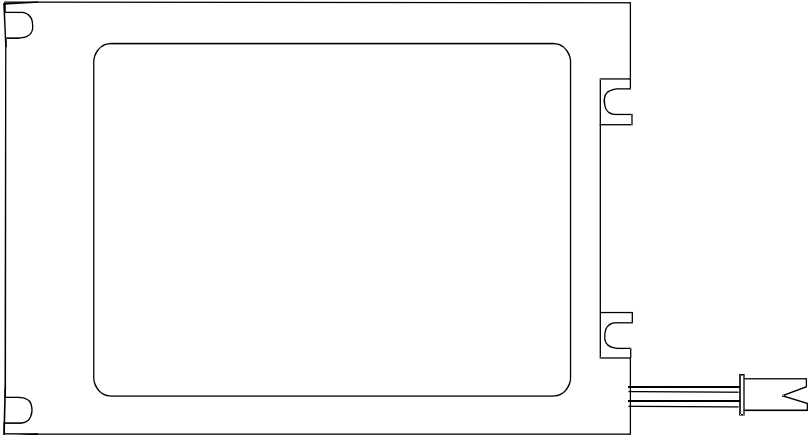




PRODUCT SPECIFICATION

**HDM3224-CL**

320 x240 COLOR GRAPHICS  
LCD DISPLAY MODULE



HANTRONIX, INC. 10080 BUBB RD. CUPERTINO, CA 95014	Q.A.:	REV:	HDM3224-CL	SHEET 1 OF 18
	ZW	1.1		DATE: 1/5/06

# 1. MECHANICAL DATA

(1) Product No.	HDM3224-CL
(2) Module Size	154.6 (W)mm x 114.8 (H)mm x 9.0 (D)mm
(3) Dot Size	0.09 (W)mm x 0.33 (H)mm
(4) Dot Pitch	0.12 (W)mm x 0.36 (H)mm
(5) Number of Dots	320 (W)xRGB x 240 (H)DOTS
(6) Duty	1/240
(7) LCD	F-STN: Color STN module Rear Polarizer: Color Transmissive Type
(8) Viewing Direction	6 O'clock
(9) Backlight	CCFL
(10) Controller	Excluded
(11) DC/DC Converter	Excluded
(12) Weight	195 g(approx.)

HANTRONIX, INC. 10080 BUBB RD. CUPERTINO, CA 95014	Q.A.:	REV.:	HDM3224-CL	SHEET 2 OF 18
	Z.W.	1.1		DATE: 1/5/06

## 2. ABSOLUTE MAXIMUM RATINGS

### (1) ELECTRICAL ABSOLUTE RATINGS

VSS=0V

ITEM	SYMBOL	MIN	MAX	UNIT	COMMENT
Power Supply for Logic	VDD-VSS	-0.3	6.5	V	
Power Supply for LCD Drive	VEE-VSS	0	30	V	
Input Voltage	VI	-0.3	VDD+0.3	V	
Static Electricity	-	-	-	-	Note 1

### (2) ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

ITEM	WIDE TEMP.			
	OPERATING		STORAGE	
	MIN.	MAX.	MIN.	MAX.
Ambient Temperature	-20	70	-30	80
Humidity (Without Condensation)	Note 2,4		Note 3,4	
Vibration	Note 5			

Note 1 LCM should be grounded during handling LCM.

Note 2 Ta ≤ 70°C : 75%RH max  
 Ta > 70°C : Absolute humidity must be lower than the humidity of 75%RH at 70°C

Note 3 Ta at -30°C will be < 48hrs, at 80°C will be < 120hrs

Note 4 Background color will change slightly depending on ambient temperature. at phenomenon is reversible.

Note 5

Frequency	5 Hz~13.95 Hz	13.95 Hz~33 Hz	33 Hz~51 Hz	51 Hz~500 Hz
Vibration Level	-	2X9.8 m/s <sup>2</sup>	-	5x9.8 m/s <sup>2</sup>
Vibration Width	0.2 inch	-	0.036 inch	-
Vibration Direction	X/Y/Z			
Vibration Time	20 min/cycle X 3 directions			

HANTRONIX, INC. 10080 BUBB RD. CUPERTINO, CA 95014	Q.A.:	REV.:	HDM3224-CL	SHEET 3 OF 18
	Z.W.	1.1		DATE: 1/5/06

# 3. ELECTRICAL CHARACTERISTICS

## 3-1. ELECTRICAL CHARACTERISTICS OF LCM

Ta=25°C, VDD=3V/5V±5%

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT			
Logic Circuit Power Supply		VDD-VSS	Ta= 25°C	4.75	5.0	5.25	V			
Logic Circuit Power Supply		VDD-VSS	Ta= 25°C	2.7	3.0	3.3	V			
Input Voltage		VIH	H level	0.8VDD	-	VDD	V			
		VIL	L level	0	-	0.2VDD	V			
Recommended LCD Driving Voltage		VEE-VSS (Vop)	Duty=1/240 VDD=3V/5V	-20°C	25.9	26.2	26.5	V		
				0°C	25.6	25.9	26.2			
				25°C	25.3	25.6	25.9			
				50°C	24.4	24.7	25.0			
				70°C	23.9	24.2	24.5			
Supply Current for Logic		IDD	VDD-VSS=3V/5V VEE-VSS=25.6V FLM=120Hz Ta=25°C	-	0.8	1.2	mA			
Supply Current for LCD		IEE	PATTERN : ■ □ ■ □ ■ □ ■ □ □ ■ □ ■ □ ■ □ ■	-	4.8	7.2	mA			
LCM	Surface Luminance	L	TB61M	VEE-VSS =25.8V Ta=25°C IL=5mA	PATTERN: (Dots All On of White Color) □ □ □ □ □ □ □ □	-	180	-	cd/m <sup>2</sup>	
			TB61V			-	170	-		
			TB61M			PATTERN: (Dots All Off) ■ ■ ■ ■ ■ ■ ■ ■	-	11.6		-
			TB61V				-	11.0		-
Recommended Frame Frequency for Optimum Contrast		FLM	-	120	140	150	Hz			

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10080 BUBB RD.  
CUPERTINO, CA 95014

Q.A.:  
Z.W.

REV.:  
1.1

HDM3224-CL

SHEET 4 OF 18

DATE:  
1/5/06

### 3-2.ELECTRICAL CHARACTERISTICS OF BACKLIGHT

Used lamp : Rating

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
Lamp Voltage	V <sub>L</sub>	-	474	-	Vrms	-
Lamp current	I <sub>L</sub>	2	5	6	mArms	
Lamp power consumption	P <sub>L</sub>	-	2.37	-	W	(*1)
Starting Voltage	V <sub>S</sub>	-	-	750	Vrms	Ta=25°C
		-	-	940	Vrms	Ta=0°C
Lamp frequency	F <sub>L</sub>	35	50	65	KHz	
Lamp life time	L <sub>L</sub>	-	40000	-	hrs	IL = 5 mArms(*2)

(\*1) Power consumption excluded inverter loss .

(\*2) Lamp life time is defined as follows : The final brightness is at 50% of original brightness .

HANTRONIX, INC. 10080 BUBB RD. CUPERTINO, CA 95014	Q.A.:	REV.:	HDM3224-CL	SHEET 5 OF 18
	Z.W.	1.1		DATE: 1/5/06

### 3.3 RECOMMENDED INVERTER (TDK TBD086N-3) (Brightness Fixed)

#### TDK TBD086N-3

#### 3-3-1 GENERAL SPECIFICATIONS

OPERATION TEMPERATURE : 0°C~55°C  
 STORAGE TEMPERATURE : -20°C~80°C  
 DIMENSION : 95.0(L)mm x 19.5(W)mm x MAX 6.5(H)mm

#### 3-3-2 INPUT CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARKS
Input Voltage	V <sub>in</sub>	11.4	12.0	12.6	V	
Input Current	I <sub>in</sub>	-	250	300	mA	
CTL Input Voltage	V <sub>rmt</sub>	2.8	3	3.2	V	ON state
		-0.5	0	0.5	V	OFF state

#### 3-3-3 PIN ASSIGNMENTS

INPUT (CN1) CONNECTOR :  
 MOLEX 53261-0590 or E&T 3802-05

OUTPUT (CN2) CONNECTOR :  
 JST SM02-(8.0)B-BHS-1

NO.	FUNCTION
1	VIN(12.0V)
2	GND
3	V <sub>rmt</sub>
4	N.C
5	N.C

NO.	FUNCTION
1	HV
2	RTN

#### 3-3-4 OUTPUT CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARKS
Input Voltage	V <sub>IN</sub>	11.4	12.0	12.6	V	
Tube Current	I <sub>L</sub>	-	5.0	-	mA	

Note : Inverter must be used in the range of V<sub>IN</sub> Input Voltage.  
 If it doesn't used in this range, the electrical characteristics  
 of backlight would not be to guarantee.

HANTRONIX, INC. 10080 BUBB RD. CUPERTINO, CA 95014	Q.A.:	REV.:	HDM3224-CL	SHEET 6 OF 18
	Z.W.	1.1		DATE: 1/5/06

# 4.OPTICAL CHARACTERISTICS

## 4-1.Optical Char. of Wide Temp. Mode

AT Vop

ITEM MODE		Cr(Contrast Ratio)										$\theta$ (Viewing Angle)		$\phi$ (Viewing Angle)	
		-20°C		0°C		25°C		50°C		70°C		25°C		25°C	
		MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.
T	M	15	20	20	25	30	35	25	30	6	9	-	F: 60 R: 40	-	±55
T	V	10	15	15	20	25	30	20	25	6	9	-	F: >60 R: 30	-	±65
NOTE		NOTE 6										NOTE 5			

note:

- T: TRANSMISSIVE
- M: FOR 6 O'CLOCK STN MODULE
- V: FOR 6 O'CLOCK STN MODULE(Special Polarizer)

AT  $\phi=0^\circ$   $\theta=0^\circ$

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	-20°C	2200	2800	3400	ms	NOTE 2
		0°C	450	600	750		
		25°C	130	160	190		
		50°C	120	150	180		
		70°C	80	100	120		
Response Time (fall)	Tf	-20°C	1700	2100	2500	ms	NOTE 2
		0°C	450	550	650		
		25°C	130	160	190		
		50°C	40	50	60		
		70°C	40	50	60		

HANTRONIX, INC. 10080 BUBB RD. CUPERTINO, CA 95014	Q.A.:	REV.:	HDM3224-CL	SHEET 7 OF 18
	Z.W.	1.1		DATE: 1/5/06

## 4-2. Color of CIE Coordinate

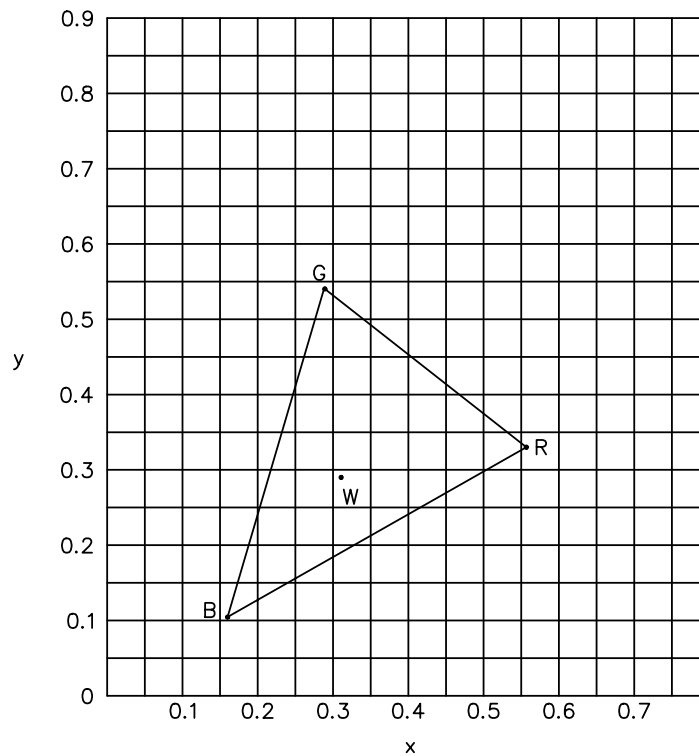
T<sub>a</sub> = 25°C

ITEM		SYMBOL	CONDITION	VALUE	NOTE
Color of CIE Coordinate	Red	X	$\phi=0^\circ, \theta=0^\circ$	0.551	Note*
		y		0.334	
	Green	X	$\phi=0^\circ, \theta=0^\circ$	0.297	
		y		0.547	
	Blue	X	$\phi=0^\circ, \theta=0^\circ$	0.155	
		y		0.105	
	White	X	$\phi=0^\circ, \theta=0^\circ$	0.298	
		y		0.314	

Note\* Measuring at position 3 on Fig.1  
CIE chromaticity diagram

Tolerance :  $\pm 0.05$

Fig.1



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CUPERTINO, CA 95014

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HDM3224-CL

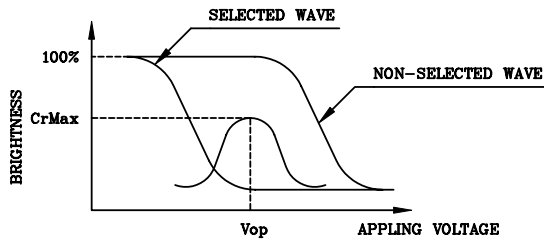
SHEET 8 OF 18

DATE: 1/5/06

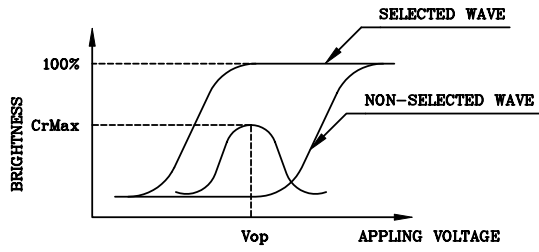


(NOTE 1)

Definition of Operation Voltage(Vop)



(positive type)



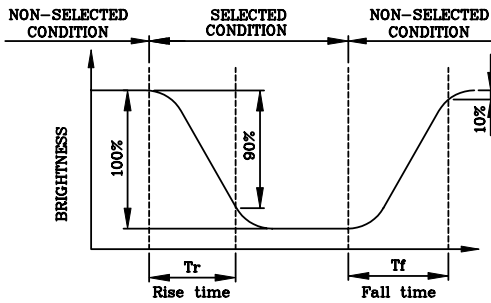
(negative type)

\*Conditions

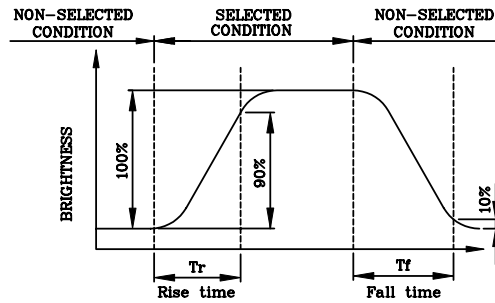
Viewing Angle : 0  
 Frame Frequency : 140Hz  
 Applying Waveform : 1/N duty 1/a bias

(NOTE 2)

Definition of Response Time(Tr,Tf)



(positive type)



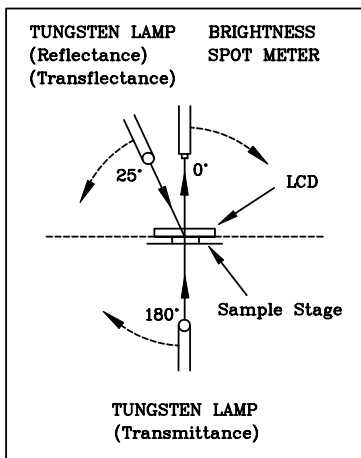
(negative type)

\*Conditions

Operating Voltage : Vop  
 Viewing Angle (θ,φ) : (0,0)  
 Frame Frequency : 140Hz  
 Applying Waveform : 1/N duty 1/a bias

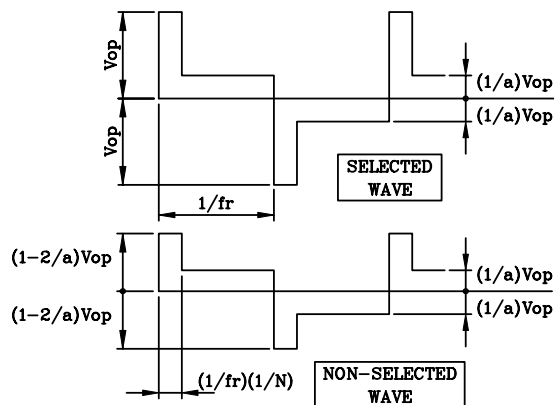
(NOTE 3)

Description of Measuring Equipment and Driving Waveforms



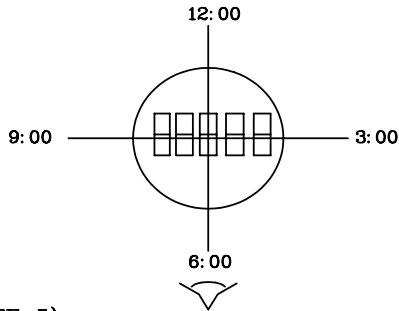
CONST.  
 TEMP.  
 CHAMBER

Multiplex Driving ( 1/N duty 1/a bias )



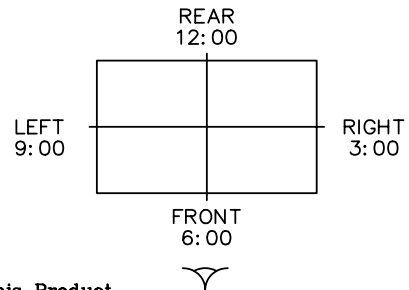
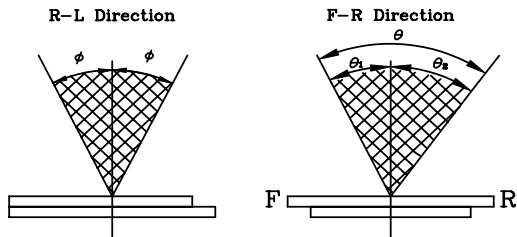
(NOTE 4)

Definition of Viewing Direction



(NOTE 5)

Definition of Viewing Angle



\*For This Product  
The Viewing Direction Is 6 O'clock  
So  $\theta_1 > \theta_2$

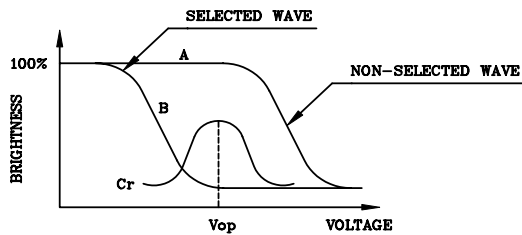
$$\theta = \theta_1 + \theta_2$$

\*Conditions

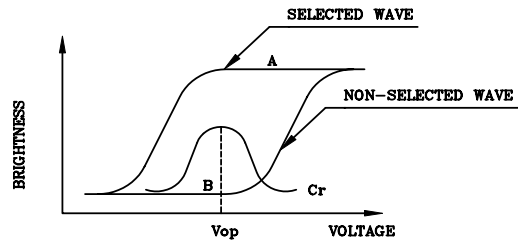
Operating Voltage :  $V_{op}$   
Frame Frequency : 140Hz  
Applying Waveform : 1/N duty 1/a bias  
Contrast Ratio : larger than 2

(NOTE 6)

Definition of Contrast Ratio (Cr)



(positive type)



(negative type)

$$\text{Contrast Ratio : } Cr = A/B$$

\*Conditions

Viewing Angle : 0  
Frame Frequency : 140Hz  
Applying Waveform : 1/N duty 1/a bias

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10080 BUBB RD.  
CUPERTINO, CA 95014

Q.A.:  
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REV.:  
1.1

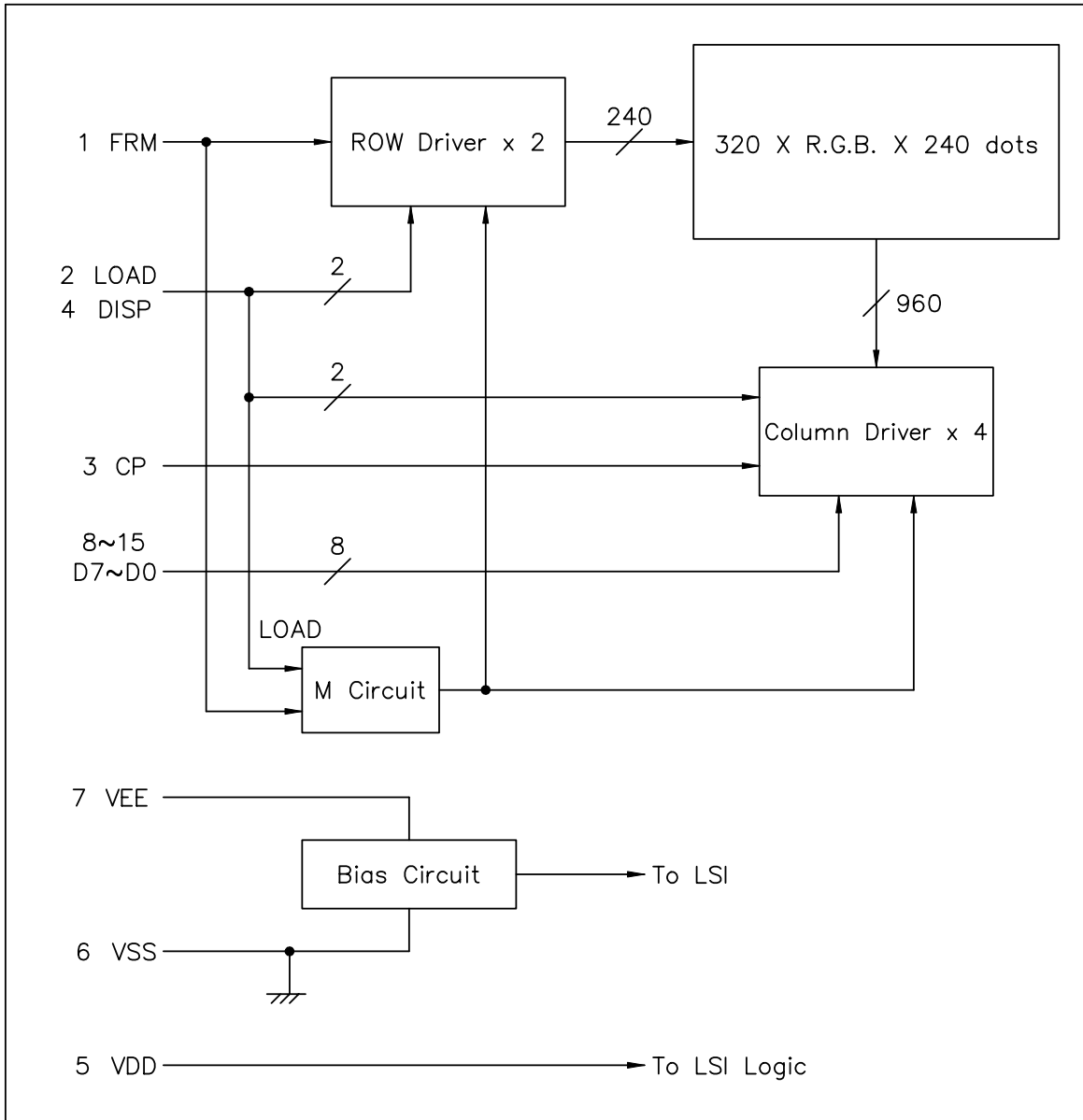
HDM3224-CL

SHEET 10 OF 18

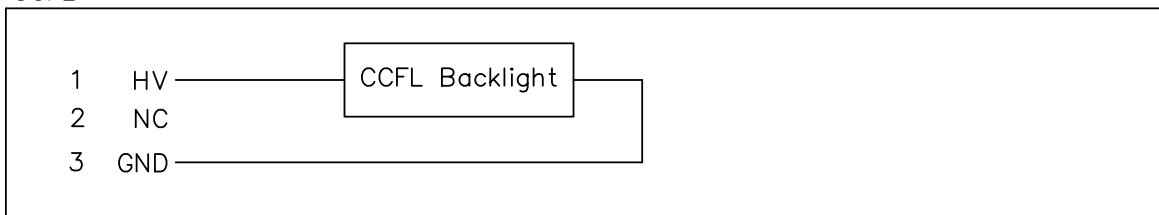
DATE:  
1/5/06

# 5. BLOCK DIAGRAM

LCD



CCFL



## 6. INTERNAL PIN CONNECTION

### LCD

Pin No.	Symbol	Level	Function
1	FRM	H	Synchronous Signal for Driving Scanning Line
2	LOAD	H→L	Data Signal Latch Clock
3	CP	H→L	Data Signal Shift Clock
4	DISP	H/L	Display Control Signal, H :Display on L :Display off
5	VDD	—	Power Supply for Logic
6	VSS	—	Power Supply (0V,GND)
7	VEE	—	Power Supply for LCD Drive
8	D7	H/L	Display Data
9	D6	H/L	Display Data
10	D5	H/L	Display Data
11	D4	H/L	Display Data
12	D3	H/L	Display Data
13	D2	H/L	Display Data
14	D1	H/L	Display Data
15	D0	H/L	Display Data

CN1 : 53261-1510(Molex)

Recommended Matching Connector : 51021-1500(Molex) or Compatible

### CCFL

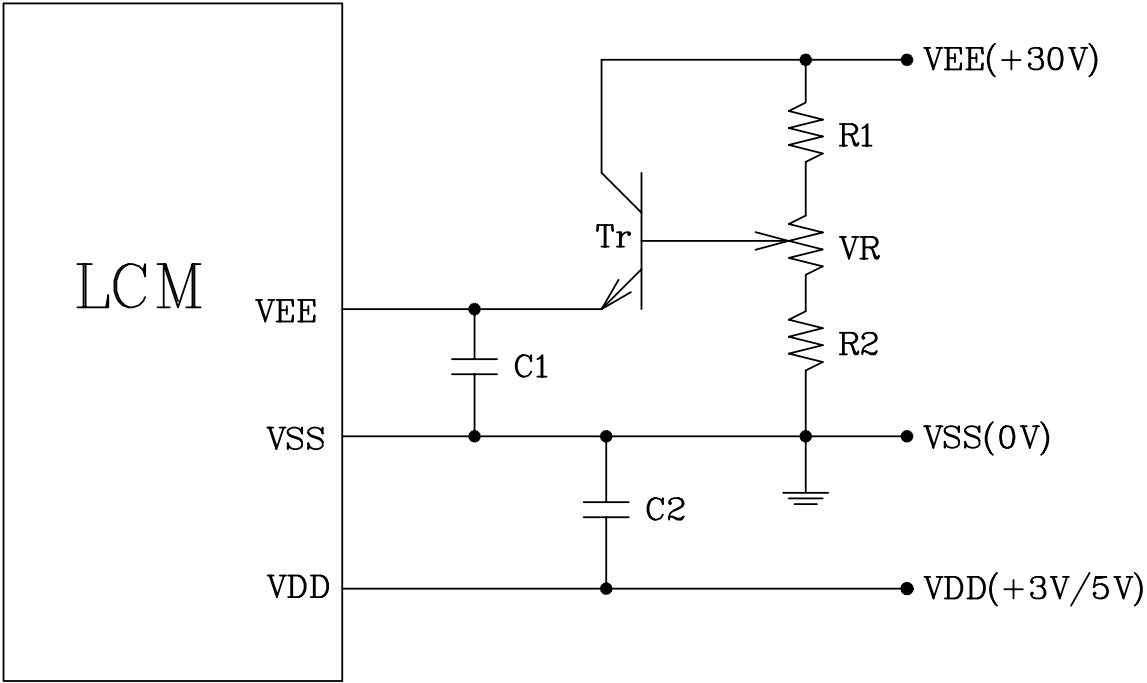
Pin No.	Symbol	Level	Function
1	HV	AC	Power Supply for CCFL(HOT)
2	NC	—	Non-connection
3	GND	—	Power Supply for CCFL(GND)

CN2 : BHR-03VS-1(JST)

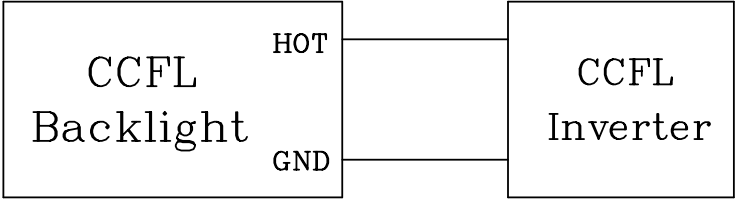
Recommended Matching Connector : SM02-(8.0)B-BHS-1(JST) or Compatible

HANTRONIX, INC. 10080 BUBB RD. CUPERTINO, CA 95014	Q.A.:	REV.:	<b>HDM3224-CL</b>	<b>SHEET 12 OF 18</b>
	Z.W.	1.1		DATE: 1/5/06

# 7. POWER SUPPLY



$R1 + R2 + VR = 10 \sim 20K \Omega$   
 $C1, C2 = 10 \mu F$

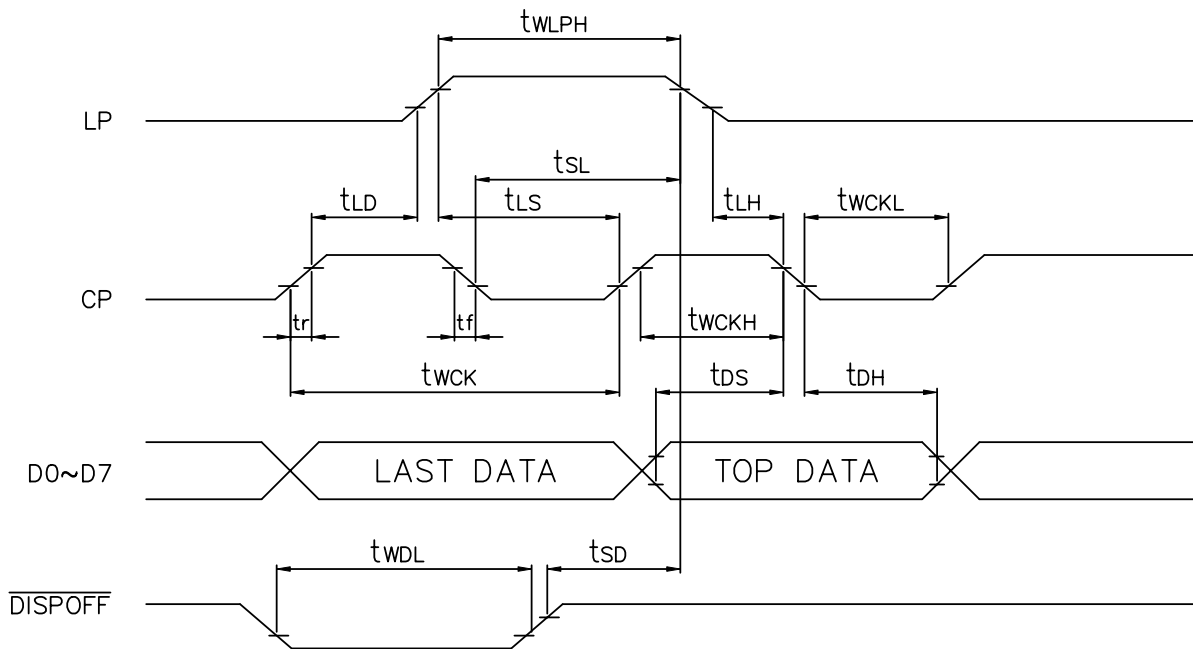


# 8. TIMING CHARACTERISTICS

## 8-1. INTERFACE TIMING

VDD=3.0/5.0V ± 10%

Parameter	SYMBOL	MIN.	MAX.	UNIT
CLOCK PULSE CYCLE TIME	$t_{wck}$	66/40	—	ns
CLOCK PULSE HIGH LEVEL WIDTH	$t_{wckH}$	23/12	—	ns
CLOCK PULSE LOW LEVEL WIDTH	$t_{wckL}$	23/14	—	ns
LATCH PULSE HIGH LEVEL WIDTH	$t_{wLPH}$	30/15	—	ns
CP→LP RISE TIME	$t_{LD}$	10/5	—	ns
CP→LP FALL TIME	$t_{SL}$	30/25	—	ns
LP→CP RISE TIME	$t_{LS}$	30/25	—	ns
LP→CP FALL TIME	$t_{LH}$	30/25	—	ns
CLOCK PULSE RISE/FALL TIME	$t_r, t_f$	—	50	ns
DATA SETUP TIME	$t_{DS}$	10/5	—	ns
DATA HOLD TIME	$t_{DH}$	25/15	—	ns
DISPOFF LOW LEVEL WIDTH	$t_{WDL}$	1.2	—	μs
DISPOFF CANCELLATION TIME	$t_{SD}$	100	—	ns



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

Q.A.:  
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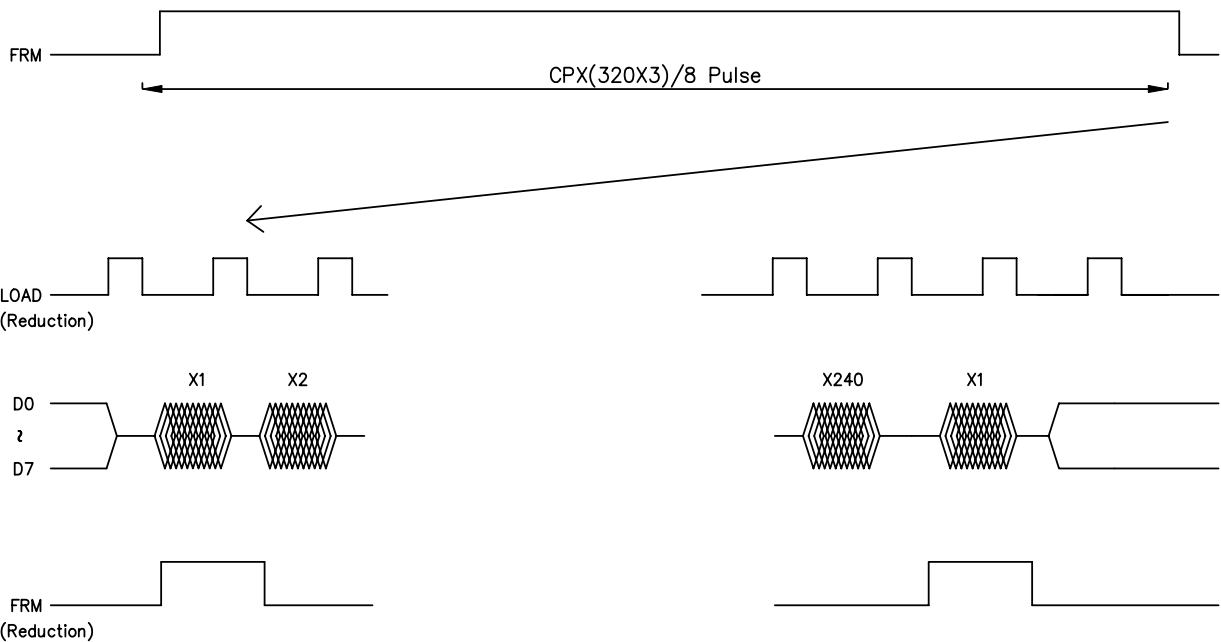
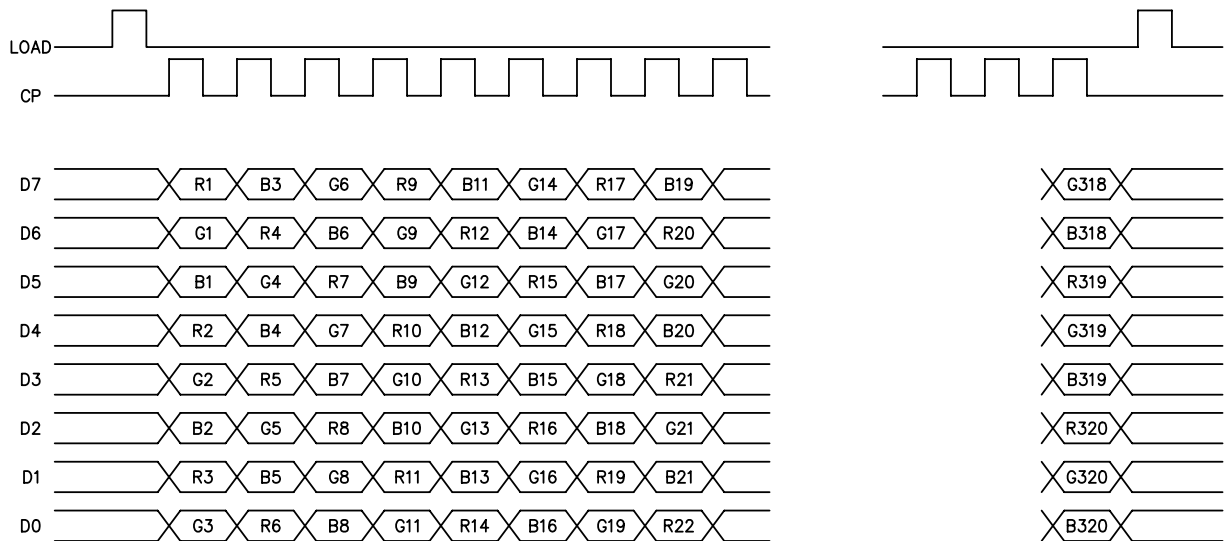
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**HDM3224-CL**

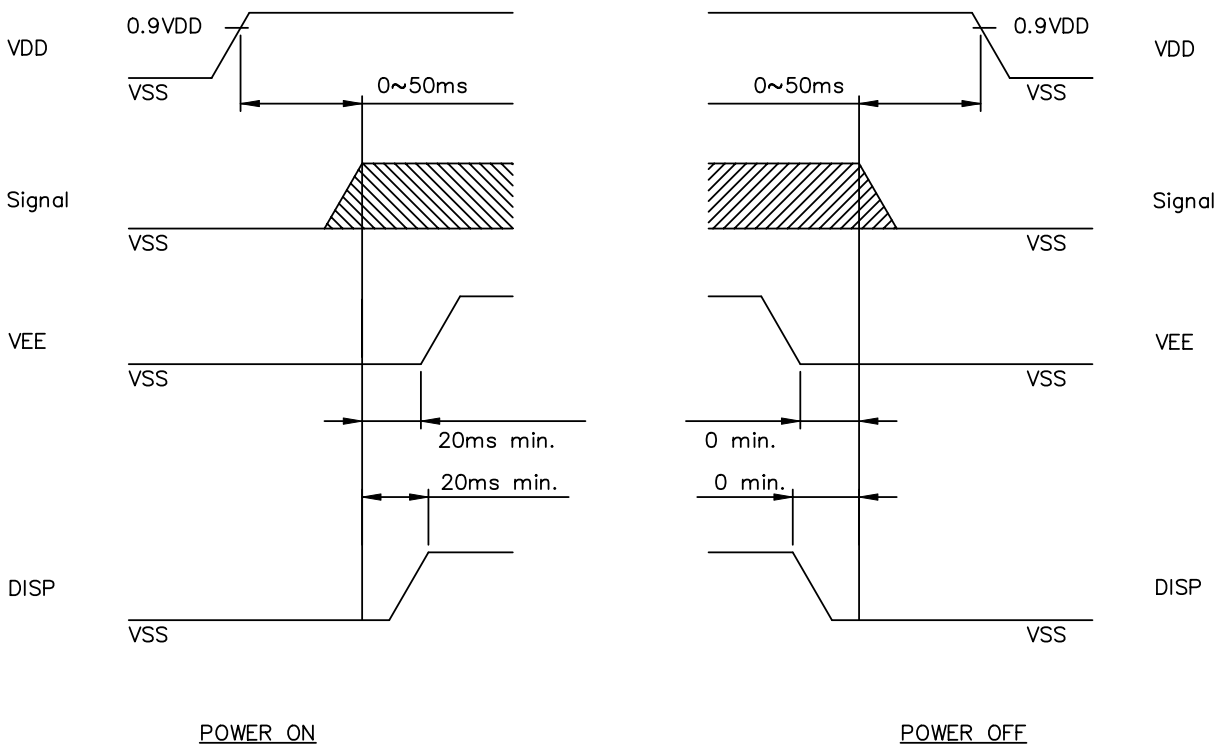
SHEET 14 OF 18

DATE:  
1/5/06

# 8-2.TIMING CHART



### 8-3. POWER ON/OFF TIMING



The missing pixels may occur when the LCM is driven beyond above power interface timing sequence.

HANTRONIX, INC. 10080 BUBB RD. CUPERTINO, CA 95014	Q.A.:	REV.:	HDM3224-CL	SHEET 16 OF 18
	Z.W.	1.1		DATE: 1/5/06



## 8-4.DISPLAY PATTERN

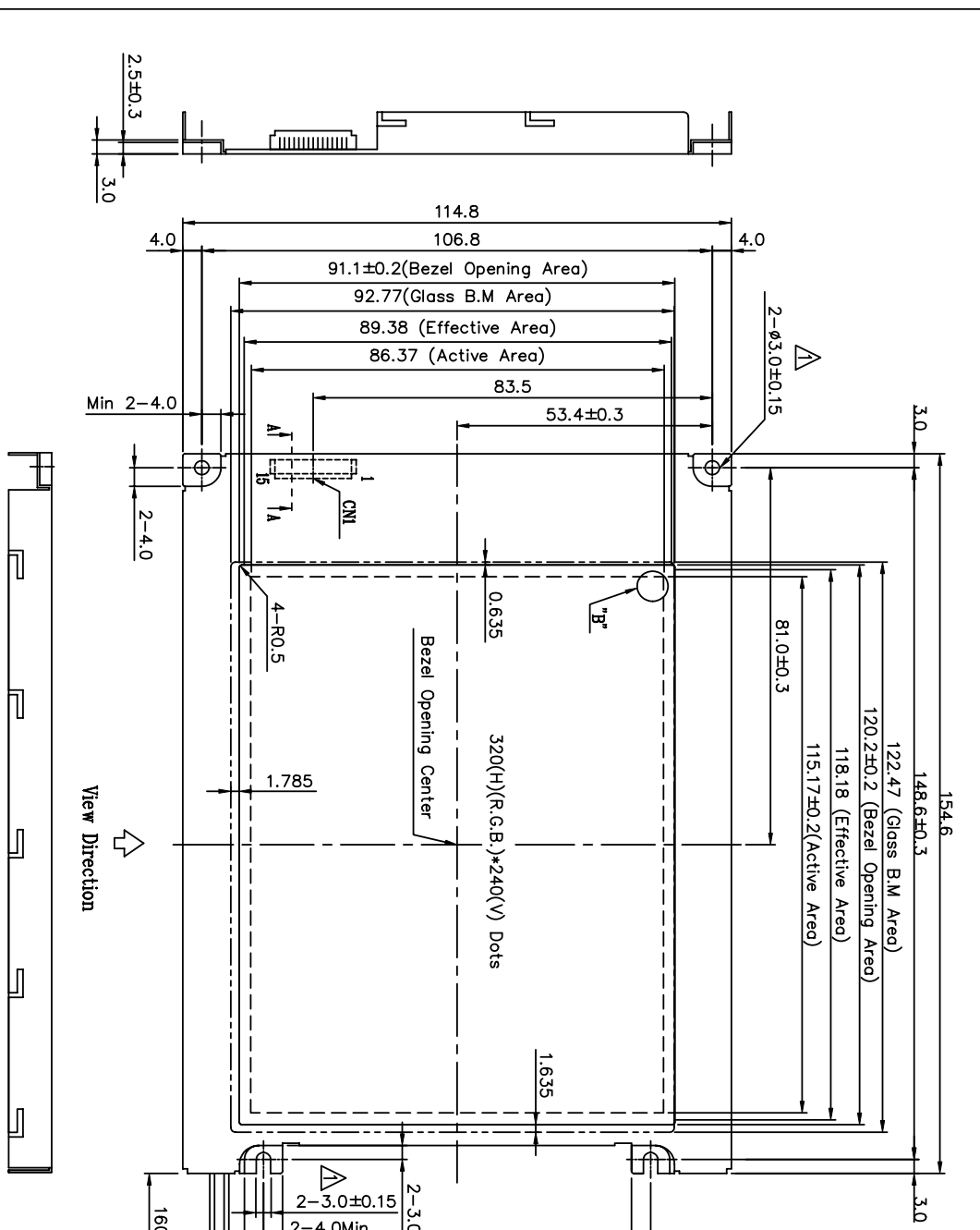
START DATA

	Y1			Y2			Y3		
X1	R1	G1	B1	R2	G2	B2	R3	G3	B3
	D7	D6	D5	D4	D3	D2	D1	D0	D7
X2	R1	G1	B1	R2	G2	B2	R3	G3	B3
	D7	D6	D5	D4	D3	D2	D1	D0	D7

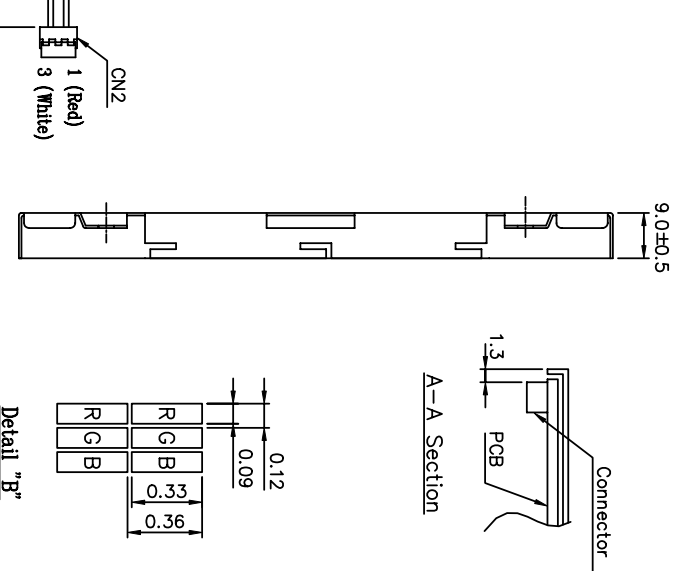
	Y318			Y319			Y320		
R318	G318	B318	R319	G319	B319	R320	G320	B320	
D0	D7	D6	D5	D4	D3	D2	D1	D0	
R318	G318	B318	R319	G319	B319	R320	G320	B320	
D0	D7	D6	D5	D4	D3	D2	D1	D0	

X239	R1	G1	B1	R2	G2	B2	R3	G3	B3
	D7	D6	D5	D4	D3	D2	D1	D0	D7
X240	R1	G1	B1	R2	G2	B2	R3	G3	B3
	D7	D6	D5	D4	D3	D2	D1	D0	D7

R318	G318	B318	R319	G319	B319	R320	G320	B320
D0	D7	D6	U5	D4	D3	D2	D1	D0
R318	G318	B318	R319	G319	B319	R320	G320	B320
D0	D7	D6	U5	D4	D3	D2	D1	D0



Start												
CH	11	12	13	...	1240	Clamp Area						
IP	D7	D6	D5	D4	D3	D2	D1	D0	DT	DE	DL	DO
ARR	R1	R2	R3	R4	R5	R6	R7	R8	R9	R20	R30	R200
EA	...	...	...	...	...	...	...	...	...	...	...	...



CN1 : 53261-1510 (Molex)

Pin No.	Symbol	Function	Level	10	D5	Function	Level
1	FRM	Synchronous signal for driving scanning line	H	11	D4	Display data	H(ON),L(OPF)
2	LOAD	Data signal latch clock	H → L	12	D3		
3	CP	Data signal shift clock	H → L	13	D2		
4	DISP	Display control signal	H(ON),L(OPF)	14	D1		
5	VDD	Power supply for logic	-	15	D0		
6	VSS	GND	-	CN2 : BFR-03VS-1 (JST)			
7	VEE	Power supply for LCD	-	Pin No. <th>Symbol</th> <th>Function</th> <th>Level</th>	Symbol	Function	Level
8	D7	Power supply for LCD	-	1	HV	Power supply for CFL	AC
9	D6			Display data	H(ON),L(OPF)	2	NC
		Display data		3	GND	Ground line (from Inverter)	-

GENERAL TOLERANCE LIST

DIMENSION	TOLERANCE
L ≤ 6	±0.25 (mm)
6 < L ≤ 18	±0.3 (mm)
18 < L ≤ 50	±0.4 (mm)
50 < L ≤ 125	±0.5 (mm)
125 < L	±0.6 (mm)
ANGLE	±1° (DEG)

HANTRONIX

REV. NO.	DESCRIPTION	DATE	DESIGN	CHECK	APPROVE	DWG NO.
△	Modified P/ALC/DRIVER 23.	91.10.18	LXJUN			HDM3224-CL
△	Modified the length of CFL Output Line 901107	90.11.07	J.S.HUANG	Lead Lee	Lead Lee	
△	Modified Dimension	90.10.24	J.S.HUANG	Y.C.LIU	TONY CHOU	
△						

- Notes :
- Resolution : 320(H)(R.G.B) × 240(V) Dots
  - Backlight : CCFL
  - Frame Material : SBCC (t=0.5)