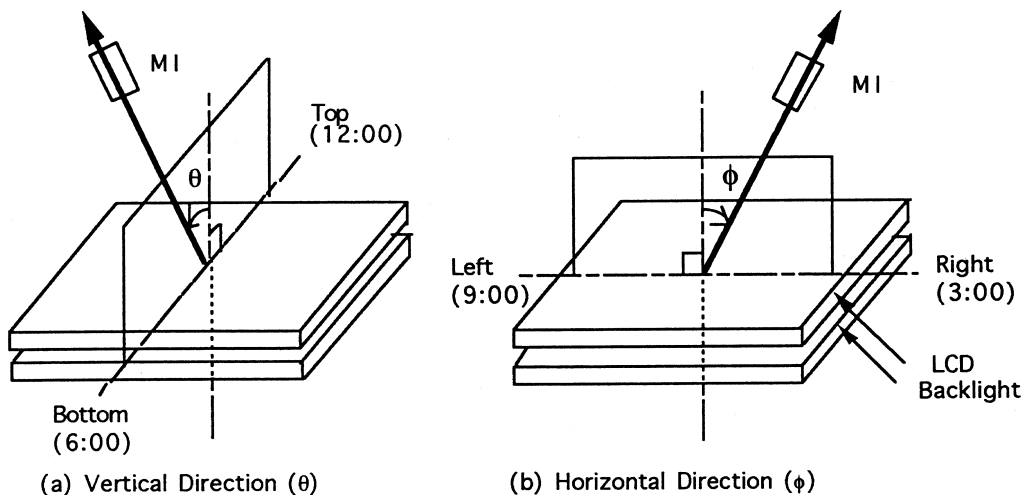


Parameter		Symbol	Min	Typ	Max	Unit
CLK	Period	$T_{clk}$	25	30	-	ns
	Width Low	$T_{wcl}$	7	15	-	ns
	Width High	$T_{wch}$	9	15	-	ns
DE	Set up Time	$T_{sde}$	6	-	-	ns
	Hold Time	$T_{hde}$	5	-	-	ns
DATA	Set up Time	$T_{sd}$	5	-	-	ns
	Hold Time	$T_{hd}$	6	-	-	ns

## 4. DEFINITION AND MEASURING METHOD

- Note 1) Viewing Angle, Contrast Ratio, Response Time, Reflectance and Chromaticity are measured at panel center.
- 2) Brightness and Brightness Uniformity are measured at 5 points as described in Fig. 4
- 3) Backlight is warmed up for more than 15 minutes to make its condition stable.
- 4) Viewing Angle, Contrast Ratio, Response Time, Brightness and Brightness Uniformity, Chromaticity and Cross Talk are measured in a dark room.
- 5) Display performance is measured at 64 gray-scale unless specified differently

### 4-1 Viewing Angle



### 4-2 Optical Measurement

#### 4-2-1 Measurement Instrument (MI)

Luminance & Chromaticity : TOPCON / Color Luminance Meter BM5(A) or similar.  
 Response Time : PRITCHARD 1980/SS or photomultiplier  
 Measurement Diameter : 5 ... 10 mm

#### 4-2-2 Module Driving Conditions

Frame Frequency : 60 Hz  
 Line Frequency : 48 kHz  
 Supply Voltage : Refer to Section 3-3-1  
 Backlight Supply Current : Refer to Section 3-3-2

### 4-3 Contrast Ratio (CR)

Definition Contrast Ratio =  $\frac{\text{Luminance in White Level (Gray Level 63)}}{\text{Luminance in Black Level (Gray Level 0)}}$

### 4-4 Definition of Response Time ( $T_r$ , $T_f$ )

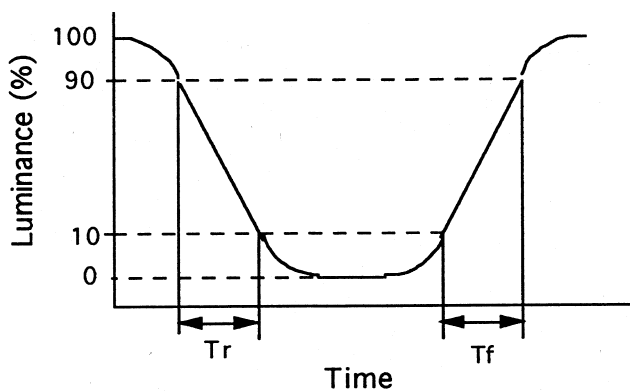


Figure 2

### 4-5 Definition of Reflectance

Reflectance :  $R = R_s / R_{ref} \times 100\%$   
 $R_s$  : Brightness of LCD reflectance  
 $R_{ref}$  : Brightness of calibrated front surface mirror reflectance

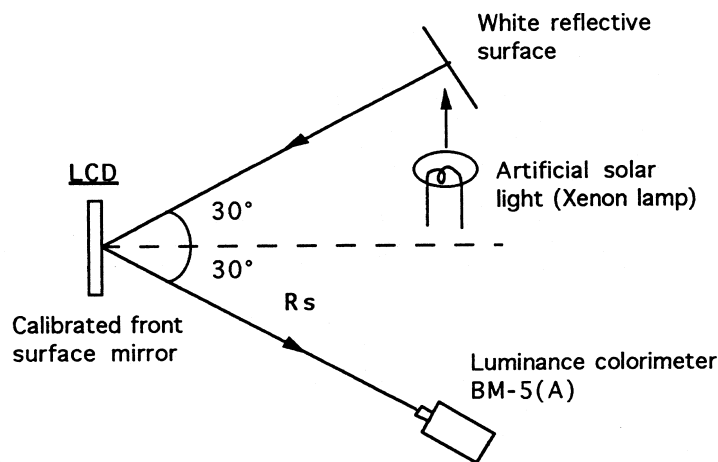


Figure 3



## 4-6 Definition of Brightness and Brightness Uniformity

Brightness : Average value of 5 points shown in Figure 4

Brightness Uniformity :  $\frac{\text{Max (Min) - Average}}{\text{Average}} \times 100 \%$

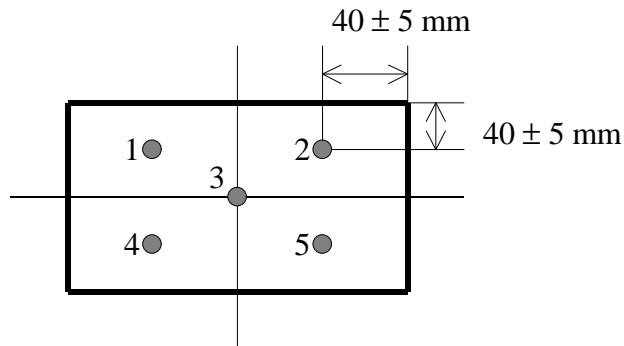


Figure 4

Condition : Display Pattern : Gray Level 63 (white)

## 4-7 Supply Current (Display without Backlight)

Maximum Current Display Pattern : Two pixel width vertical stripes with alternative 100% Black and 100% White

Typical Current Display Pattern : 64 vertical gray shades (see Figure 5)

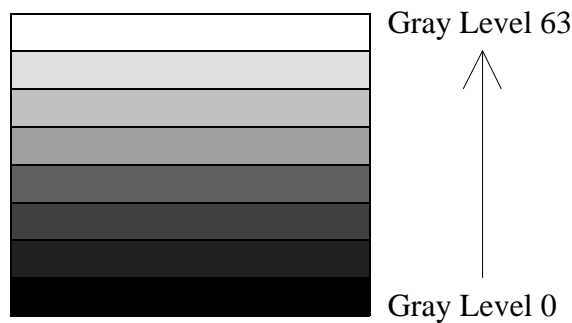
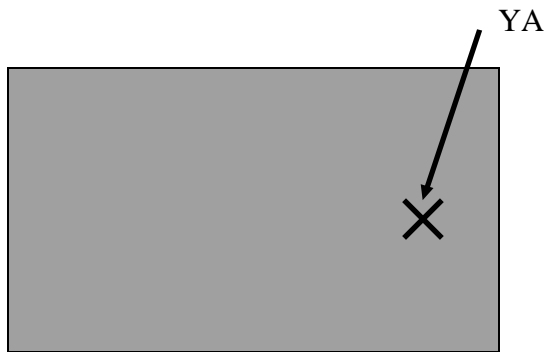


Figure 5

## 4-8 Definition of Crosstalk

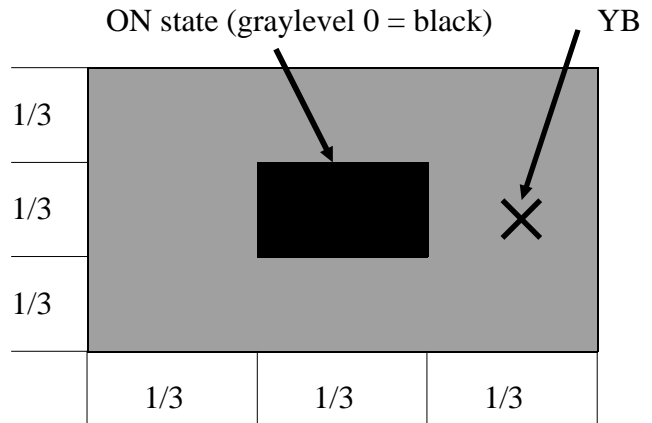
### PATTERN A

Gray level 46 (about 50% grayscale state)



### PATTERN B

Gray level 46 (about 50% grayscale state) except for square center



x = Measured Point (same location between A and B)

$$\text{Crosstalk value} = \frac{|YA - YB|}{YA} \times 100 \%$$

YA : Luminance of measured point in pattern A ( $\text{cd/m}^2$ )

YB : Luminance of measured point in pattern B ( $\text{cd/m}^2$ )

Condition :

Viewing Angle :  $\theta=0^\circ, \phi=0^\circ$

Ambient Temperature : RT



# SPECIFICATIONS

## 5. RELIABILITY

### 5-1 Test Item and Condition

Test Item		Condition	
1	Low Temperature Storage	- 20°C x 120 h	Non-operating
2	High Temperature Storage	+ 60°C x 120 h	Non-operating
3	Low Temperature ON/OFF	30s ON <--> 30s OFF at 0°C 10000 cycles	CCFL Operation
4	High Temp. / Humidity Soak	50°C , 90% RH (72h) no condensation	Operating
5	Thermal Shock	-20°C (2h) <--> 60°C (2h) x 5 cycles	Non-operating
6	Vibration (Sweep 11min / 1h each)	10...57 Hz (0,15mm P-P), 58...500Hz (1G)	Non-operating
7	Shock	3 axis (± X,Y,Z) 50G, 7ms	Non-operating
8	Backlight Life	25°C x 50.000 h min. , If ≤7 mA	Operating
9	ESD (1)	0Ω, 200pF, 200V, CN7	Non-operating
	ESD (2)	1,5kΩ, 100pF, 8kV, LCD surface	Operating / Non-operating

### 5-2 Evaluation Criteria

1. After above quality testing all displays shall be functional at RT
2. Criteria of backlight life shall be more than 50% of initial brightness

### 5-3 Display Anomalies

#### 5-3-1 Conditions

1. Lighting Condition                      Fluorescent light (day-light type)  
Display surface illumination to be 500 - 1000 lux
2. Temperature                                RT 25°C ± 5°C
3. Driving condition                        a) Equipment :                      Compatible PC with Chips 655xx Controller  
b) Supply voltage :                5 V DC  
c) Display Pattern :                Black, White, Gray #31, R , G , B  
d) Backlight current :              If = 7 mA  
e) CCFL frequency :                50 kHz

Remarks : Inspect at 20 inches from display. Defects not appearing within 1 minute shall be ignored. Standard viewing angle for inspection shall be 0° to the display surface. Variation of viewing angle to the display shall not exceed the range of specified viewing angle.



# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 20

## 5-3-2 Cosmetic Anomalies

### 5-3-2-1 Cosmetic defect

Defect Type	Count (Unit mm)	Reject (Unit mm)
Black Spot / White Spot ( $W > 1/4 L$ ) Foreign circular matter	$0,15 < D \leq 0,4$	$D > 0,4$
Scratch on polarizer	$0,01 < W \leq 0,1$ and $1,0 < L \leq 10$	$W > 0,1$ or $L > 10,0$
Polarizer bubbles	$0,1 < W \leq 0,5$ and $L \leq 1$	$W > 0,5$ or $L > 1,0$
Dent on polarizer	$0,1 < W \leq 0,5$ and $L \leq 1$	$W > 0,5$ or $L > 1,0$
Black line / White line (Streak, Lint, Hair)	$0,05 < W \leq 0,1$ and $0,3 < L \leq 2,1$	$W > 0,1$ or $L > 2,1$

Note : 1) All criteria shall be  $L \geq W$       2)  $D = (L + W) / 2$

**5-3-2-2 Dirt**      Product pass if dirt can be wiped off easily

**5-3-2-3 Following defect to be judged by limit samples when necessary**

- a) Rainbow color (Newton ring)
- b) Rubbing mark
- c) Mottling (Uniformity)
- d) Dim line (Vth shift line)

**5-3-2-4 Total number of cosmetic defect with the countable range**

Accept :  $N \leq 10$       Reject :  $N > 10$

## 5-4 Functional Anomalies Inspection Specification (Pixel defects)

There should be no displays which are unable to show any image.

### 5-4-1 Definitions

1. Each RGB element of a pixel is called subpixel
2. Subpixel which contains larger than 50% defective area is called defective subpixel
3. Brightness of an adjacent subpixel  $> 16$  levels out of 64 gray levels shall be counted as a Bright subpixel or a Dark subpixel.
4. One block of adjacent defective subpixels whose contents are one or two defective subpixels shall be counted as a block of defects



# SPECIFICATIONS

## 5-4-2 Distribution of defective subpixel

1.  $\leq 2$  defective subpixels for all types of combinations shall be allowed as adjacent defective subpixel
2. Distance between two blocks of defects shall be  $\geq 4\text{mm}$
3. Distance between two blocks of defects both of which include a bright green subpixel shall be  $\geq 8\text{mm}$
4. Blocks of defects within a circle with 20mm diameter shall be  $\leq 4$
5. Blocks of defects both of which include a bright subpixel within a circle of 20mm diameter shall be  $\leq 3$

## 5-3-3 Number of defective subpixels

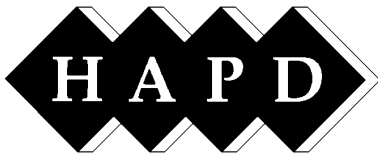
Defect Type	Accept	Reject
Bright subpixels	$N \leq 10$	$N > 10$
Bright green subpixels	$N \leq 4$	$N > 4$
Dark subpixels	$N \leq 10$	$N > 10$
Total number of defective subpixels	$N \leq 10$	$N > 10$

## 6. APPLICABLE OTHER DOCUMENTS

- Outline Drawing : HLD1506-020000 DE Rev. 0 (Attached)  
Visual Inspection : HLD1506-010130 VS Rev. A (Included before)

### 6-1 TCO 99 Certification

These panels are compliant to the TCO 99 (luminance uniformity  $< 1.7$ ) according to TCO99 testing conditions of TCO and SEMKO labs.



# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 22

## **7. CAUTION AND HANDLING PRECAUTION**

### **7-1 Handling**

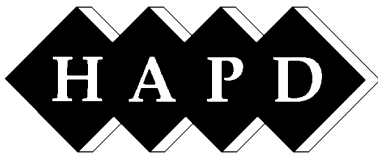
1. Do not disassemble or reassemble the module
2. Do not apply mechanical stress on the LCD module to avoid display non-uniformity  
Mechanical impact exceeding the specification of shock and vibration may cause glass damage and broken driver IC leads.
3. Use the mounting holes on the LCD module for mounting without any mechanical stress
4. In case the LCD cell is broken, do not sip or drink leaked liquid crystal material.  
If the liquid crystal material touched your skin, wash it out with soap immediately.
5. Do not drop water or any chemicals onto the display surface.
6. Handle the polarizers with care as it maybe easily scratched. Do not press or rub them with any hard object. Wipe dirty surface with soft cloth with a little solvent of paraffin "benzine" (Exxon Chemical Isopar E, etc.)
7. Do not apply high electrostatic voltage to the LCD module. It may damage CMOS / LSI circuit in the LCD module. Ground yourself when you touch the LCD module directly.
8. When you handle the LCD module for incoming inspection or assembly, use soft fingerstalls or gloves in order to keep the display quality.
9. Pay attention in handling the CCFL cable and the input interface connector  
Do not pull or fold the CCFL cable

### **7-2 Storage**

1. Store the LCD module within the ratings in order to keep the performance and prevent from any damages. Never store the LCD module under abnormal conditions of high temperature and high humidity. It is recommended that the LCD module shall be stored under the condition of temperature between 0°C and 35°C and humidity less than 60%.
2. Never store LCD module with exposure to direct sunlight

### **7-3 Operation**

1. Do not connect or disconnect the LCD module to or from the system when power is on.
2. Use the LCD module within the ratings in order to keep the performance and prevent from any damages. Never use the LCD module under abnormal conditions of high temperature and high humidity.
3. Do not change variable resistance settings on the LCD module. These are adjusted most suitable



# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 23

4. Do not display the same pattern for long time in order to avoid image retention
5. Keep the specified power-on/off sequencing to avoid malfunction of the LCD module
6. Avoid to interrupt the signals during operation. Non-signal operation will apply DC current to the LCD module which may cause image retention

## **7-4 Others**

Avoid any condensation of water during storage or operation as it may cause misoperation or disconnection of electrodes.

## **8. WARRANTY**

### **8-1 Incoming Inspection**

Incoming inspection by the customer shall be performed within thirty (30) days from the shipping date.

### **8-2 Warranty Period**

HOSIDEN AND PHILIPS warrants the LCD modules for a period of 6 months from the shipping date when stored or used under normal conditions.

## **9. OTHERS**

Any and all questions or disputes arising out of or related to this specification shall be settled by a consultation between the customer and HOSIDEN AND PHILIPS or its representatives.

## **10. DRAWING**

See following page.

If a more detailed drawing is necessary please contact HOSIDEN AND PHILIPS or its representatives.

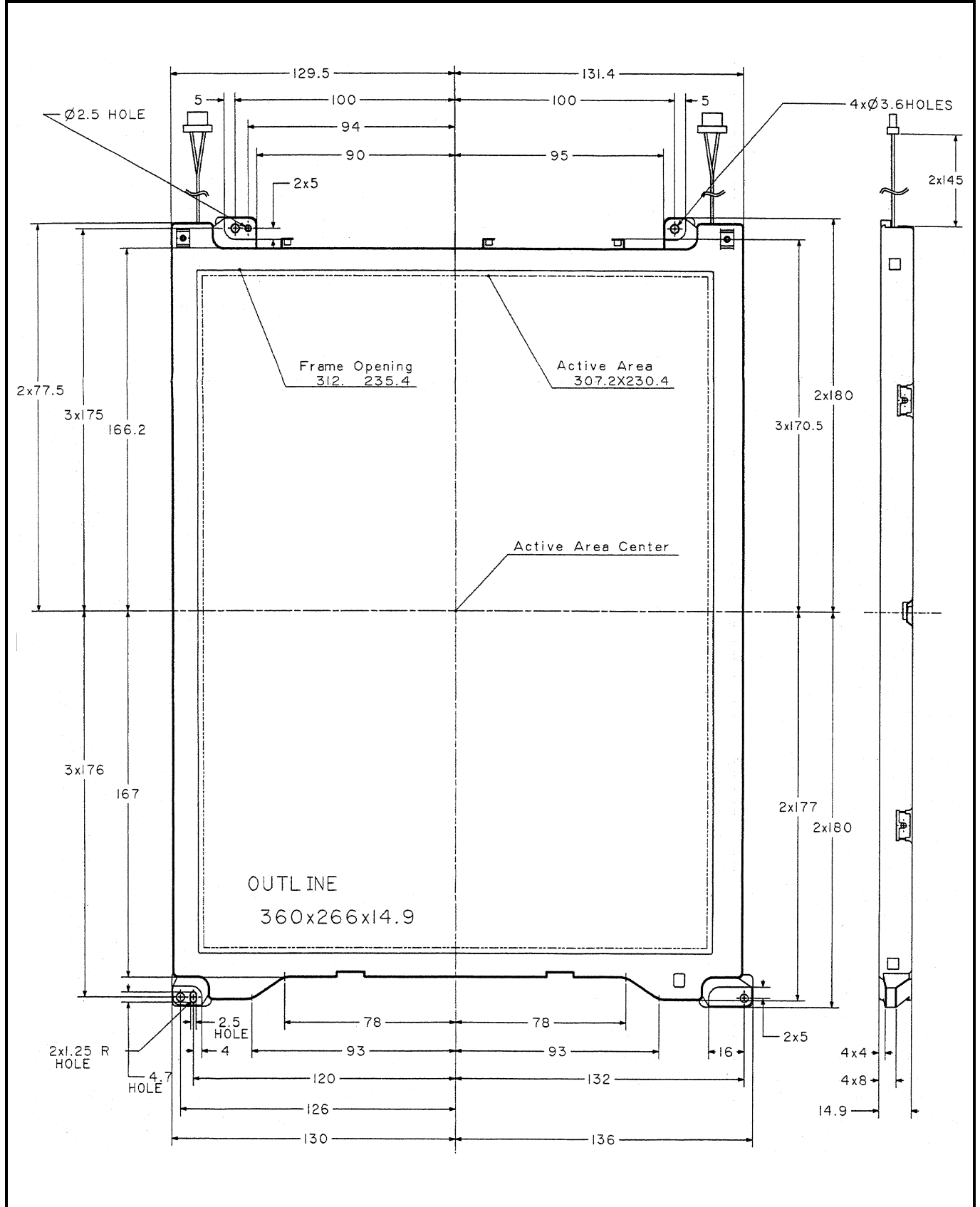
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# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 24







# SPECIFICATIONS

TITLE : 15,1" TFT COLOR MODULE

NUMBER : HLD 1509-010130 SE REV.A PAGE 25

