ENH150XD4-750 Color TFT-LCD MODULE

GENERAL DESCRIPTION

This specification applies to the 15.0 inch color TFT-LCD Module ENH150XD4-750. The display supports the XGA (1024(H) x 768(V) screen format and 262,144 colors (RGB 6-bits data). All input signals are 2 channel TTL interface compatible. This module does not contain an inverter card for backlight.

FEATURES

- XGA 1024(H) x 768(V) resolution
- 4 CCFLs (Cold Cathode Fluorescent Lamp)
- High contrast ratio, high aperture ratio
- Wide viewing angle
- High speed response
- Low power consumption

APPLICATIONS

Desktop monitors

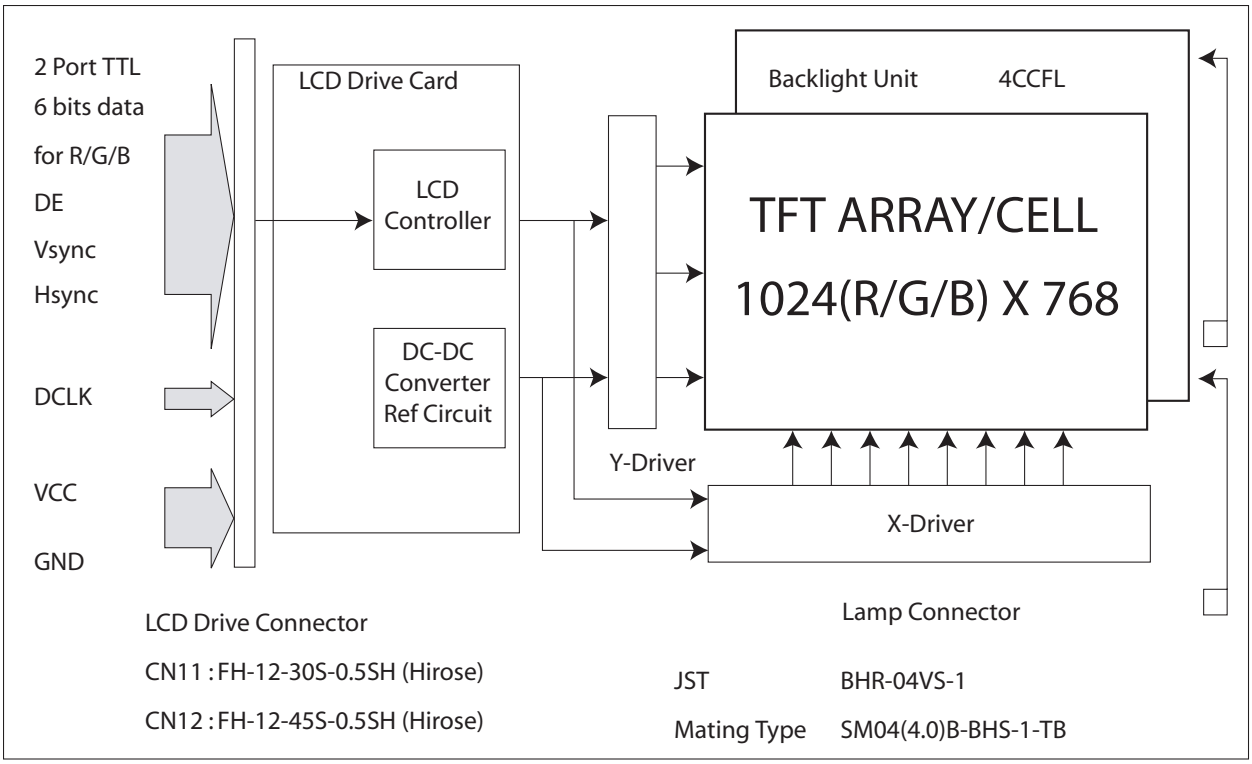
Industrial Instrumentation

DISPLAY CHARACTERISTICS

ITEMS		SPECIFICATIONS	UNIT
Screen Diagonal		381 (15")	[mm]
Outline Dimension		326 x 249.0 x 14.68 (max)	[mm]
Display Area		304.128(H) x 228.096 (38.1cm diagonal)	[mm]
Resolution		1024(R,G,B x 3) x 768	
Pixel Pitch		0.297 x 0.297	[mm]
Pixel Arrangement		R.G.B. Vertical Stripe	
Display Mode		TN Mode, Normally White	
Typical White Luminance		750 (typ.) 5.5mA (note 1)	[cd/m^2]
Crosstalk (60Hz)		1.2% max. (note 4)	
Contract Ratio		400 : 1 typ.	
Support Colors		262,144 colors (6-bit for R,G,B)	
Chromaticity (CIE 1931)	White-x	0.313	
	White-y	0.329	
Color Gamut		60% typ., of NTSC coverage	
Viewing Angle, Typ.		70(left), 70(right), 60(up), 60(down) CR=10 80(left), 80(right), 70(up), 80(down) CR=5	
Response Time		16ms typ. (Tr +Tf)	[msec]
Nominal Input Voltage Vcc		+3.3V	[Volt]
Power Consumption (Vcc line+ CCFL line)		17(typ.)@5.5mA (All Black Pattern)	[Watt]
Electrical Interface		TTL 2 port	
Frame Rate		60Hz typ., 75Hz max.	[Hz]
Weight		1420 typ.	[Grams]
Mounting Method		Side Mounting	
Temperature Range	Operating	0 to 50	[°C]
	Storage	-20 to +60	[°C]

FUNCTIONAL BLOCK DIAGRAM

The following diagram shows the functional block of 15.0" color TFT-LCD Module



HANDLING PRECAUTIONS

1) Front film is easily damaged.
2) Be sure to turn off power supply when inserting or disconnecting from input connector.
3) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
4) When the panel surface is soiled, wipe it with absorbent cotton or other non-abrasive cloth.
5) The panel is made of glass, it may break or crack if dropped or bumped on hard surface.
6) CMOS LSI is used in this module, practice appropriate ESI precautions and maintain ground when handling.
7) Do not open nor modify the Module Assembly.
8) Do not press the reflector sheet at the back of the module to any directions.
9) If a Module has to be put back into the packing container slot after once it was taken out from the container, do not press the center of the CCFL Reflector edge. Instead, press at the far ends of the CCFL Reflector edge softly. Otherwise the TFT Module may be damaged.
10) At the insertion or removal of the Signal Interface Connector, be sure not to rotate or tilt the Interface Connector of the TFT Module.
11) After installation of the TFT Module into an enclosure (LCD monitor housing, for example), do not twist nor bend the TFT Module enclosure design, it should be taken into consideration that no bending/twisting forces are allowed. Otherwise the TFT Module may be damaged.
12) Cold cathode fluorescent lamp in LCD contains a small amount of mercury. Please follow local ordinances or regulations for disposal.
13) Small amount of materials having no flammability grade are used in the LCD module. The LCD module should be supplied by power complied with requirements of Limited Power Source (2.11, IEC60950 or UL1950), or be applied exemption.
14) The LCD module is designed so that the CCFL in it is supplied by Limited Current Circuit (2.4, IEC60950 or UL1950). Do not connect the CCFL in Hazardous Voltage Circuit.

ABSOLUTE MAXIMUM RATINGS

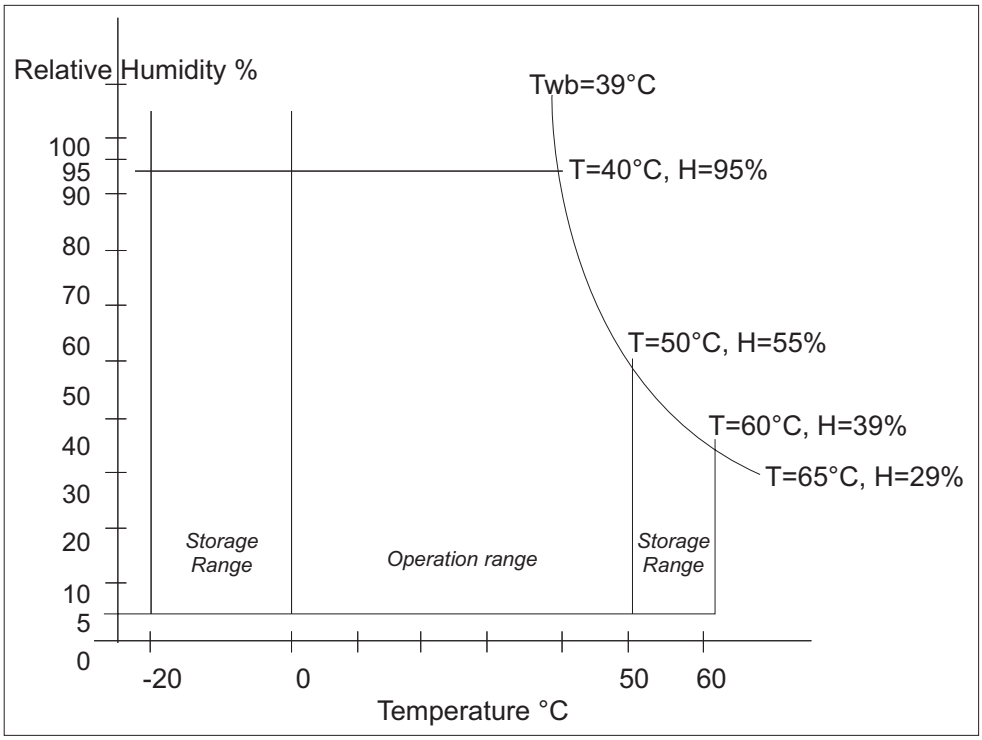
Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD Drive Voltage	V_{CC}	-0.3	+3.6	[Volt]	
Input Voltage of Signal	V_{IN}	-0.3	V_{CC}+0.3	[Volt]	
CCFL Current	ICFL	-	9.0	[mA] rms	Note 1
Operating Temperature	TOP	0	+50	[°C]	Note 2
Operating Humidity	HOP	+20	+85	[%RH]	Note 2
Storage Temperature	TST	+20	+60	[°C]	Note 2
Storage Humidity	HST	+5	+95	[%RH]	Note 2
Vibration			1.5/10-200	[G/Hz]	
Shock			50/20	[G/ms]	Half sine wave
Assured Torque at Side Mount			2.0	[kgf.cm]	
Re-screw			3	[Times[	

Note:

1 Lamp life is reduced when driven above 5.5mA. Exceeding 9.0mA may cause a safety hazard.

2 Maximum Wet-Bulb should be 39°C and no condensation.

WET-BULB TEMPERATURE CHART

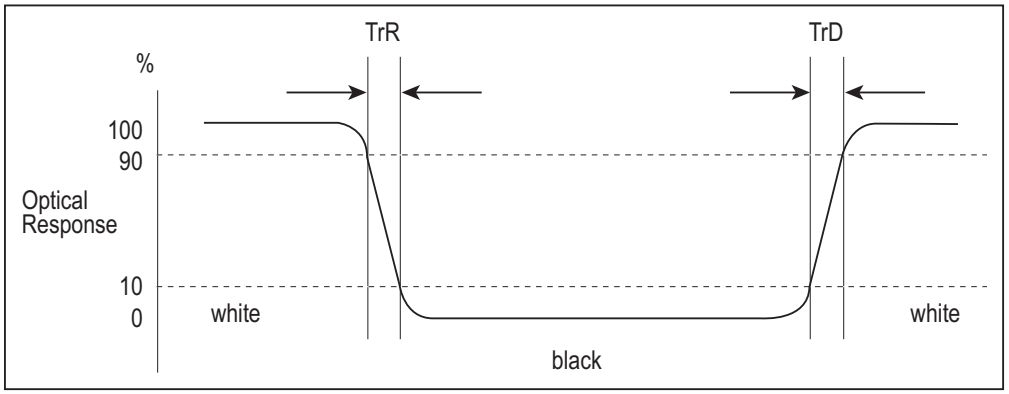


OPTICAL CHARACTERISTICS

Item	Unit	Conditions		Min.	Typ.	Max.
Viewing Angle	[degree]	Horizontal	Right	65	70	
		CR=10	Left	65	70	
		Horizontal	Right	70	80	
		CR=5	Left	70	80	
	[degree]	Vertical	Upper	50	60	
		CR=10	Lower	50	60	
		Vertical	Upper	60	70	
		CR=5	Lower	70	80	
Contrast Ratio		Normal Direction		300	400	-
Response Time (Note 1)	[msec]	Raising Time T_{on} (10%-90%)			5	9
		Falling Time T_{off} (10%-90%)		-	11	15
		Rise + Fall Time		-	16	24
Color/Chromaticity Coordinates (CIE)		Red x		0.59	0.62	0.65
		Red y		0.31	0.34	0.37
		Green x		0.27	0.30	0.33
		Green y		0.56	0.59	0.62
		Blue x		0.12	0.15	0.18
		Blue y		0.07	0.10	0.13
Color Coordinates (CIE) White		White x		0.28	0.31	0.34
		White y		0.30	0.33	0.36
White Luminance at CCFL 5.5mA	[cd/m^2]			600	700	-
Crosstalk (in 75Hz)	[%]					1.2

Note:

1) Definition of Response time: The output signals of photodetector are measured when the input signals are changed from "Black" to "White" (rising time), respectively. The response time interval between the 10% and 90% of amplitudes. Refer to figure as below.



SIGNAL INTERFACE

MODULE INTERFACE CONNECTORS

Connector Name	Interface Connector
Manufacturer	Hirose or compatible
Type/Part Number	CN11 : FH-12-30S-0.5SH (Hirose)
	CN12 : FH-12-45S-0.5SH (Hirose)

MODULE CONNECTOR PIN CONFIGURATION

CN11 : FH-12-30S-0.5SH (Hirose)			CN11 : FH-12-30S-0.5SH (Hirose)		
Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	GND	ground	1	GND	ground
2	BE5	Blue even data (MSB)	2	CLK	Data clock
3	BE4	Blue even data	3	GND	ground
4	BE3	Blue even data	4	DENA	Data enable
5	BE2	Blue even data	5	GND	ground
6	GND	ground	6	VD	Vertical sync
7	BE1	Blue even data	7	GND	ground
8	BE0	Bue even data (LSB)	8	HD	Horizontal sync
9	NC	reserve	9	GND	ground
10	NC	reserve	10	GND	ground
11	GND	ground	11	GND	ground
12	GE5	Green even data (MSB)	12	BO5	Blue odd data (MSB)
13	GE4	Green even data	13	BO4	Bue odd data
14	GE3	Green even data	14	BO3	Blue odd data
15	GE2	Green even data	15	BO2	Blue odd data
16	GND	ground	16	GND	ground
17	GE1	Green even data	17	BO1	Blue odd data
18	GE0	Green even data (LSB)	18	BO0	Blue odd data (LSB)
19	NC	reserve	19	NC	reserve
20	NC	reserve	20	NC	reserve
21	GND	ground	21	GND	ground
22	RE5	Red even data (MSB)	22	BO5	Green odd data (MSB)
23	RE4	Red even data	23	BO4	Green odd data
24	RE3	Red even data	24	BO3	Green odd data
25	RE2	Red even data	25	BO2	Green odd data
26	GND	ground	26	GND	ground
27	RE1	Red even data	27	BO1	Green odd data
28	RE0	Red even data (LSB)	28	BO0	Green odd data (LSB)
29	NC	reserve	29	NC	reserve
30	NC	reserve	30	NC	reserve
			31	GND	ground
			32	RO5	Red odd data (MSB)
			33	RO4	Red odd data
			34	RO3	Red odd data
			35	RO2	Red odd data
			36	GND	ground
			37	RO1	Red odd data
			38	RO0	Red odd data (LSB)
			39	NC	reserve
			40	NC	reserve
			41	VCC	Power input +3.3V
			42	VCC	Power input +3.3V
			43	VCC	Power input +3.3V
			44	NC	reserve
			45	NC	reserve

BACKLIGHT CONNECTORS

Connector Name/Designation	For lamp Connector
Manufacturer	JST or compatible
Type/Part Number	BHR-04VS-1
Mating Type/Part Number	SM04(4.0)B-BHS-1-TB

BACKLIGHT CONNECTOR PIN CONFIGURATION

Pin	Symbol	Description
1	HV	Lamp High Voltage
2	HV	Lamp High Voltage
3	NC	No connection
4	LV	ground

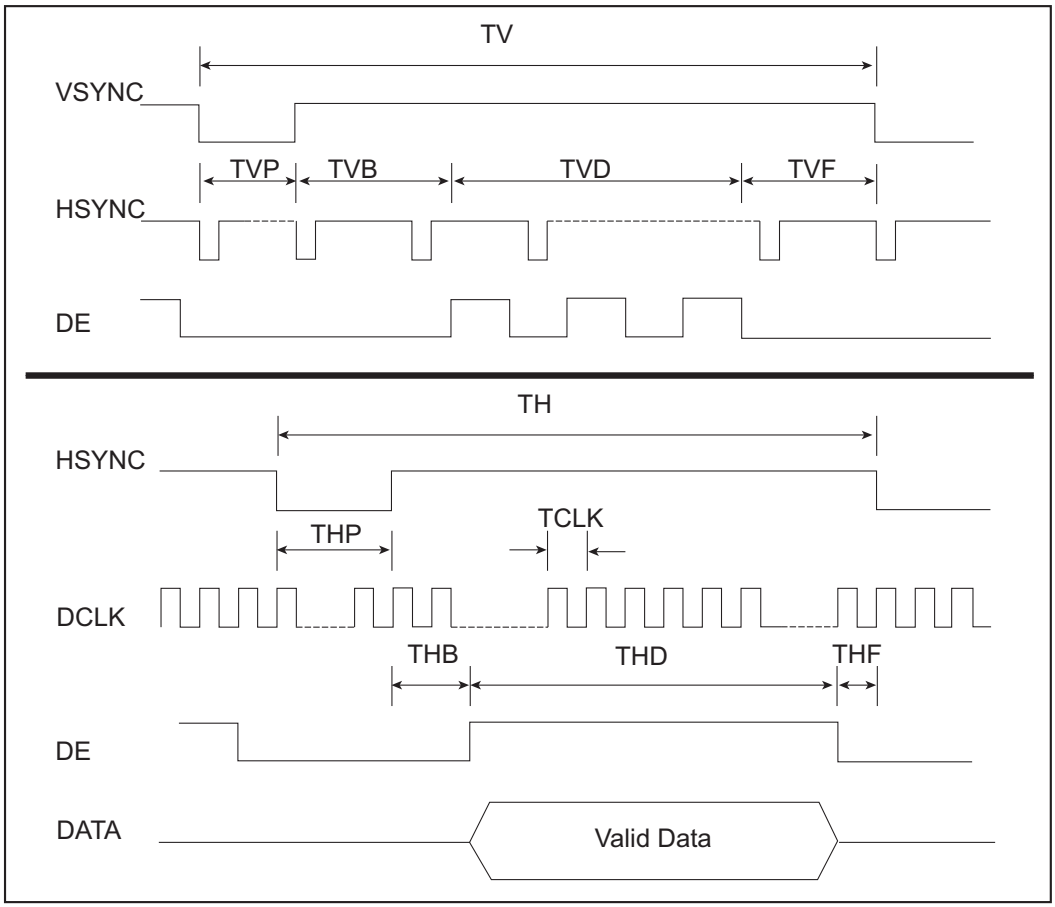
Notes:
Connector length: 150 ± 5mm
Connector-output postion: right side (front view)

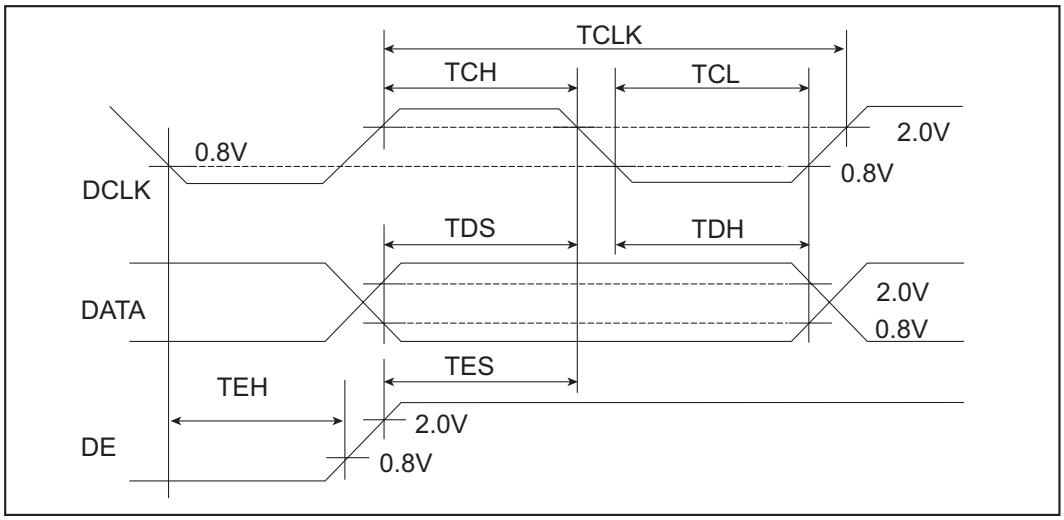
SIGNAL ELECTRICAL CHARACTERISTICS

Item	Symbol	Min	Typ	Max	Unit
LCD Drive voltage	V_{CC}	+3.0	+3.3	+3.6	[V]
"High" input signal voltage	V_{IH}	2.0	-	-	[V]
"Low" input signal voltage	V_{IL}	-	-	0.8	[V]

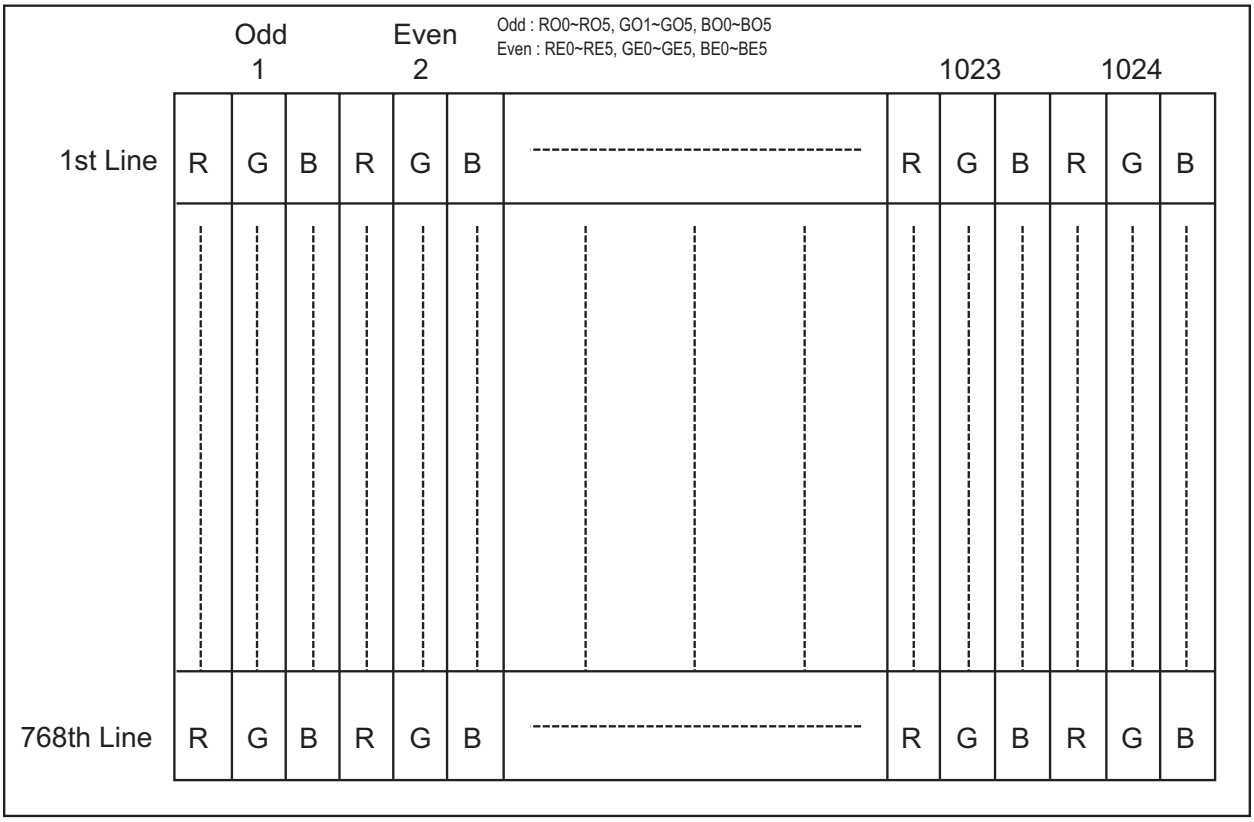
INTERFACE TIMING CHARACTERISTICS

Signal	Item	Symbol	Min	Typ	Max	Unit
DCLK	Frequency	1/TDCLK	-	32.5	40.0	MHz
	Period	TDCLK	25	30.8	-	ns
	High time	TCH	0.4	0.5	0.6	TDCLK
	Low time	TCL	0.4	0.5	0.6	TDCLK
DATA	Setup time	TDS	3	-	-	ns
	Hold time	TDH	1	-	-	ns
Data Enable	Setup time	TES	3	-	-	ns
	Hold time	TEH	1	-	-	ns
Horizontal sync	Frequency	1/TH	-	48	60	KHz
	Pulse width	THP	2	68	-	TDCLK
Horizontal Signal	Back-porch	THB	1	80	-	TDCLK
	Display period	THD	512	512	512	TDCLK
	Front-porch	THF	0	12	-	TDCLK
	H total	TH	600	672	-	-
Vertical sync	Frequency	1/TV	-	60	75	Hz
	Pulse width	TVP	1	6	-	TH
Vertical Signal	Back-porch	TVB	7	29	64	TH
	Display period	TVD	768	768	768	TH
	Front-porch	TVF	1	3	-	TH
	Vsync period + Vback-porch	TVP+TVB	8	-	64	-





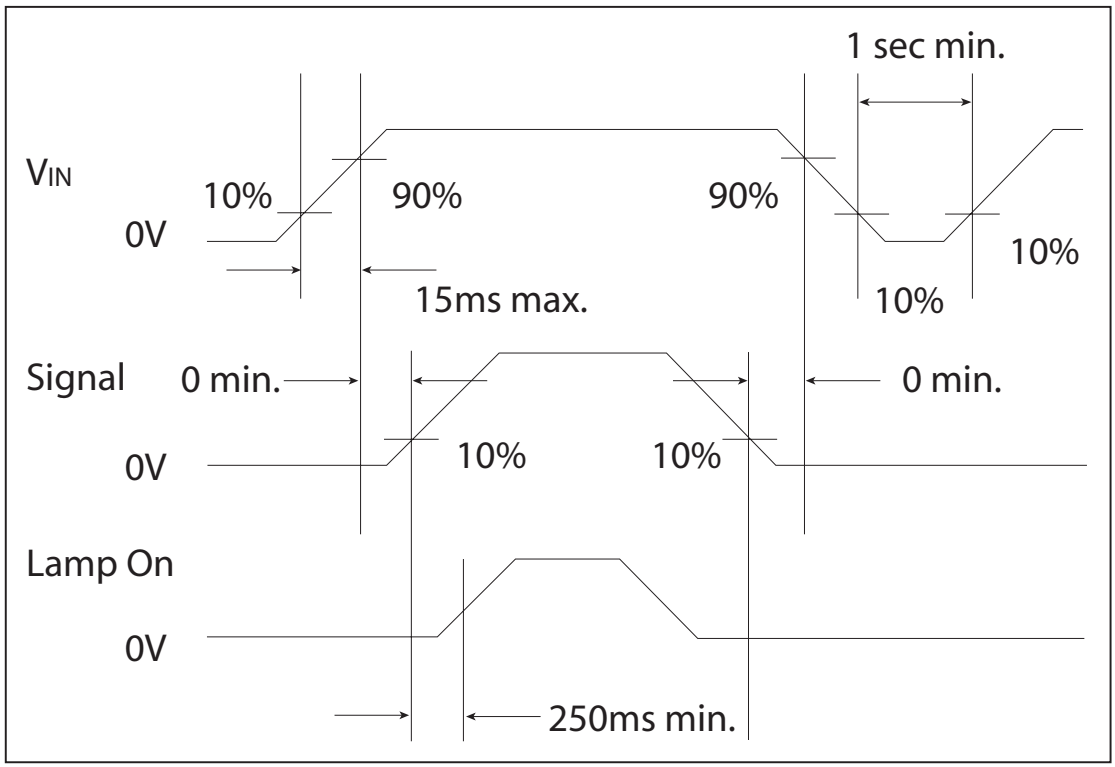
PIXEL FORMAT IMAGE



POWER CONSUMPTION

Symbol	Parameter	Min	Typ	Max	Units	Condition
V_{CC}	LCD Drive Voltage	3.0	3.3	3.6	[V]	
I_{DD}	LCD Drive Current	-	1000	1150	[mA]	V_{CC}=3.3V All Black Pattern
PDD	LCD Drive power consumption	-	3.3	3.8	[Watt]	V_{CC}=3.3V, All Black Pattern
V_{CC}ns	Allowable LCD Drive Ripple Noise	-	-	100	[mV] p-p	

POWER ON/OFF SEQUENCE



BACKLIGHT CHARACTERISTICS

SIGNAL FOR LAMP CONNECTOR

Pin #	Signal Name
1	Lamp High Voltage
2	Lamp High Voltage
3	No connection
4	Ground

PARAMETER GUIDE LINE FOR CCFL INVERTER

Symbol	Parameter	Min	Typ	Max	Units	Condition	Note
IRCFL	CCFL operation range	3.0	5.5	8.5	[mA] rms	(Ta=25°C)	4
ICFL	CCFL Inrush current	-	-	20	[mA]		
fCFL	CCFL Frequency	40	55	60	[KHz]	(Ta=25°C)	1
ViCFL (25°C) (reference)	CCFL Ignition Voltage	1000	-	-	[Volt] rms	(Ta= 25°C)	3
ViCFL (0°C) (reference)	CCFL Ignition Voltage	1300	-	-	[Volt] rms	(Ta= 0°C)	3
VCFL	CCFL Discharge Voltage (reference)	-	680	725	[Volt] rms	(Ta=25°C)	2
PCFL	CCFL Power consumption @ 5.5mA (excluding inverter)	-	15	16	[Watt]	(Ta=25°C)	2

Notes:
1) CCFL Frequency should be carefully determined to avoid interference between inverter and TFT LCD
2) Calculate value for reference (ICFL×VCFLx4=PCFL)
3) CCFL inverter should be able to give out a power that has a generating capacity of over 1300 voltage. Lamp units need 1300 voltage minimum for ignition

VIBRATION, SHOCK AND DROP

VIBRATION & SHOCK

The module shall work error free after following vibration and shock conidtion. Likewise the module shall not sustain any damage after vibration and shock test.

VIBRATION TEST SPEC

Frequency:	10-200Hz
Sweep:	30 Minutes each Axis (X,Y,Z)
Acceleration:	1.5G(10~200Hz P-P)

TEST METHOD

Acceleration (G)	1.5
Frequency (Hz)	10~200~10
Active time (min)	30

SHOCK TEST SPEC

Acceleration (G)	50
Active time (ms)	20
Wave Form	Half-sine
Times	1

ENVIRONMENT

The display module will meet the provision of this specification during operating condition or after storage or shipment condition specified below. Operation at 10% beyond the specified range will not cause physical damage to the unit.

TEMPERATURE AND HUMIDITY

Operating Conditions
The display module operates error free, when operated under the following conditions;

Temperature	0°C to 50°C
Relative Humidity	20% to 85%
Wet Bulb Temperature	39.0°C

SHIPPING CONDITIONS

The display module operates error free, after the following conditions;

Temperature	-20°C to 60°C
Relative Humidity	5% to 95%
Wet Bulb Temperature	39.0°C

ATMOSPHERIC PRESSURE

The display assembly is capable of being operated without affecting its operations over the pressure range as following specified:

	Pressure	Altitude
Maximum Pressure	1040 hPa	0 m = sea level
Minimum Pressure	601 hPa	3658 m = 12,000 feet

Note: Non-operation altitude limit of this display module = 40,000 feet. = 12193 m.

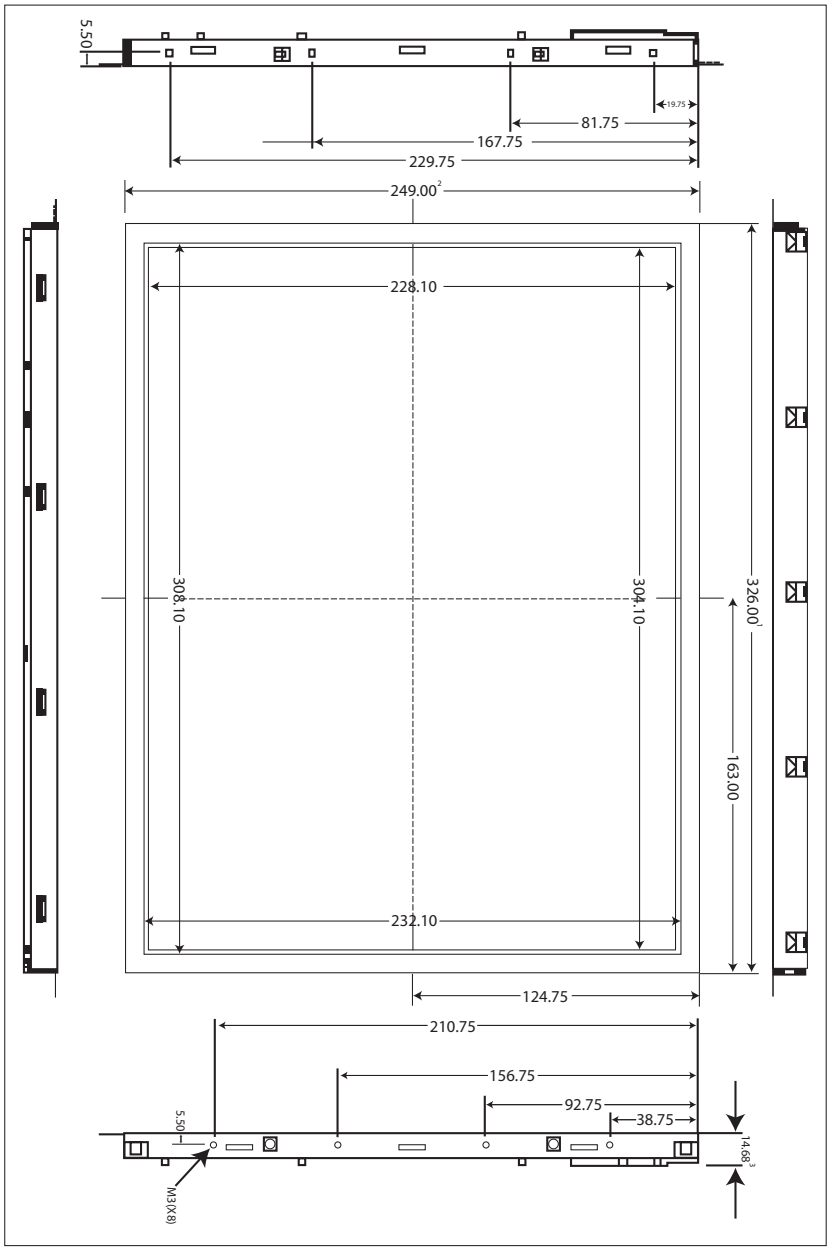
THERMAL SHOCK

The display module will not sustain damage after being subjected to 100 cycles of rapid temperature change. A cycle of rapid temperature change consists of varying the temperature from -20°C to 60°C, and back again.

Thermal shock cycle -20°C for 30min
60°C for 30min

Power is not applied during the test. After temperature cycling, the unit is placed in normal room ambient for at least 4 hours before powering on.

FRONT VIEW



Note:

1) The dimension excludes deformation
2) Tolerance without notice to be + - 0.5mm
3) Lamp cable connector to be JST BHR-03VS-1
4) I/F connector to be Hirose FH-12-45S-0.5SH and FH-12-30S-0.5SH
5) Gap between bezel front inner wall and upper polarizer to be 1.0mm MAX
6) Gap between bezel front inner wall and shielding X to be 0.8mm MAX
7) Check code 1~3 (with a circle around each number)

REAR VIEW