



## ***Display Specification***

**[WWW.LCDSOLAR.COM](http://WWW.LCDSOLAR.COM)**

Solar Technologies, Inc. – Headquarters  
26180 Enterprise Way  
Building No. 100  
Lake Forest, CA 92630

949.458.1080 Tel.  
949.458.1081 Fax  
[Sales@LCDSolar.com](mailto:Sales@LCDSolar.com)

The Solar Technologies name and logo are the service marks of Solar Technologies, Inc. All other trademarks, service marks, logos, slogans, domain names, trade names and copyrights (collectively "Marks") are the properties of their respective owners. Solar Technologies disclaims any proprietary interest in Marks other than its own. All product specifications are provided for convenience only. The product specifications contained herein are provided "as is" and with respect to the information contained therein Solar Technologies disclaims all representations and warranties of any kind, including warranties of merchantability, fitness for a particular purpose, and accuracy of the content. Please consult the manufacturer for specific product information.

## Product Specifications

### 15.4" WUXGA Color TFT-LCD Module

Model Name: SL154-0490

Document No. Revision 1.0

(▲) Preliminary Specifications  
( ) Final Specifications

Note :

1. The information contained herein is preliminary and may be changed without prior notices.
2. The information contained herein is presented merely to indicate the characteristics and performance of our products.
3. No responsibility is assumed for any intellectual property claims or other problems that may result from application based on the module described herein.



## Contents

1.0 General descriptions	p.5
2.0 Absolute maximum ratings	p.7
3.0 Optical characteristics	p.8
4.0 Electrical Specifications	p.11
5.0 Recommend Operating Condition	p.18
6.0 Electrical Characteristics	p.20
7.0 Outline dimension	p.21
8.0 Vibration, Shock, and Drop	p.23
9.0 Environment	p.24
10.0 Reliability	P.25
11.0 General precaution	p.26

## 1.0 GENERAL DESCRIPTIONS

### 1.1 Introduction

The SL154-0490 is a color active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses Low Temperature Poly silicon TFT as a switching device.

The display supports the WUXGA (1920(H) x 1200(V)) screen format and 256K colors (RGB 6-bits data).

All input signals are dual Channel LVDS interface compatible.

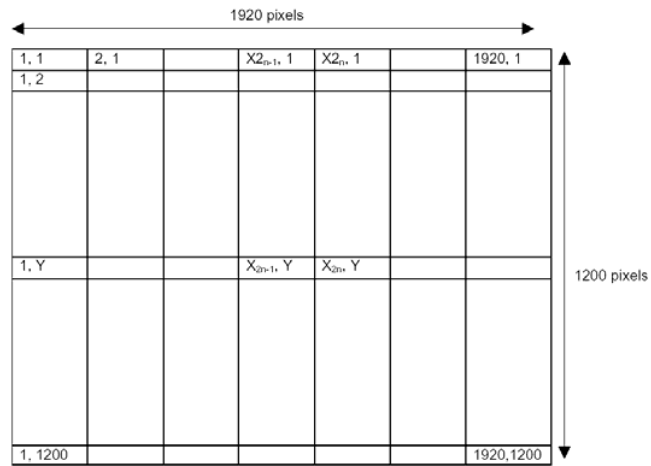
This module does not contain an inverter card for backlight.

### 1.2 Display Characteristics

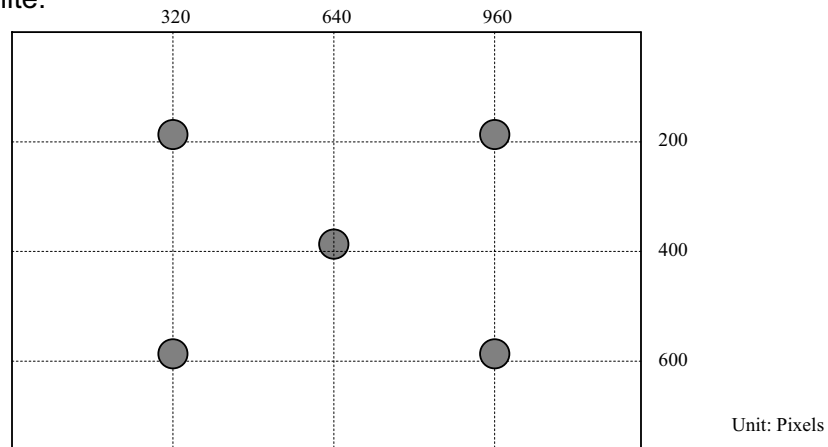
The following items are characteristics summary on the table under 25 °C condition:

ITEMS	Unit	SPECIFICATIONS	Note
Screen diagonal	[mm]	15.4"	
Outline dimension	[mm]	346(W)x229.8(H)x11(D)( typ.)	
Display Area	[mm]	331.2(H) x 207.0(V)	
Resolution		1920(R,G,B x 3) x 1200	(1)
Pixel Pitch	[mm]	0.1725 x 0.1725	(1)
Pixel Arrangement		R.G.B. Vertical Stripe	
Surface Treatment		Anti-glare and hard coat 3H on LCD surface	
Display Mode		TN mode, Normally White	
Brightness	[cd/m <sup>2</sup> ]	350(typ.)@6.0mA	(2)
Brightness uniformity		80% (typ.)	(3)
Contrast Ratio		300 : 1 (typ.)	
Support color		Native 256K colors (6-bit for R,G,B)	
Viewing angle		60(left),60(right),40(up),50(down)	
Response Time	[msec]	35 (typ.)(Tr +Tf)	
Nominal Input Voltage V <sub>DD</sub>	[Volt]	+3.3 V	
Power Consumption (V <sub>DD</sub> line + CCFL line)	[Watt]	22 (typ.)	
Input Signals		LVDS interface R <sub>x</sub> OCLK+, R <sub>x</sub> OCLK-, R <sub>x</sub> ECLK+, R <sub>x</sub> ECLK- R <sub>x</sub> OIN0+, R <sub>x</sub> OIN0-, E <sub>x</sub> EIN0+, R <sub>x</sub> EIN0- R <sub>x</sub> OIN1+, R <sub>x</sub> OIN1-, E <sub>x</sub> EIN1+, R <sub>x</sub> EIN1- R <sub>x</sub> OIN2+, R <sub>x</sub> OIN2-, E <sub>x</sub> EIN2+, R <sub>x</sub> EIN2-	
Frame rate	[Hz]	60	
Weight	[Grams]	972(typ.)	
Temperature Range			
Operating	[°C]	0 to +50	
Storage (Shipping)	[°C]	-20 to +60	

Note: (1)

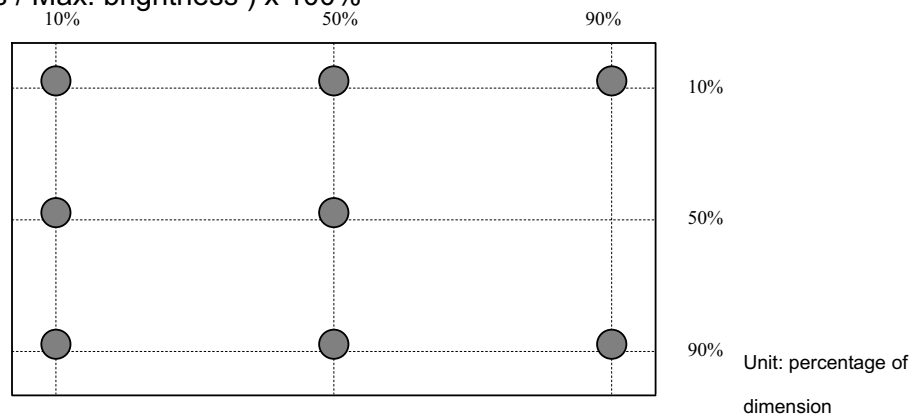


Note: (2) Average brightness is the average of brightness value at location 1 to 5 with all pixels displaying white.



Note: (3) Brightness uniformity of these 9 points is defined as below:

$$\left( \frac{\text{Min. brightness}}{\text{Max. brightness}} \right) \times 100\%$$



### 1.3 Applications

- Desktop monitors
- Display terminals for AV applications
- Monitors for industrial applications

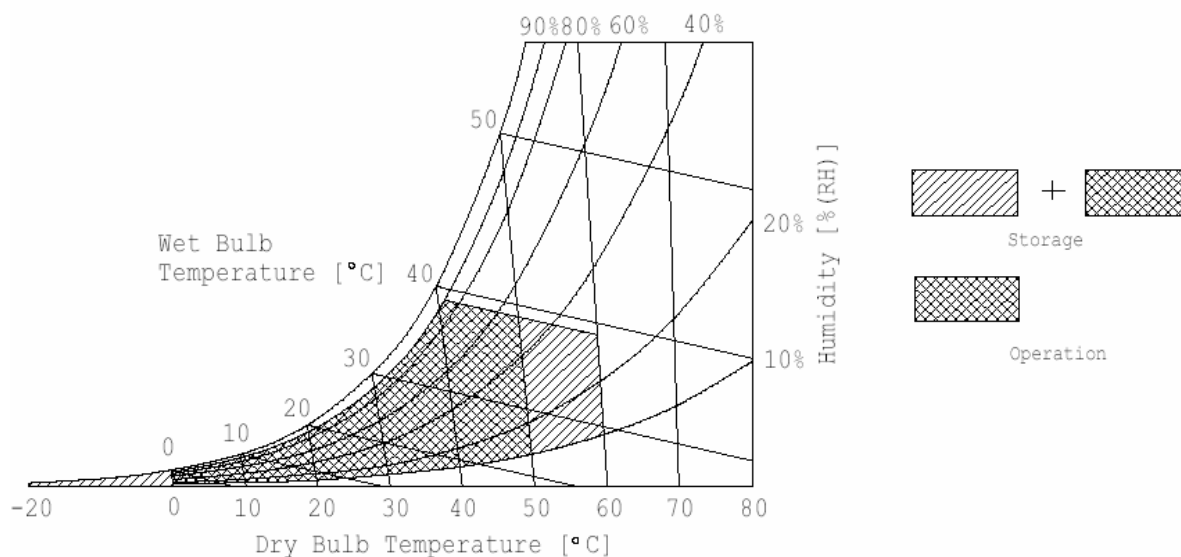
## 2.0 Absolute maximum ratings

Absolute maximum ratings of the module is as following:

Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD Drive Voltage	$V_{DD}$	-0.3	+4.0	[Volt]	
Input Voltage of Signals	$V_{IN}$	-0.3	$V_{DD}+0.3$	[Volt]	
CCFL Inrush current	$I_{CFL}$	-	20	[mA]	Note 1
CCFL Current	$I_{CFL}$	-	7.0	[mA] rms	
Operating Temperature	$T_{OP}$	0	+50	[°C]	Note 2
Operating Humidity	$H_{OP}$	20	85	[%RH]	Note 2
Storage Temperature	$T_{ST}$	-20	+60	[°C]	Note 2
Storage Humidity	$H_{ST}$	5	95	[%RH]	Note 2

Note 1: Duration=50 msec

Note 2: Wet bulb temperature should be 39°C Max, and no condensation of water. See figure below.



Note 3: Do not exceed the maximum rating values under the worst probable conditions taking into account the supply voltage variation, input voltage variation, variation in part constants, and ambient temperature and so on. Otherwise the module may be damaged.

### 3.0 OPTICAL CHARACTERISTICS

#### 3.1 Measuring Condition

Measuring surrounding : dark room  
 Lamp current  $I_{BL}$  : (6.0) $\pm$ 0.1mA, lamp freq.  $F_L$ =50KHz  
 $V_{DD}$ =3.3V  
 Input Signal: Refer typical value in "4.4 Timing Specifications".  
 Ambient temperature : 25 $\pm$ 2 $^{\circ}$ C  
 Ambient Humidity: 65 $\pm$ 20%(RH)  
 30min. Warm-up time.

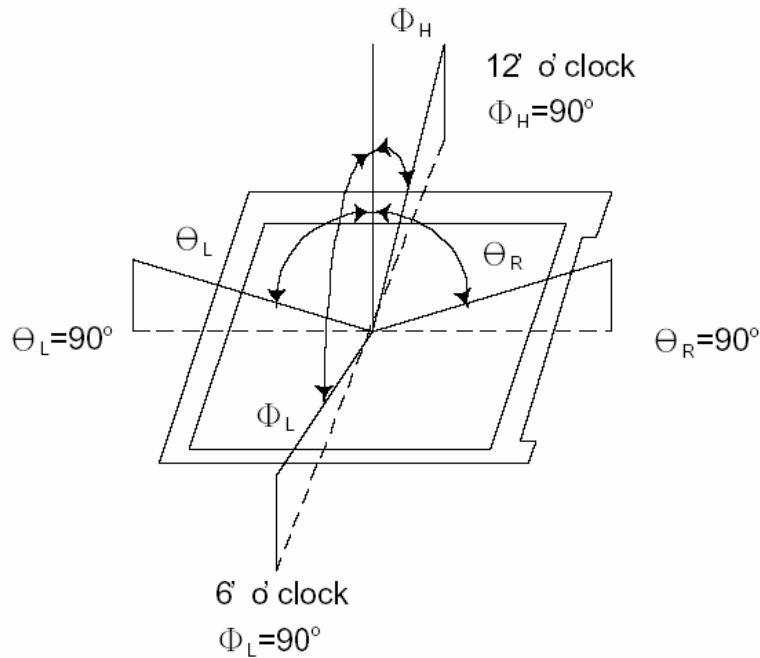
#### 3.2 Measuring Equipment

TOPCON: BM - 7

#### 3.3 Optical specification

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast		CR	$\Theta=0^{\circ}$ $\Phi=0^{\circ}$ Normal viewing angle	300	-	-	-	(1)(2)(5)
White luminance		$Y_L$		190	200	-	cd/m <sup>2</sup>	(center of screen)
Luminance Uniformity		LUNF		80			%	$L_{min}/L_{max}$
Response time	Rising	TR		-	9	15	msec	(1)(3)
	Falling	TF		-	26	35	msec	
Color chromaticity (CIE1931)	Red	Rx		0.564	0.614	0.664		(1)(4)
		Ry		0.283	0.333	0.383		
	Green	Gx		0.243	0.293	0.343	-	
		Gy		0.483	0.533	0.583	-	
	Blue	Bx		0.096	0.146	0.196	-	
		By	0.060	0.110	0.160	-		
	White	Wx	0.283	0.313	0.343	-		
		Wy	0.299	0.329	0.359	-		
Viewing angle	Hor.	$\Theta_L$	-	60	-	-	-	
		$\Theta_R$	-	60	-	-	-	
	Ver.	$\Theta_H$	-	40	-	-	-	
		$\Theta_L$	-	50	-	-	-	

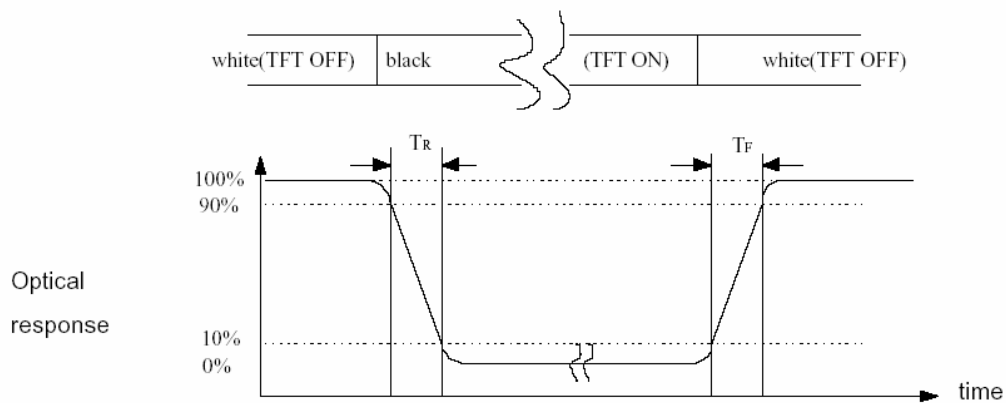
Note (1) Definition of Viewing Angle:



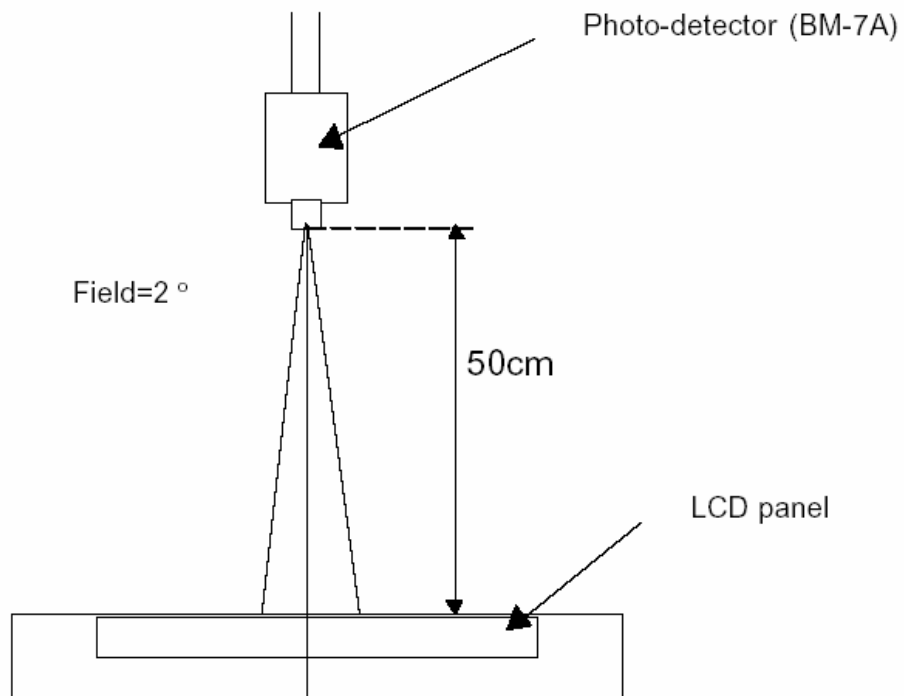
Note (2) Definition of Contrast Ratio(CR) :  
measured at the center point of panel  
Luminance with all pixels white (L63)

$$CR = \frac{\text{Luminance with all pixels white (L63)}}{\text{Luminance with all pixels black (L0)}}$$

Note (3) Definition of Response Time: Sum of TR and TF



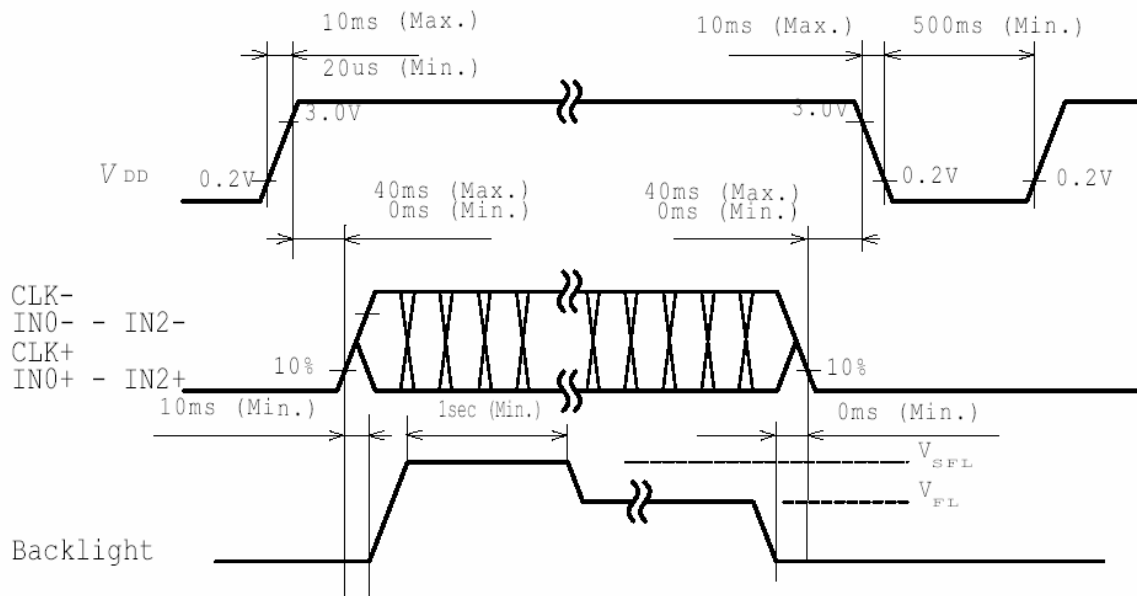
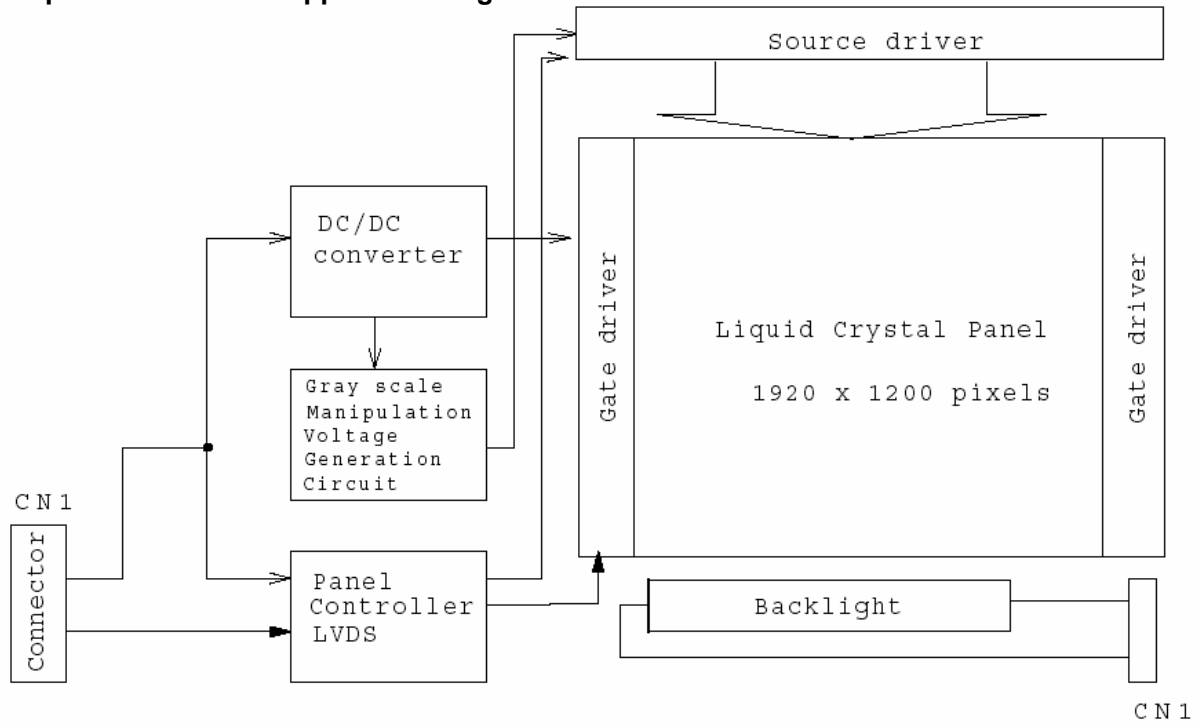
Note (4) Optical characteristic measurement setup



## 4.0 Electrical Specifications

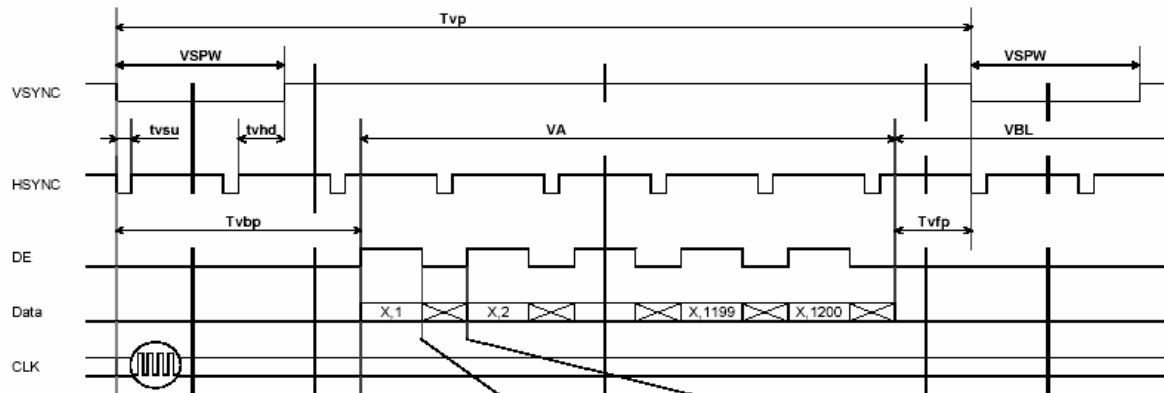
### 4.1 Circuit Diagram:

### 4.2 Sequence of Power Supplies and Signals

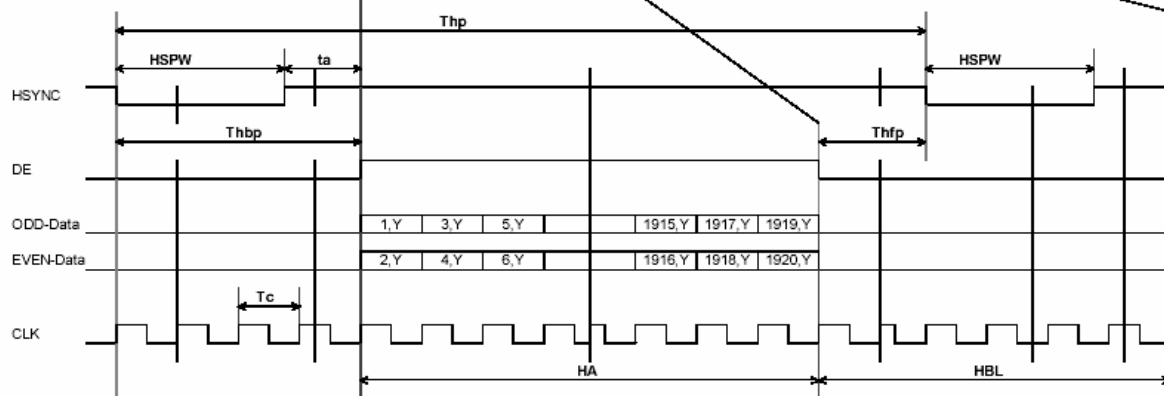


### 4.3 Timing Chart

#### (1) Vertical Timing



#### (2) Horizontal Timing



#### 4.4 Timing Specifications

Item	Symbol	Min.	Typ.	Max.	Unit
Horizontal Scanning Term	Thp	-	1024	-	Tc
		-	13.50	-	μs
H-sync Pulse Width	HSPW	4	-	136	Tc
Horizontal Front Porch	T <sub>hfp</sub>	4	-	136	Tc
Horizontal Back Porch	Thbp	16	-	-	Tc
Horizontal Sync Term	ta	4	-	-	Tc
Horizontal Blanking Term	HBL	-	64	-	Tc
Horizontal Display Term	HA	960	960	960	Tc
Frame Period	Tvp	-	1235	-	Thp
		-	16.67	16.67	Ms
V-sync Pulse Width	VSPW	1	-	-	Thp
V-sync Set UP Time (to H-sync)	tv <sub>su</sub>	8	-	-	Tc
V-sync Hold Time	tv <sub>hd</sub>	8	-	-	Tc
Vertical Front Porch	tv <sub>fp</sub>	8	-	-	Tc
Vertical Back Porch	Tv <sub>bp</sub>	4	-	-	Tc
Vertical Blanking Term	VBL	-	35	-	Thp
Vertical Display Term	VA	1200	1200	1200	Thp
DE Pulse Width	HA	960	960	960	Tc
Clock Period	Tc	13.179	13.179	-	ns

Note (1) Refer to "TIA/EIA "Timing Chart" .

Note (2) If ENAB is fixed to "H" or "L" level for certain period while NCLK is supplied, the panel displays black with some flicker.

Note (3) If NCLK is fixed to "H" or "L" level for certain period while ENAB is supplied, the panel may be damaged.

Note (4) Please adjust LCD operating signal timing and FL driving frequency, to optimize the display quality. There is a possibility that flicker is observed by the interference of LCD operating signal timing and FL driving condition (especially driving frequency), even if the condition satisfies above timing specifications and recommended operating conditions shown in 5.

Note (5) Do not make *tv*, *tv<sub>dh</sub>* and *tv<sub>ds</sub>* fluctuate.

If *tv*, *tv<sub>dh</sub>*, and *tv<sub>ds</sub>* are fluctuate, the panel displays black.

Note (6) In case of using the long frame period, the deterioration of display quality, noise etc. may be occurred.

Note (7) NCLK count of each Horizontal Scanning Time should be always the same.

V-Blanking period should be "*n*" X "Horizontal Scanning Time". (*n*: integer)

Frame period should be always the same.

Note (8) Please keep below equations.

$$VBL = Tv_{fp} + Tv_{bp}$$

$$HSPW = HBL - Th_{fp} - ta$$

$$Th_{bp} = HSPW + ta$$

## 4.5 Interface Connector

### CN1 INPUT SIGNAL

Connector:FI-XB30SRL-HF11 (Locking Type)/JAPAN AVIATION ELECTRONICS INDUSTRY,LTD.

Mating Connector :

Wire Type FI-X30H(Housing), FI-XC3-1-15000(Contact)

FPC Type FI-X30M or FI-X30MR, Coax Type FI-X30C or FI-X30C2(Housing), FI-X30CH-7000(Shell)

Terminal No.	Symbol	Function
1	GND	Ground
2	V <sub>DD</sub>	POWER SUPPLY : +3.3V
3	V <sub>DD</sub>	POWER SUPPLY : +3.3V
4	NC	Non-Connection
5	NC	Non-Connection
6	NC	Non-Connection
7	NC	Non-Connection
8	R <sub>x</sub> OIN0-	Odd Negative LVDS differential data input , [R0-R5, G0]
9	R <sub>x</sub> OIN0+	Odd Positive LVDS differential data input , [R0-R5, G0]
10	GND	Ground
11	R <sub>x</sub> OIN1-	Odd Negative LVDS differential data input , [G1-G5, B0-B1]
12	R <sub>x</sub> OIN1+	Odd Positive LVDS differential data input , [G1-G5, B0-B1]
13	GND	Ground
14	R <sub>x</sub> OIN2-	Odd Negative LVDS differential data input , [B2-B5, HS, VS, DE]
15	R <sub>x</sub> OIN2+	Odd Positive LVDS differential data input , [B2-B5, HS, VS, DE]
16	GND	Ground
17	OCLK-	Odd Clock Signal(-)
18	OCLK+	Odd Clock Signal(+)
19	GND	Ground
20	R <sub>x</sub> EIN0-	Even Negative LVDS differential data input , [R0-R5, G0]
21	R <sub>x</sub> EIN0+	Even Positive LVDS differential data input , [R0-R5, G0]
22	GND	Ground
23	R <sub>x</sub> EIN1-	Even Negative LVDS differential data input , [G1-G5, B0-B1]
24	R <sub>x</sub> EIN1+	Even Positive LVDS differential data input , [G1-G5, B0-B1]
25	GND	Ground
26	R <sub>x</sub> EIN2-	Even Negative LVDS differential data input , [B2-B5, HS, VS, DE]
27	R <sub>x</sub> EIN2+	Even Positive LVDS differential data input , [B2-B5, HS, VS, DE]
28	GND	Ground
29	ECLK-	Even Clock Signal(-)
30	ECLK+	Even Clock Signal(+)

NOTE (1) Please connect GND to ground. Don't use it as no-connect nor connection with high impedance.

### CN2 · CN3 · CN4 · CN5 CCFL POWER SOURCE

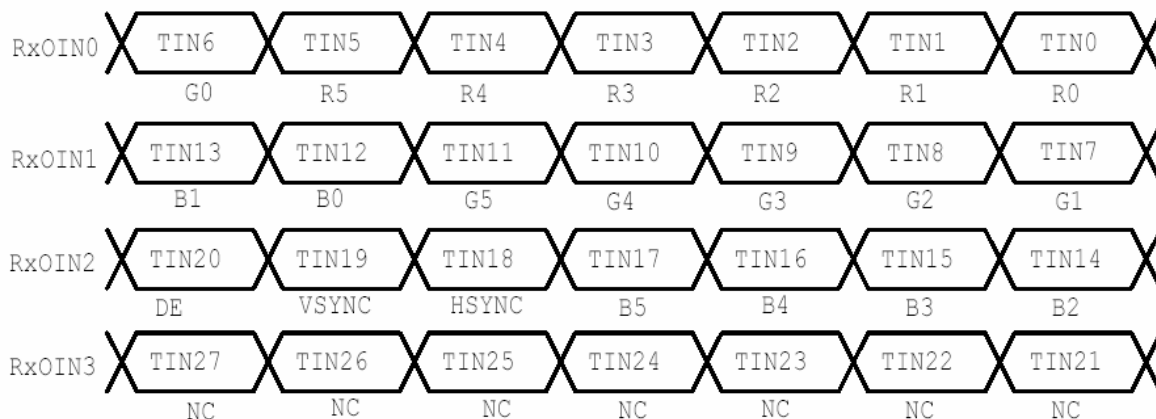
Connector: BHSR-02VS-1/JAPAN SOLDERLESS TERMINAL MFG CO., LTD.

Mating Connector : SM02B-BHS-1/JAPAN SOLDERLESS TERMINAL MFG CO., LTD.

Terminal No.	Symbol	Function
1	VL	CCFL power supply (high voltage)
2	GL	CCFL power supply (low voltage)

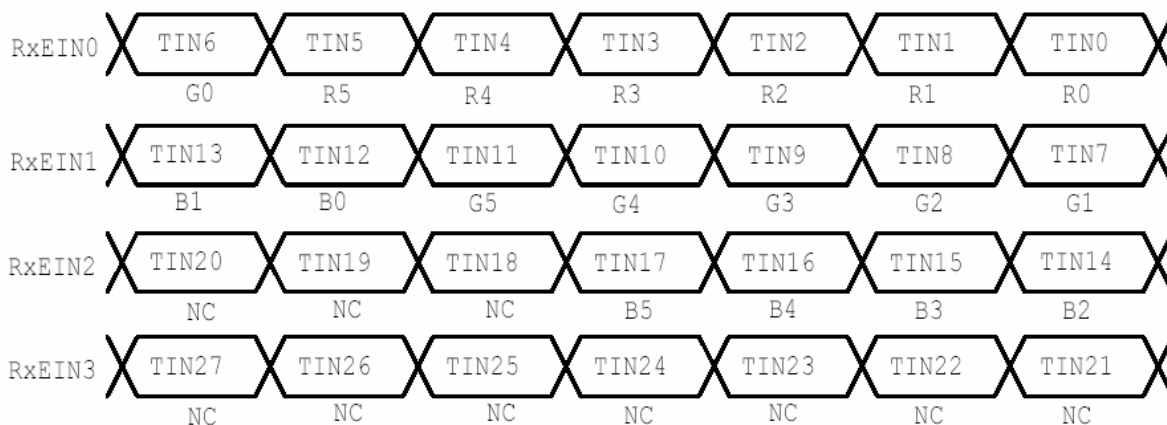
#### 4.6 RECOMMENDED TRANSMITTER (DS90CF365) TO SL154-0490 INTERFACE ASSIGNMENT ODD

Input Terminal No.		Input Signal (Graphics controller output signal)		Output Signal Symbol	To SL154-0490 Interface(CN1)	
Symbol	DS90CF365	Symbol	Function		Terminal	Symbol
T1IN0	51	RO0	Red Pixels Display Data (LSB)	T2OUT0- T2OUT0+	No.8 No.9	R <sub>x</sub> OIN0- R <sub>x</sub> OIN0+
T1IN1	52	RO1	Red Pixels Display Data			
T1IN2	54	RO2	Red Pixels Display Data			
T1IN3	55	RO3	Red Pixels Display Data			
T1IN4	56	RO4	Red Pixels Display Data			
T1IN5	3	RO5	Red Pixels Display Data (MSB)			
T1IN6	4	GO0	Green Pixels Display Data (LSB)	T2OUT1- T2OUT1+	No.11 No.12	R <sub>x</sub> OIN1- R <sub>x</sub> OIN1+
T1IN7	6	GO1	Green Pixels Display Data			
T1IN8	7	GO2	Green Pixels Display Data			
T1IN9	11	GO3	Green Pixels Display Data			
T1IN10	12	GO4	Green Pixels Display Data			
T1IN11	14	GO5	Green Pixels Display Data (MSB)			
T1IN12	15	BO0	Blue Pixels Display Data (LSB)	T2OUT2- T2OUT2+	No.14 No.15	R <sub>x</sub> OIN2- R <sub>x</sub> OIN2+
T1IN13	19	BO1	Blue Pixels Display Data			
T1IN14	20	BO2	Blue Pixels Display Data			
T1IN15	22	BO3	Blue Pixels Display Data			
T1IN16	23	BO4	Blue Pixels Display Data			
T1IN17	24	BO5	Blue Pixels Display Data (MSB)			
T1IN18	27	HSYNC	Horizontal Synchronized Signal	T2OUT3- T2OUT3+	-	-
T1IN19	28	VSYNC	Vertical Synchronized Signal			
T1IN20	30	DE	Data Enable			
T1IN21	50	NC	Non Connection (open)			
T1IN22	2	NC	Non Connection (open)			
T1IN23	8	NC	Non Connection (open)			
T1IN24	10	NC	Non Connection (open)	T2CLK OUT- T2CLK OUT+	No.17 No.18	R <sub>x</sub> OCLKIN- R <sub>x</sub> OCLKIN+
T1IN25	16	NC	Non Connection (open)			
T1IN26	18	NC	Non Connection (open)			
T1IN27	25	NC	Non Connection (open)			
T1CLK IN	31	NCLK	Data Sampling Clock			



### EVEN

Input Terminal No.		Input Signal (Graphics controller output signal)		Output Signal Symbol	To SL154-0490 Interface(CN1)	
Symbol	DS90CF365	Symbol	Function		Terminal	Symbol
T2IN0	51	RE0	Red Pixels Display Data (LSB)	T1OUT0- T1OUT0+	No.20 No.21	R <sub>x</sub> EIN0- R <sub>x</sub> EIN0+
T2IN1	52	RE1	Red Pixels Display Data			
T2IN2	54	RE2	Red Pixels Display Data			
T2IN3	55	RE3	Red Pixels Display Data			
T2IN4	56	RE4	Red Pixels Display Data			
T2IN5	3	RE5	Red Pixels Display Data (MSB)			
T2IN6	4	GE0	Green Pixels Display Data (LSB)	T1OUT1- T1OUT1+	No.23 No.24	R <sub>x</sub> EIN1- R <sub>x</sub> EIN1+
T2IN7	6	GE1	Green Pixels Display Data			
T2IN8	7	GE2	Green Pixels Display Data			
T2IN9	11	GE3	Green Pixels Display Data			
T2IN10	12	GE4	Green Pixels Display Data			
T2IN11	14	GE5	Green Pixels Display Data (MSB)			
T2IN12	15	BE0	Blue Pixels Display Data (LSB)	T1OUT2- T1OUT2+	No.26 No.27	R <sub>x</sub> EIN2- R <sub>x</sub> EIN2+
T2IN13	19	BE1	Blue Pixels Display Data			
T2IN14	20	BE2	Blue Pixels Display Data			
T2IN15	22	BE3	Blue Pixels Display Data			
T2IN16	23	BE4	Blue Pixels Display Data			
T2IN17	24	BE5	Blue Pixels Display Data (MSB)			
T2IN18	27	NC	Non Connection (open)	T1OUT3- T1OUT3+	-	-
T2IN19	28	NC	Non Connection (open)			
T2IN20	30	NC	Non Connection (open)			
T2IN21	50	NC	Non Connection (open)			
T2IN22	2	NC	Non Connection (open)			
T2IN23	8	NC	Non Connection (open)			
T2IN24	10	NC	Non Connection (open)	T1CLK OUT- T1CLK OUT+	No.29 No.30	R <sub>x</sub> ECLKIN- R <sub>x</sub> ECLKIN+
T2IN25	16	NC	Non Connection (open)			
T2IN26	18	NC	Non Connection (open)			
T2IN27	25	NC	Non Connection (open)			
T2CLK IN	31	NCLK	Data Sampling Clock			



### 4.7 Colors Combination Table

	Display	R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0	Gray Scale Level	
Basic Color	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L		
	Blue	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H		
	Green	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L		
	Light Blue	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H		
	Red	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L		
	Purple	H	H	H	H	H	H	L	L	L	L	L	L	H	H	H	H	H	H		
	Yellow	H	H	H	H	H	H	H	H	H	H	H	H	L	L	L	L	L	L		
	White	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		
Gray Scale of Red	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	Red	L0
	Dark ↕ Light	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L		L1
		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L		L2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		L3...
	H	H	H	H	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L60		
	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L61		
	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L62		
Red	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L63		
Gray Scale of Green	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	Green	L0
	Dark ↕ Light	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L		L1
		L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L		L2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	L	L	L	L	L	L	H	H	H	H	L	H	L	L	L	L	L	L	L61		
	L	L	L	L	L	L	H	H	H	H	H	L	L	L	L	L	L	L	L62		
	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L	L63		
Green	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L			
Gray Scale of Blue	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	Blue	L0
	Dark ↕ Light	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H		L1
		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L		L2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		L3...
	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	L	H	L60		
	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L	L61		
	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L	L62		
Blue	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	L63		
Gray Scale of White & Black	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	White	L0
	Dark ↕ Light	L	L	L	L	L	H	L	L	L	L	L	H	L	L	L	L	L	H		L1
		L	L	L	L	H	L	L	L	L	L	H	L	L	L	L	L	H	L		L2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		L3...
	H	H	H	H	L	H	H	H	H	H	L	H	H	H	H	H	L	H	L60		
	H	H	H	H	H	L	H	H	H	H	H	L	H	H	H	H	H	L	L61		
	H	H	H	H	H	L	H	H	H	H	H	L	H	H	H	H	H	L	L62		
White	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L63		

## 5.0 Recommended Operating Conditions

### 5.1 Electrical System of LCD Module:

Item	Symbol	Value			Unit	Remarks
		Min.	Typ.	Max.		
Supply Voltage	$V_{DD}$	3.0	3.3	3.6	V	(3)
Comon Mode Input Voltage	$V_{CM}$	0.5	1.2	1.75	V	
Differential Input High Threshold	$V_{TH}$	-	-	100	mV	$V_{CM}=1.2V$
Differential Input Low Threshold	$V_{TL}$	-100	-	-	mV	$V_{CM}=1.2V$

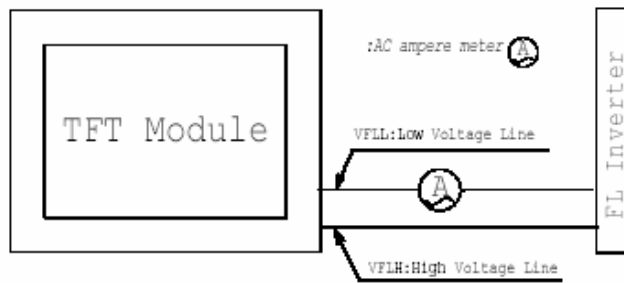
### 5.2 Back-Light Unit:

The backlight system is an edge-lighting type with 2-CCFL (Cold Cathode Fluorescent Lamp). The characteristics of dual lamps are shown in the following tables.

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Lamp current	$I_L$	4.0	6.0	6.5	mA(rms)	(1)
Lamp voltage	$V_L$	690	710	890	V(rms)	$I_L=6.0$ mA
Frequency	$f_L$	40	50	60	KHz	(2)
Operating life time	Hr	30,000			Hour	(6)
Startup voltage	$V_s$	1250			V(rms)	at 25°C
		155		1800		at 0°C

Note:

- (1) The module should be always operated within these ranges. The "Typ." shows the recommendable value.
- (2) Recommended LVDS transmitter: Be based on TIA/EIA specification transmitter. Panel Controller contains LVDS, which is based on TIA/EIA specification.
- (3) Pin Terminal:  $V_{DD}$ , GND (GND:  $V_{SS}=0V$ )
- (4) Checked Pin Terminal:  $IN0+/-$ ,  $IN1+/-$ ,  $IN2+/-$ ,  $CLK+/-$ , GND (0V)  
Measure:  $|V_{IN0+}-V_{IN0-}|$ ,  $|V_{IN1+}-V_{IN1-}|$ ,  $|V_{IN2+}-V_{IN2-}|$ ,  $|V_{CLK+}-V_{CLK-}|$
- (5) Checked Pin Terminal:  $IN0+/-$ ,  $IN1+/-$ ,  $IN2+/-$ ,  $CLK+/-$ , GND (0V)  
Measure:  $1/2 \times (V_{IN0+}+V_{IN0-})$ ,  $1/2 \times (V_{IN1+}+V_{IN1-})$ ,  $1/2 \times (V_{IN2+}+V_{IN2-})$ ,  $1/2 \times (V_{CLK+}+V_{CLK-})$
- (6) Checked Pin Terminal:  $V_{FLH} - V_{FLL}$
- (7) IF FL input current ( $I_{FL}$ ) is higher than typical value(6.0mA(rms)), then FL lifetime becomes shorter.
- (8) Measuring Method of  $I_{FL}$ .



- (9) Input FL starting voltage (VSFL) should not be less than one second.  
If it were less than one second, it may cause unstable operation of FL.
- (10) Please adjust LCD operating signal timing and FL driving frequency, to optimize the display quality. There is a possibility that flicker is observed by the interference of LCD operating signal timing and FL driving condition (especially driving frequency), even if the condition satisfies above recommended operating conditions and timing specifications shown in 4.4 .
- (3) Life time (Hr) can be defined as the time in which it continues to operate under the condition:  
Temp. = $25\pm 3^{\circ}\text{C}$ ,  $I_L=6.0\text{mA(rms.)}$  and  $f_L=50\text{ KHz}$  until one of the following event occurs:  
1. When the brightness becomes 50%.  
2. When the startup voltage ( $V_s$ ) at  $0^{\circ}\text{C}$  becomes higher than the maximal value of  $V_s$  specified above.

## 6. Electrical Characteristics:

### 6.1 Test Conditions

Ambient Temperature:  $T_a$  25±5°C

Ambient Humidity :  $H_a$  65±20%

Supply Volatge :  $V_{DD}$  3.3V

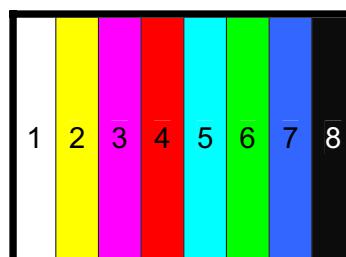
Input Signal : Refer typical value in “4.4 Timing Specifications”.

### 6.2 Specifications

Item	Symbol	Min.	Typ. <sup>(1)</sup>	Max.	Unit	Remark
Current Consumption	$I_{DD}$	-	515	700	mA	$V_{DD}$ Terminal Current

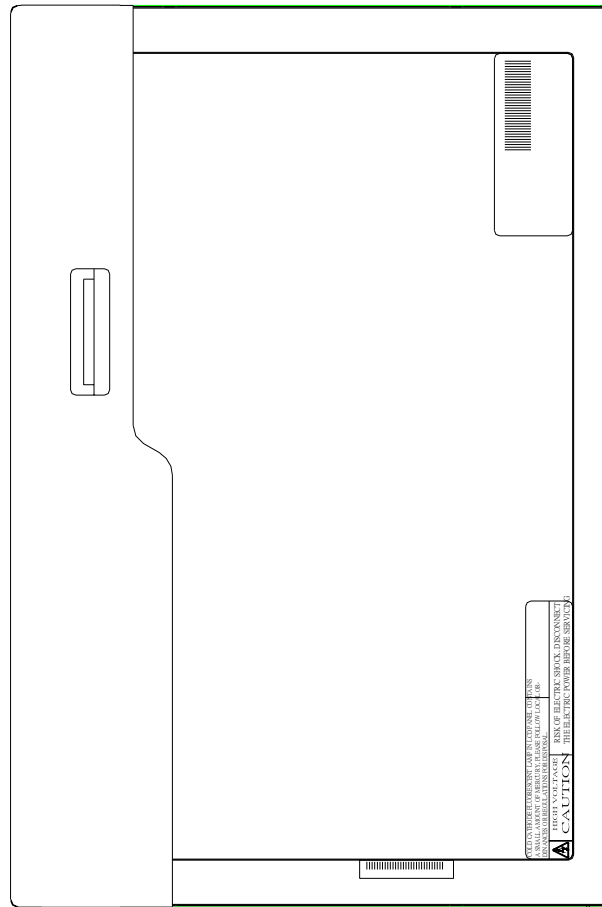
Note (1) The Typical value of  $I_{DD}$  is measured in the following pattern.

1. White
2. Yellow
3. Purple
4. Red
5. Light Blue
6. Green
7. Blue
8. Black





Unit: mm



7.2 Back View

## 8.0 Vibration, Shock, and Drop

### 8.1 Vibration & Shock

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

### 8.2 Shock Test Spec:

Acceleration (G) -a	50
Active time -b	20
Wave form	half-sin
Times	1

Direction:  $\pm X$  ,  $\pm Y$  ,  $\pm Z$

### 8.3 Drop test

Package test: The drop height is 60 cm.

## 9.0 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.

### 9.1 Temperature and Humidity

#### 9.1.1 Operating Conditions

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

Temperature	0 °C to 50 °C
Relative Humidity	8% to 95%
Wet Bulb Temperature	39.0 °C

#### 9.1.2 Shipping Conditions

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

Temperature	-20 °C to 60 °C
Relative Humidity	8% to 95%
Wet Bulb Temperature	39.0 °C

## 9.2 Atmospheric Pressure

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

	Pressure	Note
Maximum Pressure	1040hPa	0m = sea level
Minimum Pressure	674hPa	3048m = 10.000 feet

Note : Non-operation attitude limit of this display module = 30,000 feet. = 9145 m.

## 9.3 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.

<b>Thermal shock cycle</b>	-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.

## 10.0 Reliability

This display module and the packaging of that will comply following standards.

### 10.1 Failure Criteria

The display assembly will be considered as failing unit when it no longer meets any of the requirements stated in this specification. Only as for maximum white luminance, following criteria is applicable.

**Note : Maximum white Luminance shall be 125 cd/m<sup>2</sup> or more.**

### 10.2 Failure Rate

The average failure rate of the display module (from first power-on cycle till 1,000 hours later) will not exceed 1.0%.

The average failure rate of the display module from 1,000 hours until 16,000 hours will not exceed 0.7% per 1,000 hours.

#### 10.2.1 Usage

The assumed usage for the above criteria is:

220 power-on hours per month

500 power on/off cycles per month

Maximum brightness setting

Operation to be within office environment (25<sup>0</sup>C typical)

#### 10.2.2 Component De-rating

All the components used in this device will be checked the load condition to meet the failure rate criteria.

### 10.3 CCFL Life

The assumed CCFL Life will be longer than 25,000 hours, typical value is 30,000 hours under stable condition at 25 ± 5<sup>0</sup>C;

Standard current at 6.0 ± 0.5mA.

Definition of life: brightness becomes 50% or less than the minimum luminance value of CCFL.

### 10.4 ON/OFF Cycle

The display module will be capable of being operated over the following ON/OFF Cycles.

ON/OFF	Value	Cycles
+Vin and CCFL power	30,000	10 seconds on / 10 seconds off

## **11.0 GENERAL PRECAUTION**

### **11.1 Use Restriction**

This product is not authorized for use in life supporting systems, aircraft navigation control systems, military systems and any other application where performance failure could be life-threatening or otherwise catastrophic.

### **11.2 Disassembling or Modification**

Do not disassemble or modify the module. It may damage sensitive parts inside LCD module, and may cause scratches or dust on the display. Warranty is void if the module is modified or disassembled.

### **11.3 Breakage of LCD Panel**

11.3.1 If LCD panel is broken and liquid crystal spills out, do not ingest or inhale liquid crystal, and do not contact liquid crystal with skin.

11.3.2 If liquid crystal contacts mouth or eyes, rinse out with water immediately.

11.3.3 If liquid crystal contacts skin or cloths, wash it off immediately with alcohol and rinse thoroughly with water.

11.3.4 Handle carefully with chips of glass that may cause injury, when the glass is broken.

### **11.4 Electric Shock**

11.4.1 Disconnect power supply before handling LCD module.

11.4.2 Do not pull or fold the CCFL cable.

11.4.3 Do not touch the parts inside LCD modules and the fluorescent lamp's connector or cables in order to prevent electric shock.

### **11.5 Absolute Maximum Ratings and Power Protection Circuit**

11.5.1 Do not exceed the absolute maximum rating values, such as the supply voltage variation, input voltage variation, variation in parts' parameters, environmental temperature, etc., otherwise LCD module may be damaged.

11.5.2 Please do not leave LCD module in the environment of high humidity and high temperature for a long time.

11.5.3 It's recommended employing protection circuit for power supply.

### **11.6 Operation**

11.6.1 Do not touch, push or rub the polarizer with anything harder than HB pencil lead.

11.6.2 Use fingerstalls of soft gloves in order to keep clean display quality, when persons handle the LCD module for incoming inspection or assembly.

11.6.3 When the surface is dusty, please wipe gently with absorbent cotton or other soft material.

11.6.4 Wipe off saliva or water drops as soon as possible. If saliva or water drops contact with polarizer for a long time, they may causes deformation or color fading.

11.6.5 When cleaning the adhesives, please use absorbent cotton wetted with a little petroleum benzine or other adequate solvent.

### **11.7 Mechanism**

Please mount LCD module by using mounting holes arranged in four corners tightly.

### **11.8 Static Electricity**

11.8.1 Protection film must remove very slowly from the surface of LCD module to prevent from electrostatic occurrence.

11.8.2 Because LCD module uses CMOS-IC on circuit board and TFT-LCD panel, it is very weak to electrostatic discharge. Please be careful with electrostatic discharge.

11.8.3 Persons who handle the module should be grounded through adequate methods.

### **11.9 Strong Light Exposure**

The module shall not be exposed under strong light such as direct sunlight. Otherwise, display characteristics may be changed.

### **11.10 Disposal**

When disposing LCD module, obey the local environmental regulations.