* The date(Create Date, Approved Date, Check Date) is based on Korean standard time(GMT+9)

| | |
|---|---|
| Created Date | 2012-06-11 09:14 (Korea Time) |
| Requested by | 최찬용 ( Monitor양산팀 / 주임연구원 , 82-031-610-6597 ) |
| Subject | [Approval Formal] EAJ62073401(LGD_LM185WH2-TLD1 TN 200nits) |

EDMS Attributes

| | |
|---|---|
| Retention | 3 Year |
| Security Grade | Internal use (Only) |
| Tag | 승인원 회람 |
| Access | *LG전자;*Monitor Product Support Team |
| Permission | Read Only;Download |

## Component Development Information

Model : E1942C/E1941C/E1942TC/M1932D
Approval type : New ( ● ) Limit ( ) Revision ( ) 4M ( )
HSMS (RoHS) : Complete (●) Limit Approval () Warranty Approval ()
Reliability test : Needless ( ) Need (Test Report No: ● )
Class Name : LCD,Module-TFT
Part Number : EAJ62073401
Maker : LGD
Specification : LM185WH2-TLD1 HD 18.5INCH 1366X768 200CD COLOR 72% 16/9 600:1 60Hz
Inverter N LED 2D R/T:5ms,V/A:90/65
Key part list : Pol:LGC,Fab:P6,Module assy:GM/GZ,T-con:ED Tech,S-ic:Lusem,GIP
BL Assy:New optics,LED:Wooree/LGIT,Sheet:Diffuser 3ea
Development History : LGD 18.5" TN 200nits New module development

★Safety Standard Parts [안전규격부품 List]
Power Cord, Power Plug, X / Y-Capacitor, Power Switch, Fuse, SMPS Trans, Stand-By Trans, Photo coupler, Insulation (절연) Resistor, Discharge (방전)Resistor, Fusing Resistor, FBT,CPT, CRT Socket, DY, D-Coil, Line Filter, PCB Material, Front / Back-cover Material, Relay(1-2차간), Varistor, Adaptor, PSU(Power supply unit)
★EMC Standard Parts [전파규격 부품 List]
Power Plug, Line Filter, X-Capacitor, Y-Capacitor, SMPS Trans, Tuner, Saw-Filter, Shield Case, Oscillator, Pattern Change
★Green [유해물질 확인사항]
This item must meet the standards of LG Electronics for six major substances as designated by RoHS for control.

Approval Line

| Approval Type | Status | Approved Date | Approved by / Comment |
|---|---|---|---|
| Agree | Approved | 2012-06-14 17:15 | xiangtai jin ( LGEND IT Development VP.Component Development Team.Module De / officer 1 )<br>Comment : OK |
| Agree | Approved | 2012-06-15 11:38 | xiaodong li ( LGEND IT Development VP.Component Development Team / senior manager B )<br>Comment : OK |
| Agree | Approved | 2012-06-16 17:48 | huan chen ( LGEND IT Development VP.IT Planning Team.Safety Part / assistant manager )<br>Comment : OK |
| Agree | Approved | 2012-06-18 09:26 | tongsuo yao ( LGEND IT Development VP.IT Planning Team.Safety Part / officer 1 )<br>Comment : OK |
| Approval | Approved | 2012-06-18 11:12 | danyang huang ( LGEND IT Development VP.IT Planning Team.Standard Part / manager b )<br>Comment : OK,200nits,non-TCO model. |
| Agree | Approved | 2012-06-18 11:56 | 이진범 ( LGEND IT Development VP.IT Mechanic Team / 선임연구원 )<br>Comment : ok |
| Agree | Approved | 2012-06-18 12:12 | 한상석 ( LGEND IT Development VP.IT Dvelopment Team / 책임연구원 )<br>Comment : 확인합니다. |
| Approval | Approved | 2012-06-18 12:45 | 윤석재 ( Monitor양산팀 / 책임연구원 )<br>Comment : 확인합니다. |
| Approval | Approved | 2012-06-18 15:39 | 배권일 ( Monitor양산팀 / 수석연구원 )<br>Comment : 확인합니다 |

| | |
|---|---|
| CC | 김진훈 ( IT모듈구매팀 / 차장 )<br>윤시열 ( IT R&D기획팀 / 수석연구원 )<br>송재학 ( IT양산품질보증팀 / 차장 )<br>강희철 ( LGEND IT Development VP.Component Development Team / 책임연구원 )<br>김상인 ( Monitor양산팀 / 주임연구원 )<br>한상석 ( LGEND IT Development VP.IT Dvelopment Team / 책임연구원 )<br>손상익 ( IT모듈구매팀 / 차장 )<br>이기형 ( IT R&D기획팀 / 책임연구원 )<br>최찬용 ( Monitor양산팀 / 주임연구원 )<br>송성호 ( Monitor회로팀 / 책임연구원 )<br>김경진 ( TV부품품질보증계 / 주임 )<br>김철회 ( Monitor기구팀 / 선임연구원 )<br>허희준 ( IT R&D기획팀 / 선임연구원 )<br>류동우 ( IT모듈구매팀 / 과장 )<br>곽명근 ( Monitor회로팀 / 책임연구원 )<br>김창섭 ( Monitor기구팀 / 선임연구원 )<br>이경원 ( Monitor기구팀 / 선임연구원 )<br>손현우 ( IT혁신팀 / 선임연구원 )<br>박종철 ( IT혁신팀 / 선임연구원 )<br>김철홍 ( Monitor기구팀 / 주임연구원 )<br>김부영 ( IT R&D기획팀 / 선임연구원 )<br>류정일 ( Monitor선행개발팀 / 주임연구원 )<br>이송화 ( IT모듈구매팀 / 대리 )<br>김영주 ( IT R&D기획팀 / 연구원 )<br>조대현 ( Monitor SW팀 / 주임연구원 )<br>이인규 ( Monitor기구팀 / 연구원 )<br>임창성 ( IT양산품질보증팀 / 차장 )<br>김아련 ( IT R&D기획팀 / 주임연구원 )<br>윤석재 ( Monitor양산팀 / 책임연구원 )<br>박영춘 ( Signage회로팀 / 주임연구원 )<br>이종수 ( Monitor양산팀 / 주임연구원 )<br>남유조 ( IT모듈구매팀 / 사원 )<br>박경열 ( Monitor양산팀 / 책임연구원 )<br>이동규 ( IT모듈구매팀 / 사원 )<br>이재민 ( Monitor회로팀 / 수석연구원 )<br>송종인 ( IT R&D기획팀 / 연구원 )<br>조대근 ( IT품질관리반 / 사원 )<br>최승원 ( IT모듈구매팀 / 대리 )<br>이충곤 ( Monitor기구팀 / 주임연구원 )<br>황동선 ( LGEND IT Development VP.S/W Team / 수석연구원 )<br>김종태 ( IT Development VP / 수석연구원 )<br>배권일 ( Monitor양산팀 / 수석연구원 )<br>이문희 ( LGEND IT Development VP.IT Mechanic Team / 책임연구원 )<br>김명욱 ( Monitor회로팀 / 수석연구원 )<br>배덕호 ( Monitor기구팀 / 책임연구원 )<br>한태수 ( TV부품품질보증계 / 기장 )<br>hui kang ( LGEND IT Development VP.Component Development Team.Module De / manager b )<br>xiangtai jin ( LGEND IT Development VP.Component Development Team.Module De / officer 1 )<br>xing jin ( LGEND IT Development VP.Component Development Team.Module De / officer 1 ) |
| EDMS Doc Link | |
| Attached Local Files | LM185WF2-TLD1 Safety document.zip<br>[LGE Approval] CAS LM185WF2-TLD1.pdf<br>[LGE Approval] IIS LM185WF2-TLD1.pdf<br>LM185WF2-TLD1 Key part & module comparison sheet.egg<br>LM185WF2-TLD1 TCO05 document.pdf<br>LM185WH2-TLD1.zip<br>LM185WF2-TLD1 LGD Test report.egg |

# SPECIFICATION FOR APPROVAL

( ) Preliminary Specification
(◆) Final Specification

| Title | 18.5" HD TFT LCD |
|---|---|

| BUYER | LGE |
|---|---|
| MODEL | |

| SUPPLIER | LG Display Co., Ltd. |
|---|---|
| *MODEL | LM185WH2 |
| SUFFIX | TLD1 |

*When you obtain standard approval,
please use the above model name without suffix

| SIGNATURE | DATE |
|---|---|
| / | |
| / | |
| / | |

Please return 1 copy for your confirmation
With your signature and comments.

| APPROVED BY | DATE |
|---|---|
| B.C. Kim / G.Manager | |
| **REVIEWED BY** | |
| J.H. Kim / Manager [C] | |
| Y.H. HWANG / Manager [M] | |
| M.S. Kang / Manager [P] | |
| S.H. Han / Manager [O] | |
| **PREPARED BY** | |
| S.H. Han / Engineer | |

**IT/Mobile Development Division 1.**
**LG Display Co., Ltd**

# Contents

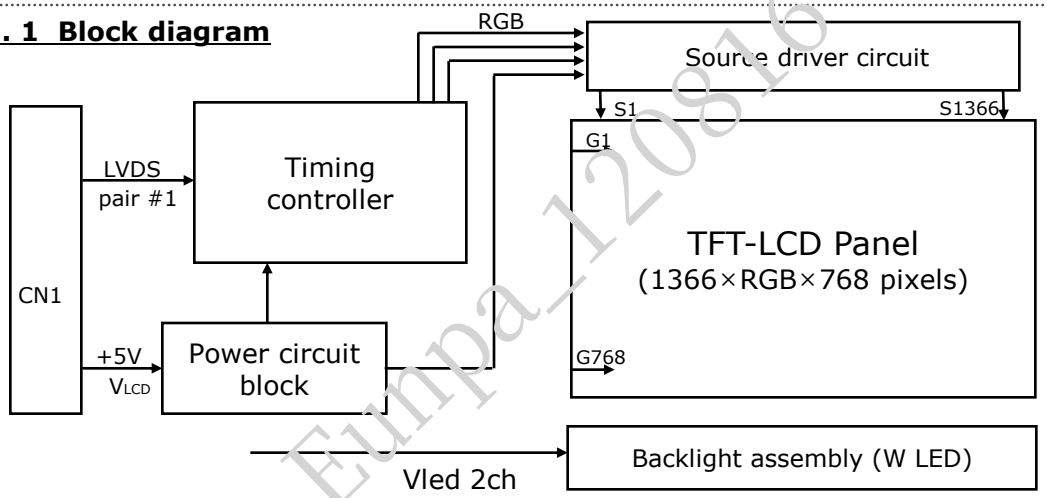
# Record of revisions

| Revision No | Date | Page | Description |
|---|---|---|---|
| Ver 0.0 | Feb.13.2012 | - | Preliminary Specifications |
| Ver0.1 | Mar.23.2012 | 4, 7 | Change the LED Array Electrical characteristics |
| | | 4, 23 | Updated LCM's Weight ( 1350g(typ), 1420g(max)) |
| | | 10 | Added LED Mating CNT(SHJP-06-A-K (HF) |
| | | 19 | Updated Optical Characteristics (Color Coordinates: R,G,B) |
| | | 22 | Delete Notes of TCO5.0 Luminance uniformity |
| | | 29 | Updated Packing information. |
| Ver1.0 | June.01.2012 | | Final Specifications |
| | | 28 | Update safety on International standards |
| | | 30 | Change the Operating precautions<br>→ 3: (In Higher temperature, it becomes lower.) |
| | | 25,26 | Update LCM's drawing |

# 1. General description

LM185WH2-TLD1 is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode(LED) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. It has a 18.5 inch diagonally measured active display area with HD resolution (768 vertical by 1366 horizontal pixel array) Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot, thus, presenting a palette of more than 16,7M colors with Advanced-FRC(Frame Rate Control). It has been designed to apply the interface method that enables low power, high speed, low EMI. FPD Link or compatible must be used as a LVDS(Low Voltage Differential Signaling) chip. It is intended to support applications where thin thickness, wide viewing angle, low power are critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LM185WH2-TLD1 characteristics provide an excellent flat panel display for office automation products such as monitors.

**FIG. 1 Block diagram**






## General features

| | |
|---|---|
| Active screen size | 18.51 inches (470.1mm) diagonal |
| Outline Dimension | 430.4(H) x 254.6(V) x 10.2(D) mm(Typ.) |
| Pixel Pitch | 0.10*RGB(H)mm x 0.30(V)mm |
| Pixel Format | 1366 horizontal By 768 vertical Pixels. RGB stripe arrangement |
| Interface | LVDS 1Port |
| Color depth | 16.7M colors |
| Luminance, white | 200 cd/m$^2$ ( Center 1Point, typ) |
| Viewing Angle (CR>10) | R/L 90(Typ.), U/D 50(Typ.) |
| Power Consumption | Total 10.4W(Typ.), (3.60 W@$V_{LCD}$ , 6.8W@Is = 100mA) |
| Weight | 1350g(Typ) |
| Display operating mode | Transmissive mode, Normally White |
| Surface treatments | Hard coating (3H), Anti-glare treatment of the front polarizer |

## 2. Absolute maximum ratings

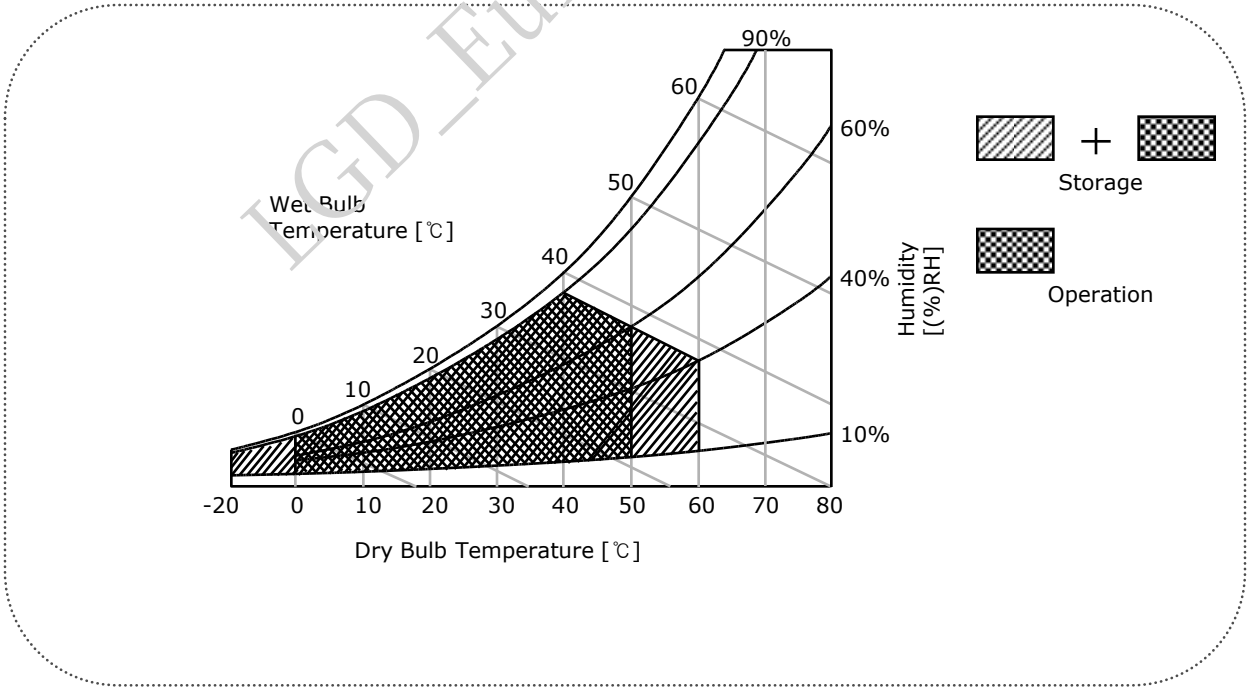
The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

**Table 1. Absolute maximum ratings**

| Parameter | Symbol | Values | | Units | Notes |
|---|---|---|---|---|---|
| | | Min | Max | | |
| Power Supply Input Voltage | $V_{LCD}$ | -0.3 | +6.0 | Vdc | At 25℃ |
| Operating Temperature | $T_{OP}$ | 0 | 50 | ˚C | 1,2,3 |
| Storage Temperature | $T_{ST}$ | -20 | 60 | ˚C | |
| Operating Ambient Humidity | $H_{OP}$ | 10 | 90 | %RH | |
| LCM Surface Temperature (Operation) | $T_{Surface}$ | 0 | 65 | ℃ | 1,4 |

Note : 1. Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39 ˚C Max, and no condensation of water.
2. Maximum Storage Humidity is up to 40℃, 90% RH only for 4 corner light leakage Mura.
3. Storage condition is guaranteed under packing condition.
4. LCM Surface Temperature should be Min. 0℃ and Max. 65℃ under the VLCD=5.0V, fV=60Hz, 25℃ ambient Temperature no humidity control and LED string current is typical value.

**FIG. 2 Temperature and relative humidity**



# 3. Electrical specifications

## 3-1. Electrical characteristics

It requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input power for the LED/Backlight, is typically generated by a LED Driver. The LED Driver is an external unit to the LCDs.

**Table 2. Electrical characteristics**

| Parameter | Symbol | Values | | | Unit | Notes |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| MODULE : | | | | | | |
| Power Supply Input Voltage | $V_{LCD}$ | 4.5 | 5.0 | 5.5 | Vdc | |
| Permissive Power Input Ripple | $V_{LCD}$ | - | - | 0.3 | V | 3 |
| Power Supply Input Current | $I_{LCD-MOSAIC}$ | - | 720 | 940 | mA | 1 |
| | $I_{LCD-BLACK}$ | - | 900 | 1170 | mA | 2 |
| Power Consumption | $P_{LCD}$ | - | 3.60 | 4.70 | Watt | 1 |
| Inrush current | $I_{RUSH}$ | - | - | 3.0 | A | 4 |

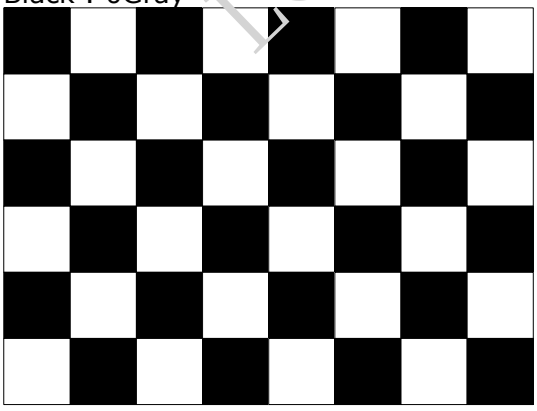
Note :

1. The specified current and power consumption are under the $V_{LCD}$=5.0V, 25 ± 2°C,$f_V$=60Hz condition whereas mosaic pattern(8 x 6) is displayed and $f_V$ is the frame frequency.
2. The current is specified at the maximum current pattern.
3. Permissive power ripple should be measured under VCC=5.0V, 25°C, $f_V$ (frame frequency)=75Hz condition and At that time, we recommend the bandwidth configuration of oscilloscope is to be under 20MHz.
4. The duration of rush current is about 5ms and rising time of power Input is 500us ± 20%.

**FIG.3 pattern for Electrical characteristics**

power consumption measurement

White : 255Gray
Black : 0Gray



Mosaic Pattern(8 x 6)

power input ripple

Full Black Pattern

**Table 3. LED array ELECTRICAL CHARACTERISTICS**

| Parameter | Symbol | Condition | Values | | | Unit | Notes |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| LED String Current | Is | | - | 100 | 115 | mA | 1,2,5 |
| LED String Voltage | Vs | | 31.9 | 34.1 | 36.3 | V | 1,5 |
| Power Consumption | PBar | | - | 6.8 | 7.3 | Watt | 1,2,4 |
| LED Life Time | LED_LT | | 30,000 | - | - | Hrs | 3 |

Notes) The LED Bar consists of 22LED packages, 2 strings (parallel) x 11 packages (serial)

LED driver design guide

: The design of the LED driver must have specifications for the LED in LCD Assembly.
The performance of the LED in LCM, for example life time or brightness, is extremely influenced by the characteristics of the LED driver.
So all the parameters of an LED driver should be carefully designed and output current should be Constant current control.
Please control feedback current of each string individually to compensate the current variation among the strings of LEDs.
When you design or order the LED driver, please make sure unwanted lighting caused by the mismatch of the LED and the LED driver (no lighting, flicker, etc) never occurs.
When you confirm it, the LCD module should be operated in the same condition as installed in your instrument.

1. Specified values are for a single LED bar.
2. The specified current is defined as the input current for a single LED string with 100% duty cycle.
3. The LED life time is defined as the time when brightness of LED packages become 50% or less than the initial value under the conditions at Ta = 25±2°C and LED string current is typical value.
4. The power consumption shown above does not include loss of external driver.
   The typical power consumption is calculated as $P_{Bar}$ = Vs(Typ.) x Is(Typ.) x No. of strings.
   The maximum power consumption is calculated as $P_{Bar}$ = Vs(Max.) x Is(Typ.) x No. of strings.
5. LED operating conditions are must not exceed Max. ratings.

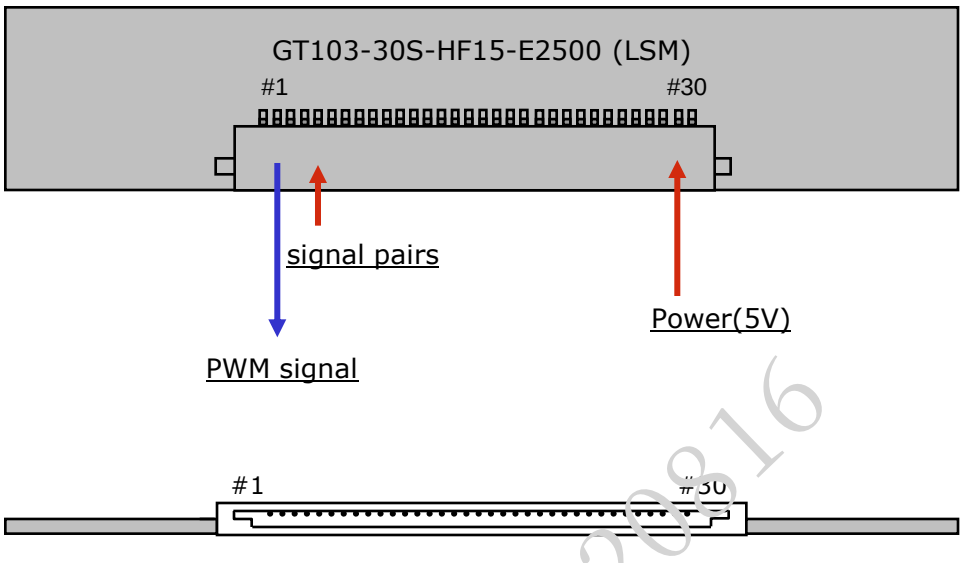
## 3-2. Interface connections

LCD Connector(CN1): GT103-30S-HF15-E2500(LSM) or IS100-L30O-C23 (UJU)
Mating connector : FI-X30H and FI-X30HL (JAE) or Equivalent

**Table 4. Module connector(CN1) pin configuration**

| Pin No | Symbol | Description |
|---|---|---|
| 1 | NC | No Connection (For LCD internal use only.) |
| 2 | PWM_OUT | Reference signal for inverter control |
| 3 | NC | No Connection (For LCD internal use only.) |
| 4 | GND | Ground |
| 5 | RX0- | Minus signal of channel 0 (LVDS) |
| 6 | RX0+ | Plus signal of channel 0 (LVDS) |
| 7 | GND | Ground |
| 8 | RX1- | Minus signal of channel 1 (LVDS) |
| 9 | RX1+ | Plus signal of channel 1 (LVDS) |
| 10 | GND | Ground |
| 11 | RX2- | Minus signal of channel 2 (LVDS) |
| 12 | RX2+ | Plus signal of channel 2 (LVDS) |
| 13 | GND | Ground |
| 14 | RXCLK- | Minus signal of clock channel (LVDS) |
| 15 | RXCLK+ | Plus signal of clock channel (LVDS) |
| 16 | GND | Ground |
| 17 | RX3- | Minus signal of channel 3 (LVDS) |
| 18 | RX3+ | Plus signal of channel 3 (LVDS) |
| 19 | GND | Ground |
| 20 | NC | No Connection (For LCD internal use only.) |
| 21 | NC | No Connection (For LCD internal use only.) |
| 22 | NC | No Connection (For LCD internal use only.) |
| 23 | GND | Ground |
| 24 | GND | Ground |
| 25 | GND | Ground |
| 26 | $V_{LCD}$ | Power Supply (5.0V) |
| 27 | $V_{LCD}$ | Power Supply (5.0V) |
| 28 | $V_{LCD}$ | Power Supply (5.0V) |
| 29 | $V_{LCD}$ | Power Supply (5.0V) |
| 30 | $V_{LCD}$ | Power Supply (5.0V) |

## FIG. 4 Connector diagram




**Rear view of LCM**



Note:

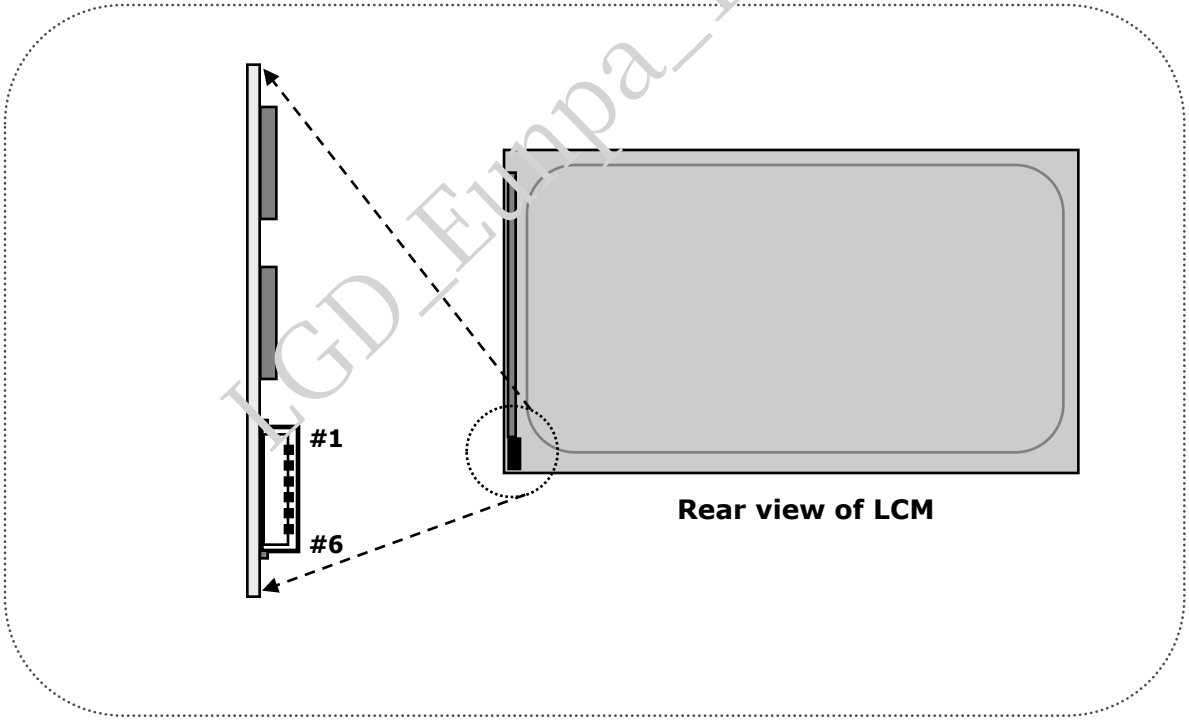
1. NC: No Connection.
2. All GND(ground) pins should be connected together and to Vss which should also be connected to the LCD's metal frame.
3. All $V_{LCD}$ (power input) pins should be connected together.
4. Input Level of LVDS signal is based on the IEA 664 Standard.
5. PWM_OUT is a reference signal for inverter control.
   This PWM signal is synchronized with vertical frequency.
   Its frequency is 3 times of vertical frequency, and its duty ratio is 50%.
   If the system don't use this pin, do not connect.

**Table 5. BACKLIGHT CONNECTOR PIN CONFIGURATION**

The LED interface connector is a model SM06B-SHJH(HF), Wire locking Type manufactured by JST.
The mating connector is a SHJP-06V-S(HF) or or SHJP-06V-A-K(HF) and Equivalent.
The pin configuration for the connector is shown in the table below.

| Pin | Symbol | Description | Notes |
|---|---|---|---|
| 1 | FB1 | Channel1 Current Feedback | |
| 2 | NC | No connection | |
| 3 | VLED | LED Power Supply | |
| 4 | VLED | LED Power Supply | |
| 5 | NC | No connection | |
| 6 | FB2 | Channel2 Current Feedback | |

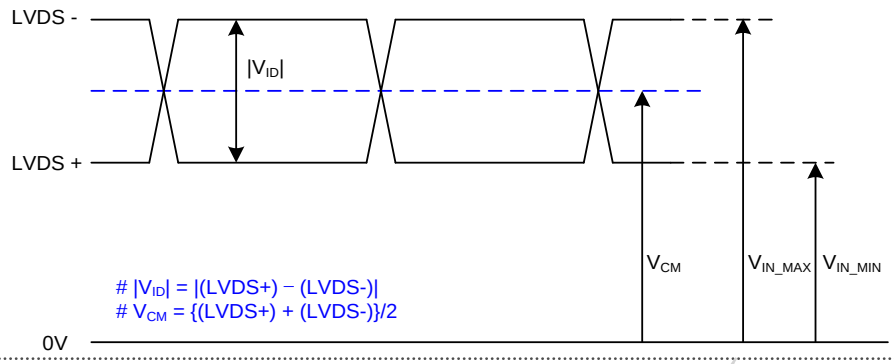





**[ Figure 5 ] Backlight connector view**

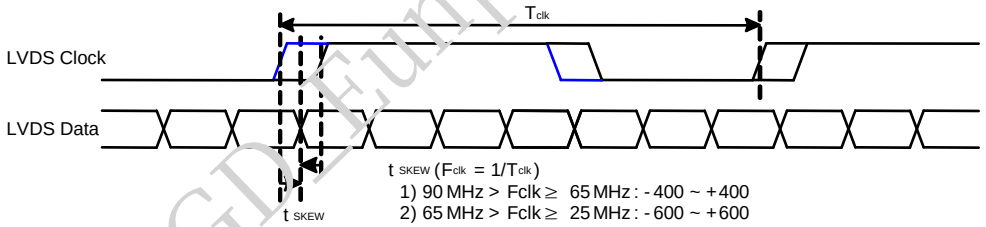
## 3-3. LVDS characteristics

### 3-3-1. DC Specification

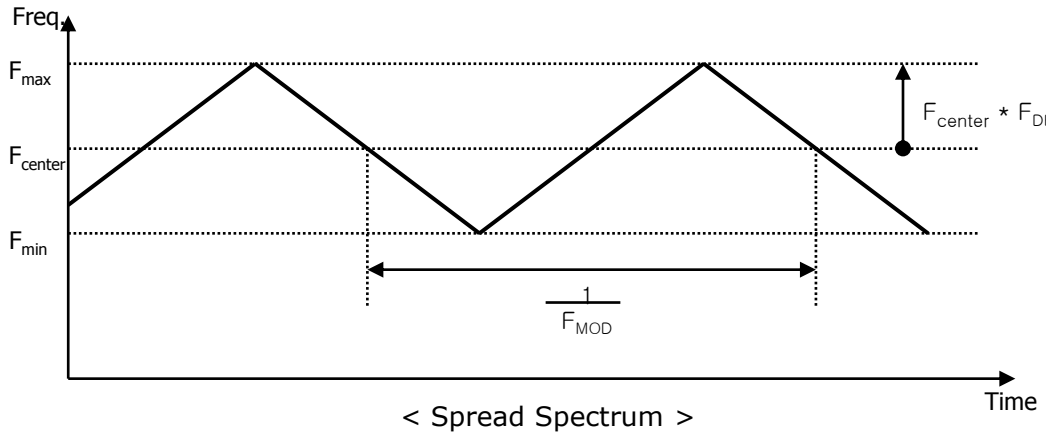



| Description | Symbol | Min | Max | Unit | Notes |
|---|---|---|---|---|---|
| LVDS Differential Voltage | $\|V_{ID}\|$ | 200 | 600 | mV | - |
| LVDS Common mode Voltage | $V_{CM}$ | 0.6 | 1.8 | V | - |
| LVDS Input Voltage Range | $V_{IN}$ | 0.3 | 2.1 | V | - |

### 3-3-2. AC Specification

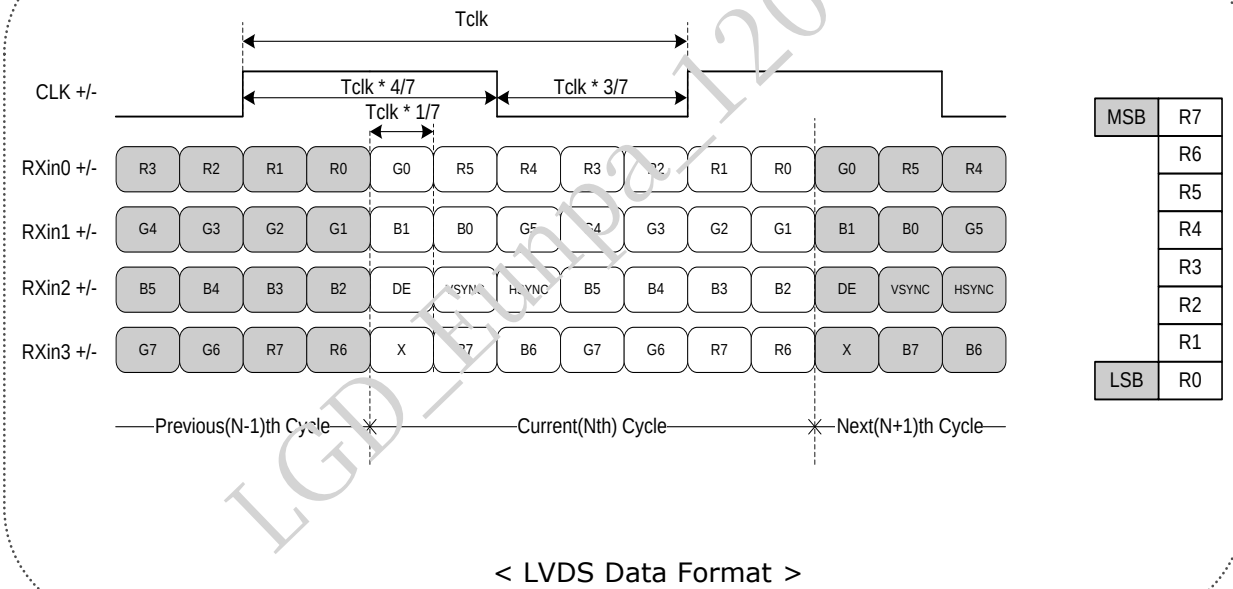



| Description | Symbol | Min | Max | Unit | Notes |
|---|---|---|---|---|---|
| LVDS Clock to Data Skew Margin | $t_{SKEW}$ | - 400 | + 400 | ps | 90MHz > Fclk ≥ 65MHz |
| | $t_{SKEW}$ | - 600 | + 600 | ps | 65MHz > Fclk ≥ 25MHz |
| Maximum deviation of input clock frequency during SSC | $F_{DEV}$ | - | ± 3 | % | - |
| Maximum modulation frequency of input clock during SSC | $F_{MOD}$ | - | 200 | KHz | - |




< Spread Spectrum >

## 3-3-3. LVDS Data format




< LVDS Data Format >

**Table 6. Required signal assignment for Flat Link(NS:DS90CF383) transmitter**

| Pin # | Pin Name | Require Signal | Pin # | Pin Name | Require Signal |
|---|---|---|---|---|---|
| 1 | VCC | Power Supply for TTL Input | 29 | GND | Ground pin for TTL |
| 2 | D5 | TTL Input (R7) | 30 | D26 | TTL Input (DE) |
| 3 | D6 | TTL Input (R5) | 31 | $T_X$ CLKIN | TTL Level clock Input |
| 4 | D7 | TTL Input (G0) | 32 | PWR DWN | Power Down Input |
| 5 | GND | Ground pin for TTL | 33 | PLL GND | Ground pin for PLL |
| 6 | D8 | TTL Input (G1) | 34 | PLL VCC | Power Supply for PLL |
| 7 | D9 | TTL Input (G2) | 35 | PLL GND | Ground pin for PLL |
| 8 | D10 | TTL Input (G6) | 36 | LVDS GND | Ground pin for LVDS |
| 9 | VCC | Power Supply for TTL Input | 37 | TxOUT3+ | Positive LVDS differential data output 3 |
| 10 | D11 | TTL Input (G7) | 38 | TxOUT3− | Negative LVDS differential data output 3 |
| 11 | D12 | TTL Input (G3) | 39 | $T_X$ CLKOUT+ | Positive LVDS differential clock output |
| 12 | D13 | TTL Input (G4) | 40 | $T_X$ CLKOUT− | Negative LVDS differential clock output |
| 13 | GND | Ground pin for TTL | 41 | $T_X$ OUT2+ | Positive LVDS differential data output 2 |
| 14 | D14 | TTL Input (G5) | 42 | $T_X$ OUT2− | Negative LVDS differential data output 2 |
| 15 | D15 | TTL Input (B0) | 43 | LVDS GND | Ground pin for LVDS |
| 16 | D16 | TTL Input (B6) | 44 | LVDS VCC | Power Supply for LVDS |
| 17 | VCC | Power Supply for TTL Input | 45 | $T_X$ OUT1+ | Positive LVDS differential data output 1 |
| 18 | D17 | TTL Input (B7) | 46 | $T_X$ OUT1− | Negative LVDS differential data output 1 |
| 19 | D18 | TTL Input (B1) | 47 | $T_X$ OUT0+ | Positive LVDS differential data output 0 |
| 20 | D19 | TTL Input (B2) | 48 | $T_X$ OUT0− | Negative LVDS differential data output 0 |
| 21 | GND | Ground pin for TTL Input | 49 | LVDS GND | Ground pin for LVDS |
| 22 | D20 | TTL Input (B3) | 50 | D27 | TTL Input (R6) |
| 23 | D21 | TTL Input (B4) | 51 | D0 | TTL Input (R0) |
| 24 | D22 | TTL Input (B5) | 52 | D1 | TTL Input (R1) |
| 25 | D23 | TTL Input (RSVD) | 53 | GND | Ground pin for TTL |
| 26 | VCC | Power Supply for TTL Input | 54 | D2 | TTL Input (R2) |
| 27 | D24 | TTL Input (HSYNC) | 55 | D3 | TTL Input (R3) |
| 28 | D25 | TTL Input (VSYNC) | 56 | D4 | TTL Input (R4) |

Notes : Refer to LVDS Transmitter Data Sheet for detail descriptions.

## 3-4. Signal timing specifications

This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

**Table 7. Timing table**

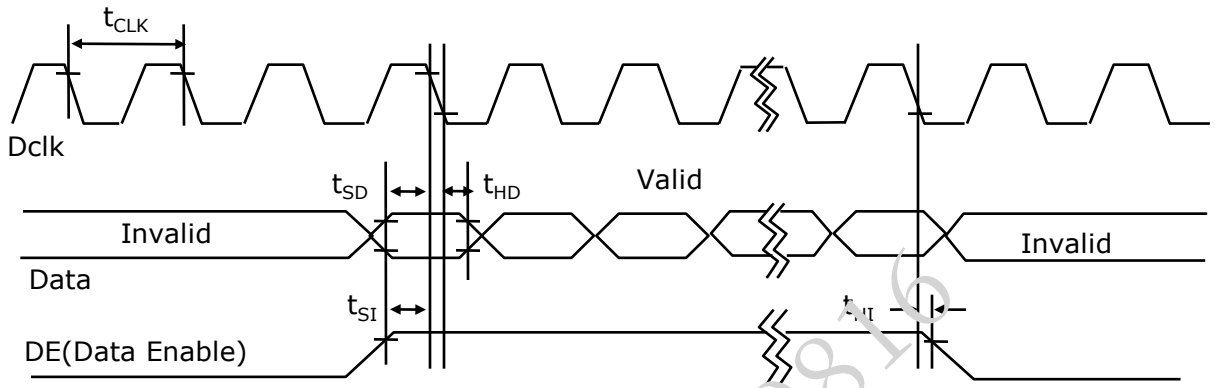
| Parameter | | Symbol | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|---|---|
| $D_{CLK}$ | Period | $t_{CLK}$ | 11.1 | 13.0 | 16.2 | ns | |
| | Frequency | $f_{CLK}$ | 61.6 | 77.0 | 90.0 | MHz | |
| Horizontal | Horizontal Valid | $t_{HV}$ | 1366 | 1366 | 1366 | $t_{CLK}$ | |
| | H Period Total | $t_{HP}$ | 1430 | 1608 | 2044 | | |
| | Hsync Frequency | $f_H$ | 38.3 | 47.9 | 62.0 | kHz | |
| Vertical | Vertical Valid | $t_{VV}$ | 768 | 768 | 768 | $t_{HP}$ | |
| | V Period Total | $t_{VP}$ | 776 | 798 | 1108 | | |
| | Vsync Frequency | $f_V$ | 48 | 60 | 76 | Hz | |
| DE (Data Enable) | DE Setup Time | $t_{SI}$ | 4 | - | - | ns | For $D_{CLK}$ |
| | DE Hold Time | $t_{HI}$ | 4 | - | - | | |
| Data | Data Setup Time | $t_{SD}$ | 4 | - | - | ns | For $D_{CLK}$ |
| | Data Hold Time | $t_{HD}$ | 4 | - | - | | |



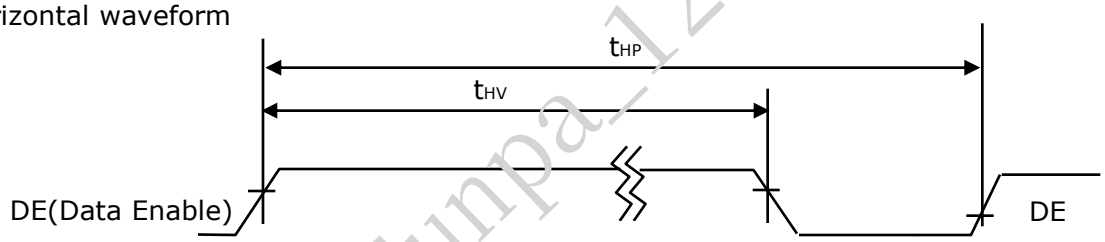
Note:
1. LM185WH2-TLD1 is DE Only mode operation. The input of Hsync & Vsync signal does not have an effect on LCD normal operation.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.
3. Horizontal period should be even.

## 3-5. Signal timing waveforms

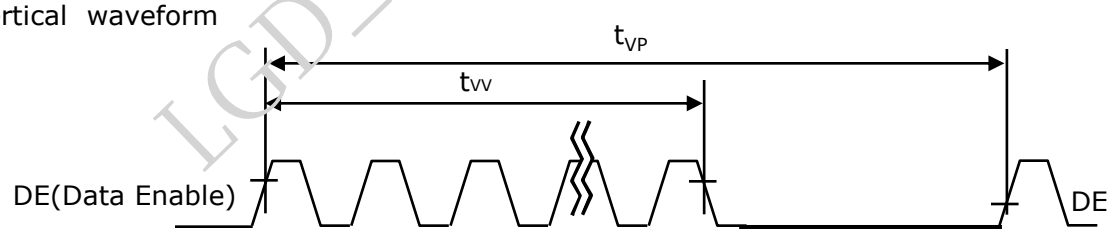
1. DCLK , DE, DATA waveforms




2. Horizontal waveform




3. Vertical waveform



## 3-6. Color input data reference

The brightness of each primary color (red,green and blue) is based on the 8bit gray scale data input for the color ; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

**Table 8. Color data reference**

| Color | | Input Color Data | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Red | | | | | | | | Green | | | | | | | | Blue | | | | | | | |
| | | MSB | | | | | | | LSB | MSB | | | | | | | LSB | MSB | | | | | | | LSB |
| | | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Color | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (255) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue (255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 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 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Red | Red(000) Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(002) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | - - - - - - - - - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | - - - - - - - - - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Red(253) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(254) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(255) Bright | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green | Green(000) Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(002) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | - - - - - - - - - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | - - - - - - - - - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Green(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(255)Bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue | Blue(000) Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue(002) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | - - - - - - - - - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | - - - - - - - - - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Blue(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(255) Bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

## 3-7. Power sequence

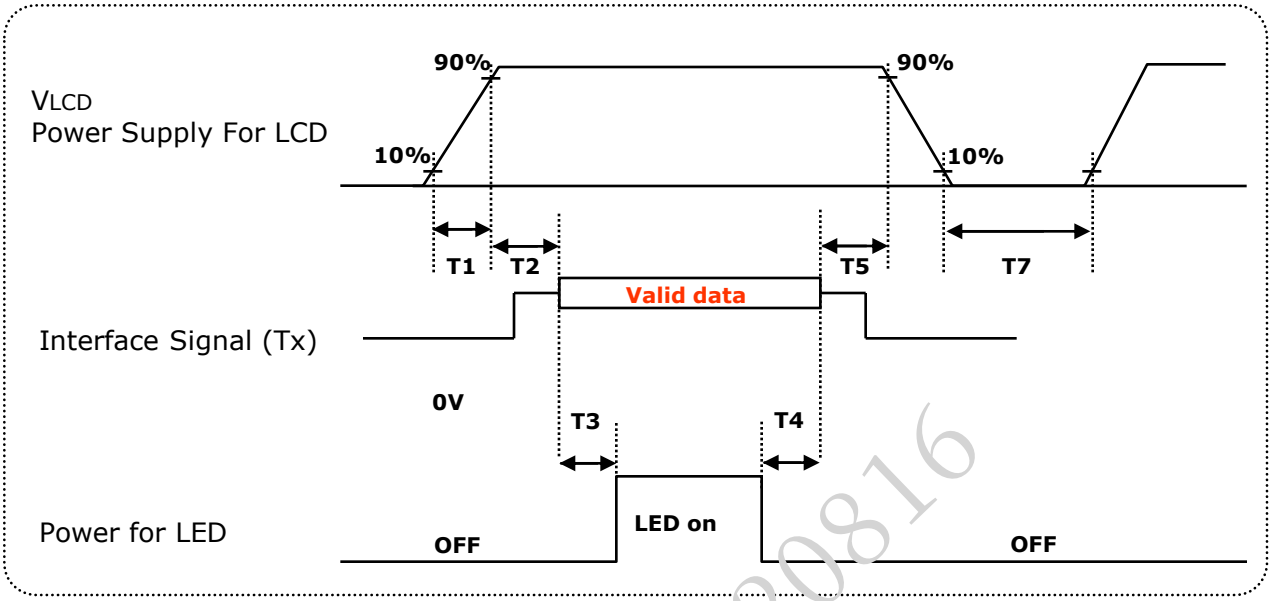



**Table 9. Power sequence**

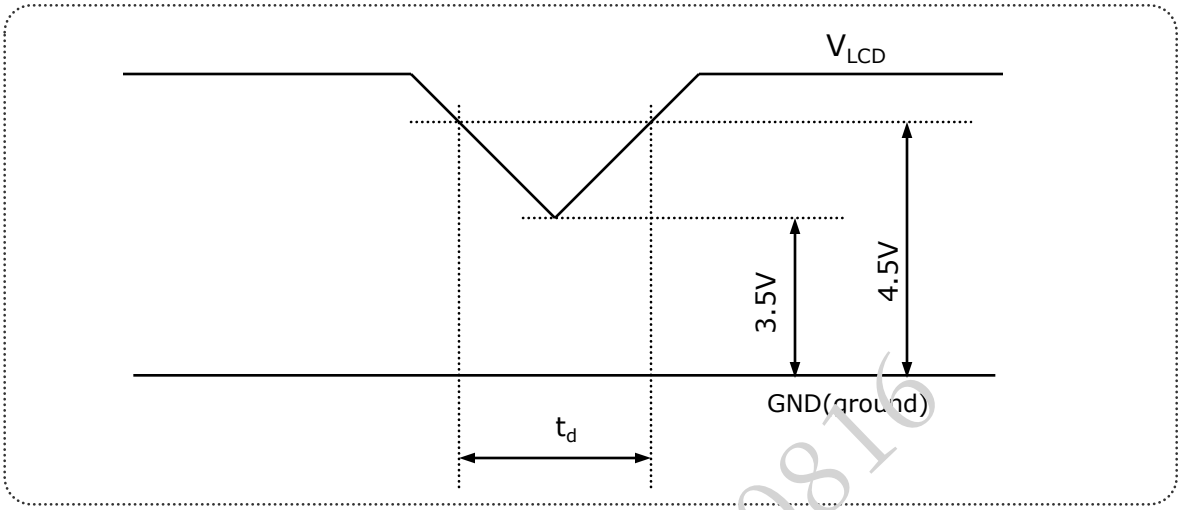
| Parameter | Values | | | Units |
|---|---|---|---|---|
| | Min | Typ | Max | |
| T1 | 0.5 | - | 10 | ms |
| T2 | 0.01 | - | 50 | ms |
| T3 | 500 | - | - | ms |
| T4 | 200 | - | - | ms |
| T5 | 0.01 | - | 50 | ms |
| T7 | 1 | - | - | s |

Notes :

1. Please avoid floating state of interface signal at invalid period.
2. When the interface signal is invalid, be sure to pull down the power supply for LCD $V_{LCD}$ to 0V.
3. LED power must be turn on after power supply for LCD an interface signal are valid.

## 3-8. $V_{LCD}$ Power dip condition

**FIG. 6 Power dip condition**




1) Dip condition

$3.5V \leq V_{LCD} < 4.5V$ , $t_d \leq 20ms$

2) $V_{LCD} < 3.5V$

$V_{LCD}$-dip conditions should also follow the Power On/Off conditions for supply voltage.

## 4. Optical specification

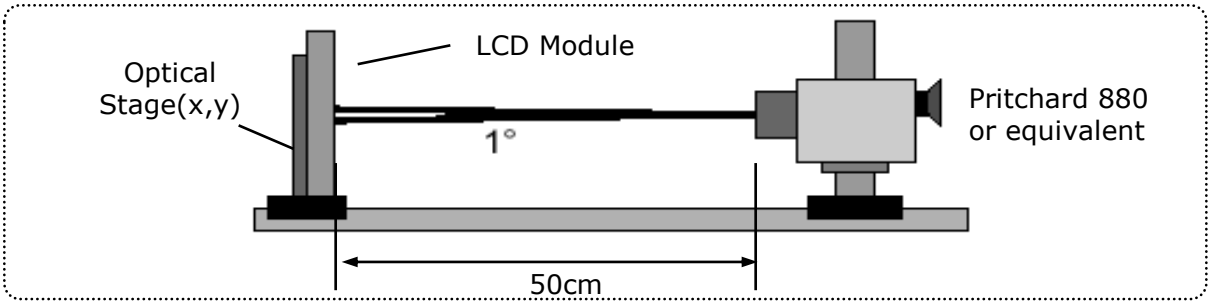
Optical characteristics are determined after the unit has been 'ON' for 30 minutes in a dark environment at 25°C.

**Table 10. Optical characteristics** Ta= 25°C, $V_{LCD}$=5.0V, fv=60Hz $f_{CLK}$= 77.0MHz, Is=100mA

| Parameter | | Symbol | Values | | | Units | Notes |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Contrast Ratio | | CR | 400 | 600 | - | | 1 (PR-880) |
| Surface Luminance, white | | $L_{WH}$ | 160 | 200 | - | cd/m² | 2 (PR-880) |
| Luminance Variation | | $\delta_{WHITE}$ 9P | | | 1.5 | | 3 (PR-880) |
| Response Time | Rise Time | $Tr_R$ | - | 1.1 | 2.6 | ms | 4 (RD80S) |
| | Decay Time | $Tr_D$ | - | 3.9 | 7.4 | ms | |
| Color Coordinates [CIE1931] | RED | Rx | Typ -0.03 | 0.646 | Typ +0.03 | | (PR-650) |
| | | Ry | | 0.333 | | | |
| | GREEN | Gx | | 0.318 | | | |
| | | Gy | | 0.626 | | | |
| | BLUE | Bx | | 0.152 | | | |
| | | By | | 0.063 | | | |
| | WHITE | Wx | | 0.313 | | | |
| | | Wy | | 0.329 | | | |
| Viewing Angle (CR>10) | | | | | | | 5 (PR-880) |
| | x axis, right(ϕ=0°) | θr | 40 | 45 | | Degree | |
| | x axis, left (ϕ=180°) | θl | 40 | 45 | | | |
| | y axis, up (ϕ=90°) | θu | 10 | 15 | | | |
| | y axis, down (ϕ=270°) | θd | 30 | 35 | | | |
| Crosstalk | | | | | 1.5 | % | (PR880) |

The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 °.
FIG. 7 presents additional information concerning the measurement equipment and method.

**FIG. 7 Optical characteristic measurement equipment and method**




Notes :

1. Contrast ratio(CR) is defined mathematically as :It is measured at center point(1)

$$\text{Contrast ratio} = \frac{\text{Surface luminance with all white pixels}}{\text{Surface luminance with all black pixels}}$$

2. Surface luminance is the luminance value at center 1 point(1) across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 8.

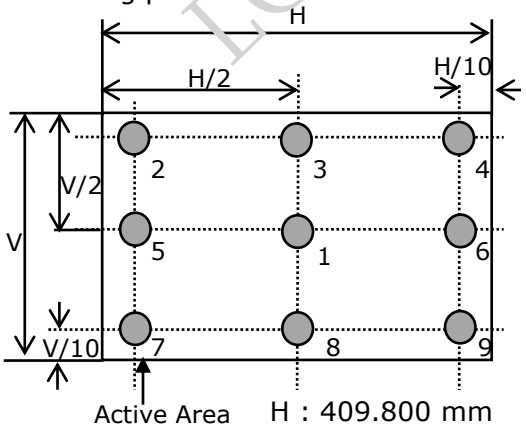
3. The variation in surface luminance , $\delta_{WHITE}$ is defined as

$$\delta_{WHITE} = \frac{\text{Maximum (P1,P2 .....P9)}}{\text{Minimum (P1,P2 .....P9)}}$$

For more information see Figure 8.

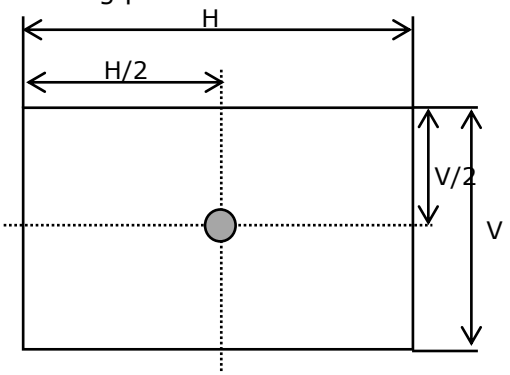
**FIG. 8 Luminance measuring point**

<Measuring point for luminance variation>




H : 409.800 mm
V : 230.400 mm
@ H,V : Active Area

<Measuring point for surface luminance>

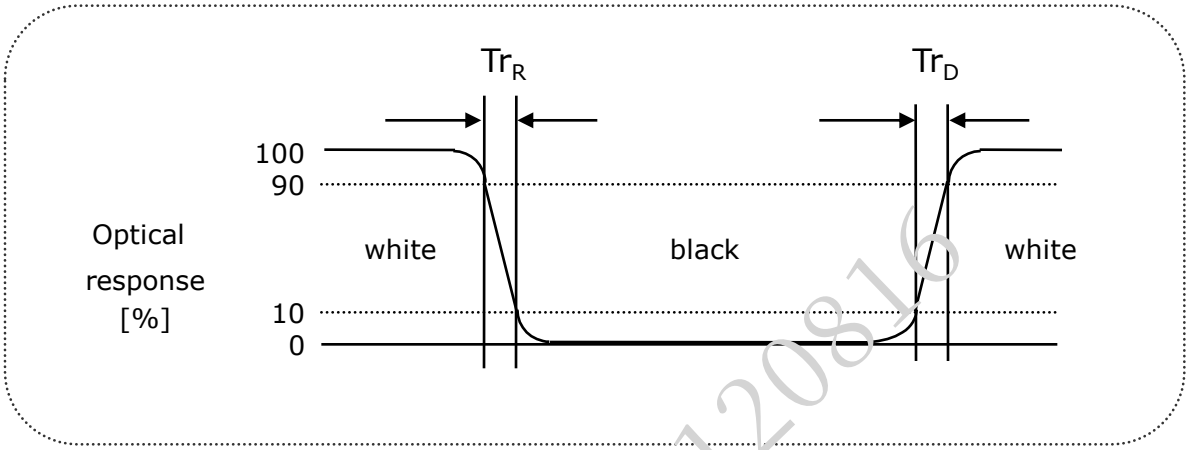


Notes :

4. Response time is the time required for the display to transition from black to white (Decay Time, $Tr_D$) and from white to black (Rise Time, $Tr_R$)
The sampling rate is 2,500 sample/sec. For additional information see FIG. 9.

The response time is defined as the following figure and shall be measured by switching the input signal for each gray to gray.

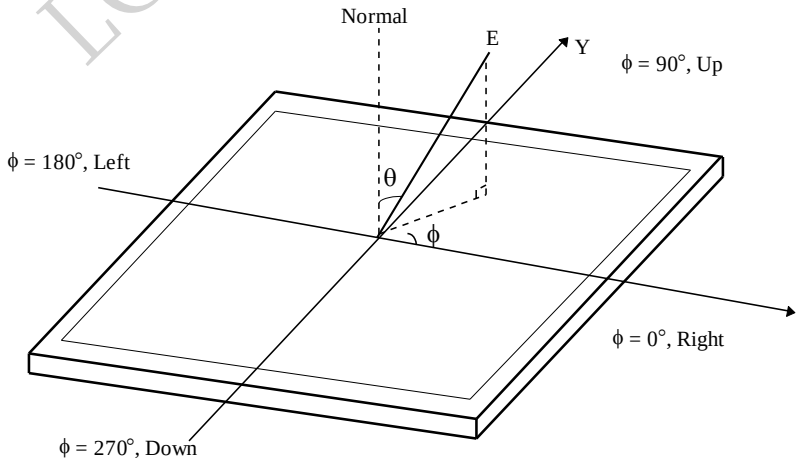
**FIG. 9 Response time**




5. Viewing angle is the angle at which the contrast ratio is greater than 10 or 5. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG. 10 .

**FIG. 10 Viewing angle**

<Dimension of viewing angle range>



Notes :

6. Gray scale specification

**Table 11. Gray scale**

| Gray level | Luminance [%] (Typ) |
|---|---|
| L0 | 0.10 |
| L31 | 0.97 |
| L63 | 4.43 |
| L95 | 11.06 |
| L127 | 21.13 |
| L159 | 34.88 |
| L191 | 54.53 |
| L223 | 77.00 |
| L255 | 100 |

7. Color grayscale linearity , Δu'v' is defined as

$$\sqrt{(u'_A - u'_B)^2 + (v'_A - v'_B)^2}$$

Where indices A and B are the two gray levels found to have the largest color differences between them.

i.e. get the largest Δu' and Δv' of each 6pairs of u' and v' and calculate Δu'v' .

-Test pattern :

100% full white pattern with a test pattern as shown FIG.12
Squares of 40mm by 40mm in size, filled with 255, 225, 195, 165, 135 and 105 grayscale steps should be arranged in the center of the screen.

-Test method :

First gray step :

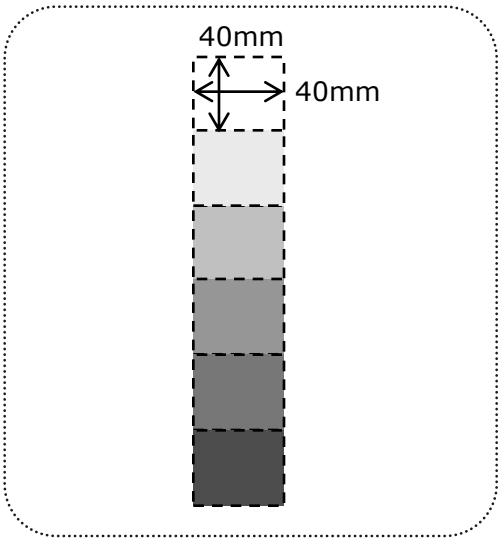
Move a square of 255 gray level should be moved into the center of the screen and measure luminance and u' and v' coordinates.

Next gray step :

Move a 255 gray square into the center and measure both luminance and u' and v' coordinates.
The same procedure shall then be repeated for gray steps 195, 165, 135 and 105.

Notes :

**FIG. 12 Color grayscale linearity**



## 5. Mechanical characteristics

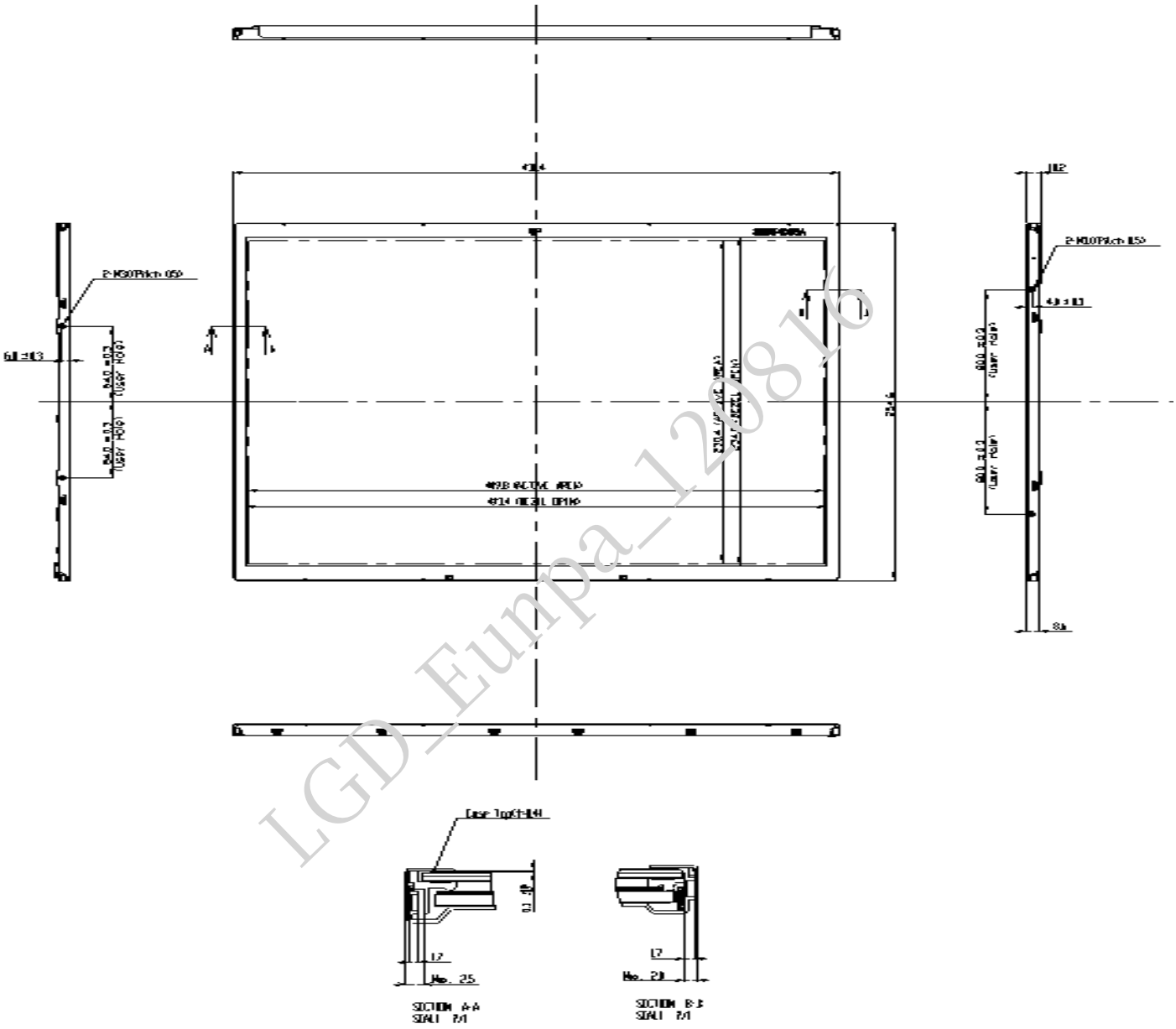
The contents provide general mechanical characteristics. In addition the figures in the next page are detailed mechanical drawing of the LCD.

**Table 12. Mechanical characteristics**

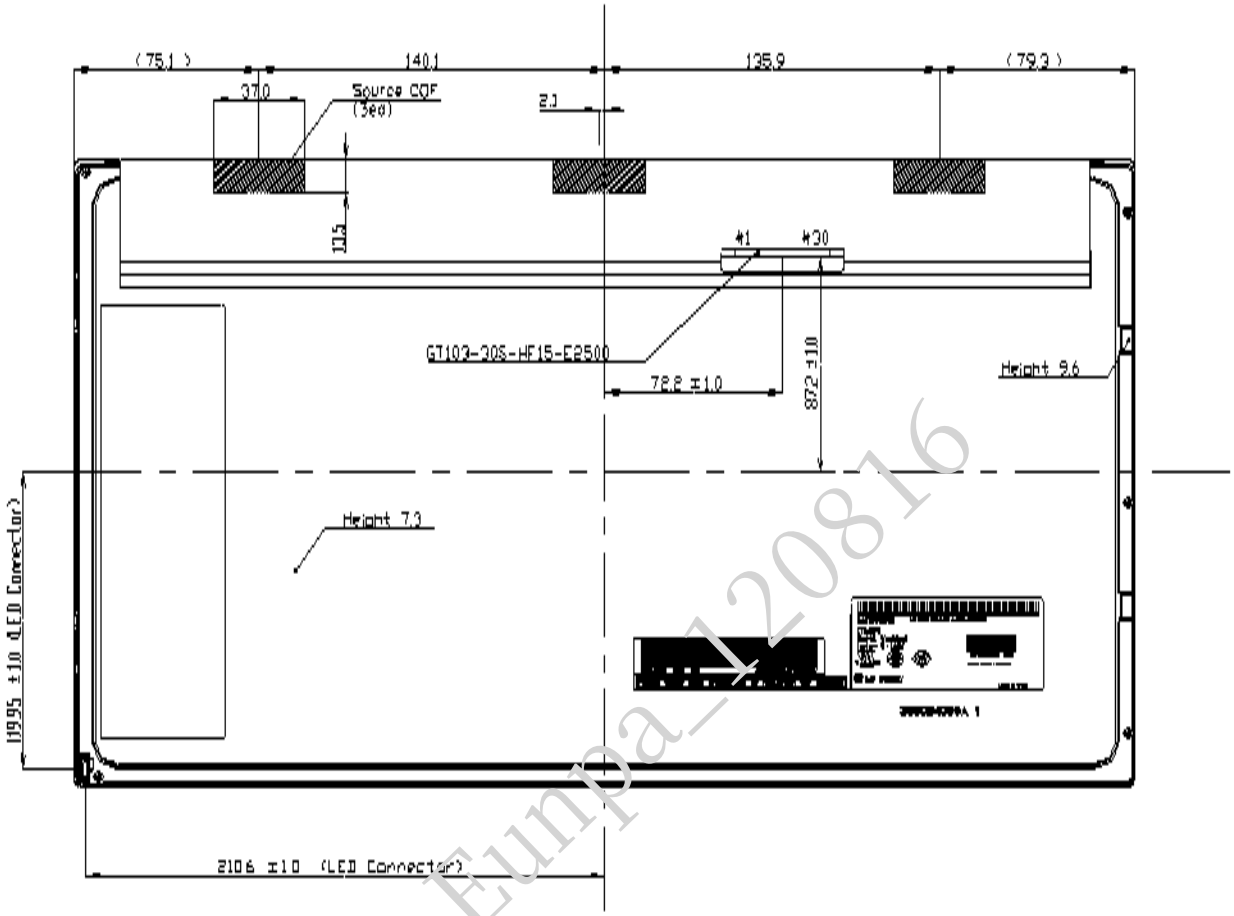
| | | |
|---|---|---|
| Outline dimension | Horizontal | 430.4 mm |
| | Vertical | 254.6 mm |
| | Depth | 10.20 mm |
| Bezel area | Horizontal | 413.4 mm |
| | Vertical | 234.0 mm |
| Active display area | Horizontal | 409.800 mm |
| | Vertical | 230.400 mm |
| Weight | 1350g(Typ), 1420g(Max) | |
| Surface treatment | Hard coating(3H)<br>Anti-glare treatment of the front polarizer | |

Notes : Please refer to a mechanic drawing in terms of tolerance at the next page.

## <FRONT VIEW>

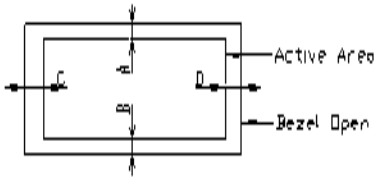


## <REAR VIEW>






Notes
1. I/F Connector Specification : GT103-30S-HF15-E2500(LSM)
2. LED Connector specification
   - JST, SM06B-SHJH(HF), 6PIN
3. Torque of user hole : 2.5~3.5 kgf-cm
4. Tilt and partial disposition tolerance of display area as following
   (1) Y-Direction : |A-B| ≤ 1.0
   (2) X-Direction : |C-D| ≤ 1.0




5. Unspecified tolerances to be ± 0.5mm
6. The COF area is weak & sensitive. So, please don't press the COF area.

## 6. Reliability

**Table 13. Environment test conditions**

| No | Test Item | Condition |
|---|---|---|
| 1 | High temperature storage test | Ta= 60°C 240hrs |
| 2 | Low temperature storage test | Ta= -20°C 240hrs |
| 3 | High temperature operation test | Ta= 50°C 50%RH 240hrs |
| 4 | Low temperature operation test | Ta= 0°C 240hrs |
| 5 | Vibration test<br>(non-operating) | Wave form : random<br>Vibration level : 1.0GRMS<br>Bandwidth : 10-300Hz<br>Duration : X,Y,Z, 30 min<br>One time each direction |
| 6 | Shock test<br>(non-operating) | Shock level : 120G<br>Waveform : half sine wave, 2msec<br>Direction : ±X, ±Y, ±Z<br>One time each direction |
| 7 | Altitude<br>operating<br>storage / shipment | <br>0 - 10,000 feet(3,048m)<br>0 - 40,000 feet(12,192m) |

{ Result evaluation criteria }
There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

# 7. International standards

## 7-1. Safety

a) UL 60950-1, Second Edition, Underwriters Laboratories Inc.
Information Technology Equipment - Safety - Part 1 : General Requirements.

b) CAN/CSA C22.2 No.60950-1-07, Second Edition, Canadian Standards Association.
Information Technology Equipment - Safety - Part 1 : General Requirements.

c) EN 60950-1:2006 + A11:2009, European Committee for Electrotechnical Standardization (CENELEC).
Information Technology Equipment - Safety - Part 1 : General Requirements.

d) IEC 60950-1:2005, Second Edition, The International Electrotechnical Commission (IEC).
Information Technology Equipment - Safety - Part 1 : General Requirements.
(Including report of IEC60825-1:2001 clause 8 and clause 9)

Notes
1. Laser (LED Backlight) Information

| Class 1M LED Product<br>IEC60825-1 : 2001<br>Embedded LED Power (Class1M) |
|---|

2. Caution
: LED inside.
Class 1M laser (LEDs) radiation when open.
Do not open while operating.



## 7-2. EMC

a) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHZ to 40GHz. "American National Standards Institute(ANSI),1992

b) C.I.S.P.R "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." International Special Committee on Radio Interference.

c) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electro-technical Standardization.(CENELEC), 1998 ( Including A1: 2000 )

# 8. Packing

## 8-1. Designation of lot mark

a) Lot mark

| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

A,B,C : Size (Inch)
E : Month
D : Year
F ~ M : Serial No.

Note:

1. Year

| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mark | A | B | C | D | E | F | G | H | J | K |

2. Month

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mark | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C |

b) Location of lot mark

Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.



## 8-2. Packing form

a) Package quantity in one box : 12 pcs
b) Box size : 350 mm X 300 mm X 470 mm

# 9. Precautions

Please pay attention to the followings when you use this TFT LCD module.

## 9-1. Mounting Precautions

(1) You must mount a module using holes arranged in four corners or four sides.
(2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the Module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
(3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.
(4) You should adopt radiation structure to satisfy the temperature specification.
(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
(6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth.
(Some cosmetics are detrimental to the polarizer.)
(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
(9) Do not open the case because inside circuits do not have sufficient strength.

## 9-2. Operating precautions

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage : V=±200mV(Over and under shoot voltage)
(2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
(3) Brightness depends on the temperature. (In higher temperature, it becomes lower.) And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
(4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
(6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.
(7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can not be operated its full characteristics perfectly.
(8) A screw which is fastened up the steels should be a machine screw (if not, it causes metal foreign material and deal LCM a fatal blow)
(9) Please do not set LCD on its edge.

## 9-3. Electrostatic discharge control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

## 9-4. Precautions for strong light exposure

Strong light exposure causes degradation of polarizer and color filter.

## 9-5. Storage

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
(2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.

## 9-6. Handling precautions for protection film

(1) The protection film is attached to the bezel with a small masking tape.
When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
(2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
(3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.