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PRODUCT SPECIFICATIONS

SHARP

AVC Liquid Crystal Displays Group

# LK520D1LH08

## TFT-LCD Module

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Spec. Issue Date: June 30, 2007

No: LD-20125-1

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# RECORDS OF REVISION

MODEL No. : LK520D1LH08

SPEC No. : LD-20125-1

| DATE | NO. | REVISED No. | PAGE | SUMMARY | NOTE |
|---|---|---|---|---|---|
| 2007.04.12 | LD-20125 | – | – | – | 1st Issu |
| 2007.09.28 | LD-20125-1 | A | P26 | Changed Timing characteristics | 2nd Issue |

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## 1. Application

This specification applies to the color 52.0" TFT-LCD module LK520D1LH08.

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## 2. Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver ICs, control circuit, power supply circuit, inverter circuit and back light system etc. Graphics and texts can be displayed on a 1920×RGB×1080 dots panel with one billion colors by using LVDS (Low Voltage Differential Signaling) to interface, +12V of DC supply voltages.

This module not includes the DC/AC inverter to dri ve the CCFT.

And in order to improve the response time of LCD, this module applies the Over Shoot driving (O/S driving) technology for the control circuit .In the O/S driving technology, signals are being applied to the Liquid Crystal according to a pre-fixed process as an image signal of the present frame when a difference is found between image signal of the previous frame and that of the current frame after comparing them.

With this technology, image signals can be set so that liquid crystal response completes within one frame. As a result, motion blur reduces and clearer display performance can be realized.

## 3. Mechanical Specifications

| Parameter | Specifications | Unit |
|---|---|---|
| Display size | 132.174 (Diagonal) | cm |
| | 52.0 (Diagonal) | inch |
| Active area | 1152.0(H) x 648.0 (V) | mm |
| Pixel Format | 1920(H) x 1080(V)<br>(1pixel = R + G + B dot) | pixel |
| Pixel pitch | 0.600(H) x 0.600 (V) | mm |
| Pixel configuration | R, G, B vertical stripe | |
| Display mode | Normally black | |
| Unit Outline Dimensions (*1) | 1219.0(W) x 706.7(H) x 64.6(D) | mm |
| Mass | 21.0 ±1.0 | kg |
| Surface treatment | Anti glare<br>Hard coating: 2H | |

(*1) Outline dimensions are shown in Fig.1 (excluding protruding portion)

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**4. Input Terminals**

4-1. TFT panel driving

CN1 (Interface signals) (Shown in Fig.1-2)

Using connector : FI-RE41S-HF (Japan Aviation Electronics Ind. , Ltd.)

Mating connector : FI-RE41HL,FI-R41H (Japan Aviation Electronics Ind. , Ltd.)

Mating LVDS transmitter :THC63LVDM83R(THine) or equivalent device

| Pin No. | Symbol | Function | Remark |
|---|---|---|---|
| 1 | GND | GND | |
| 2 | AIN0- | Aport (-)LVDS CH0 differential data input | LVDS |
| 3 | AIN0+ | Aport (+)LVDS CH0 differential data input | LVDS |
| 4 | AIN1- | Aport (-)LVDS CH1 differential data input | LVDS |
| 5 | AIN1+ | Aport (+)LVDS CH1 differential data input | LVDS |
| 6 | AIN2- | Aport (-)LVDS CH2 differential data input | LVDS |
| 7 | AIN2+ | Aport (+)LVDS CH2 differential data input | LVDS |
| 8 | GND | GND | |
| 9 | ACK- | Aport LVDS Clock signal(-) | LVDS |
| 10 | ACK+ | Aport LVDS Clock signal(+) | LVDS |
| 11 | AIN3- | Aport (-)LVDS CH3 differential data input | LVDS |
| 12 | AIN3+ | Aport (+)LVDS CH3 differential data input | LVDS |
| 13 | NC | It is required to set non-connection (OPEN) | |
| 14 | NC | It is required to set non-connection (OPEN) | |
| 15 | GND | GND | |
| 16 | BIN0- | Bport (-)LVDS CH0 differential data input | LVDS |
| 17 | BIN0+ | Bport (+)LVDS CH0 differential data input | LVDS |
| 18 | BIN1- | Bport (-)LVDS CH1 differential data input | LVDS |
| 19 | BIN1+ | Bport (+)LVDS CH1 differential data input | LVDS |
| 20 | BIN2- | Bport (-)LVDS CH2 differential data input | LVDS |
| 21 | BIN2+ | Bport (+)LVDS CH2 differential data input | LVDS |
| 22 | GND | GND | |
| 23 | BCK- | Bport LVDS Clock signal(-) | LVDS |
| 24 | BCK+ | Bport LVDS Clock signal(+) | LVDS |
| 25 | BIN3- | Bport (-)LVDS CH3 differential data input | LVDS |
| 26 | BIN3+ | Bport (+)LVDS CH3 differential data input | LVDS |
| 27 | NC | It is required to set non-connection (OPEN) | |
| 28 | NC | It is required to set non-connection (OPEN) | |
| 29 | GND | GND | |
| 30 | SELLVDS | Select LVDS data order [Note 1] | 10kΩ Pull up :3.3V |
| 31 | R/L | Horizontal shift direction[Note 2] | 10kΩ Pull Down :GND |
| 32 | U/D | Vertical shift direction [Note 2] | 10kΩ Pull Down :GND |
| 33 | VBRT | Inverter Brightness Control (Analog Voltage:0-3.3V) | [Note 4] |
| 34 | Frame1 | Frame frequency setting H:60Hz, L:50Hz | 10kΩ Pull Down :GND |
| 35 | Reserved | It is required to set non-connection (OPEN) | |
| 36 | TEMP3 | Data3 of panel surface temperature [Note3] | 10kΩ Pull Down :GND |
| 37 | TEMP2 | Data2 of panel surface temperature [Note3] | 10kΩ Pull Down :GND |
| 38 | TEMP1 | Data1 of panel surface temperature [Note3] | 10kΩ Pull Down :GND |
| 39 | VON | Inverter ON/OFF setting H:ON, L:OFF [Note 4] | 10kΩ Pull Down :GND |
| 40 | O/Sset | O/S operation setting H:O/S_ON, L:O/S_OFF | 10kΩ Pull Down :GND |
| 41 | NC | It is required to set non-connection (OPEN) | |

[note] GND of a liquid crystal panel drive part has connected with a module chassis.

[note] L,"0": Low level voltage (GND) H,"1": High level voltage(3.3V)

[note]In case of O/S set setting "0"(O/S_OFF), it should be set the Temp1~3 to "0".



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CN2（+12V DC power supply Shown in Fig.1-2）

Using connector : SM20B-SHLDS-G-TF(LF)(SN) (J.S.T. Mfg Co.,Ltd.)

Mating connector : SHLDP-20V-S-1 (connector)（J.S.T. Mfg Co.,Ltd.）

: SSHL-003GA1-P0.2 (Terminal)（J.S.T. Mfg Co.,Ltd.）

| Pin No. | Symbol | Function | Remark |
|---|---|---|---|
| 1 | VCC | +12V Power Supply | |
| 2 | VCC | +12V Power Supply | |
| 3 | VCC | +12V Power Supply | |
| 4 | VCC | +12V Power Supply | |
| 5 | VCC | +12V Power Supply | |
| 6 | GND | GND | |
| 7 | GND | GND | |
| 8 | GND | GND | |
| 9 | GND | GND | |
| 10 | GND | GND | |
| 11 | Reserved | It is required to set non-connection (OPEN) | |
| 12 | Reserved | It is required to set non-connection (OPEN) | |
| 13 | Reserved | It is required to set non-connection (OPEN) | |
| 14 | Reserved | It is required to set non-connection (OPEN) | |
| 15 | Reserved | It is required to set non-connection (OPEN) | |
| 16 | Reserved | It is required to set non-connection (OPEN) | |
| 17 | Reserved | It is required to set non-connection (OPEN) | |
| 18 | Reserved | It is required to set non-connection (OPEN) | |
| 19 | Reserved | It is required to set non-connection (OPEN) | |
| 20 | Reserved | It is required to set non-connection (OPEN) | |

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[Note 2] LVDS Data order

| SELLVDS | | |
|---|---|---|
| Data | L(GND) or Open | H(3.3V) |
| TA0 | R2 | R4 |
| TA1 | R3 | R5 |
| TA2 | R4 | R6 |
| TA3 | R5 | R7 |
| TA4 | R6 | R8 |
| TA5 | R7 | R9(MSB) |
| TA6 | G2 | G4 |
| TB0 | G3 | G5 |
| TB1 | G4 | G6 |
| TB2 | G5 | G7 |
| TB3 | G6 | G8 |
| TB4 | G7 | G9(MSB) |
| TB5 | B2 | B4 |
| TB6 | B3 | B5 |
| TC0 | B4 | B6 |
| TC1 | B5 | B7 |
| TC2 | B6 | B8 |
| TC3 | B7 | B9(MSB) |
| TC4 NA | | NA |
| TC5 NA | | NA |
| TC6 | DE(*) | DE(*) |
| TD0 | R8 | R2 |
| TD1 | R9(MSB) | R3 |
| TD2 | G8 | G2 |
| TD3 | G9(MSB) | G3 |
| TD4 | B8 | B2 |
| TD5 | B9(MSB) | B3 |
| TD6 | NA | N/A |
| TE0 | R0(LSB) | R0(LSB) |
| TE1 | R1 | R1 |
| TE2 | G0(LSB) | G0(LSB) |
| TE3 | G1 | G1 |
| TE4 | B0(LSB) | B0(LSB) |
| TE5 | B1 | B1 |
| TE6 | NA | N/A |

NA: Not Available

(*)Since the display position is prescribed by the rise of DE(Display Enable)signal, please do not fix DE signal during operation at ”High”.

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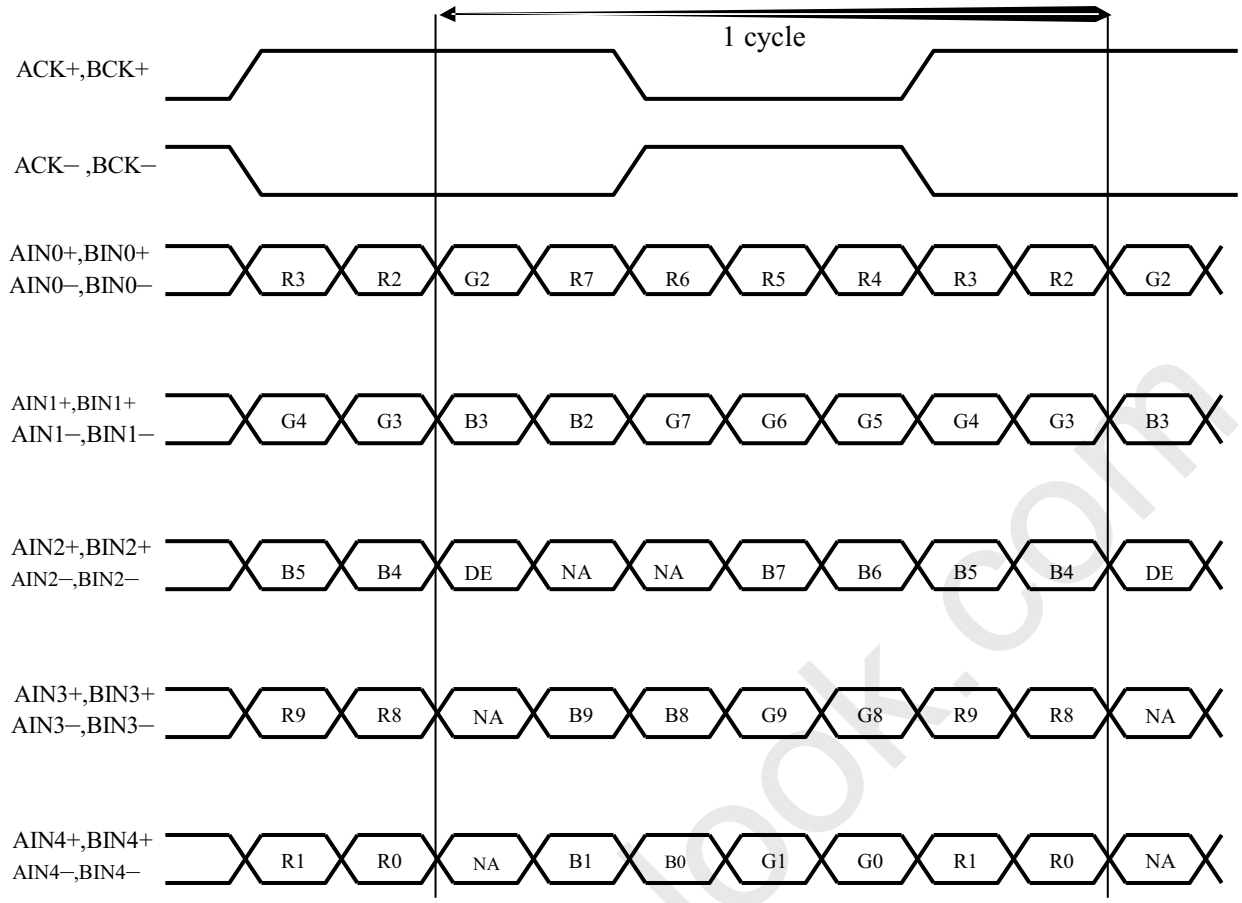
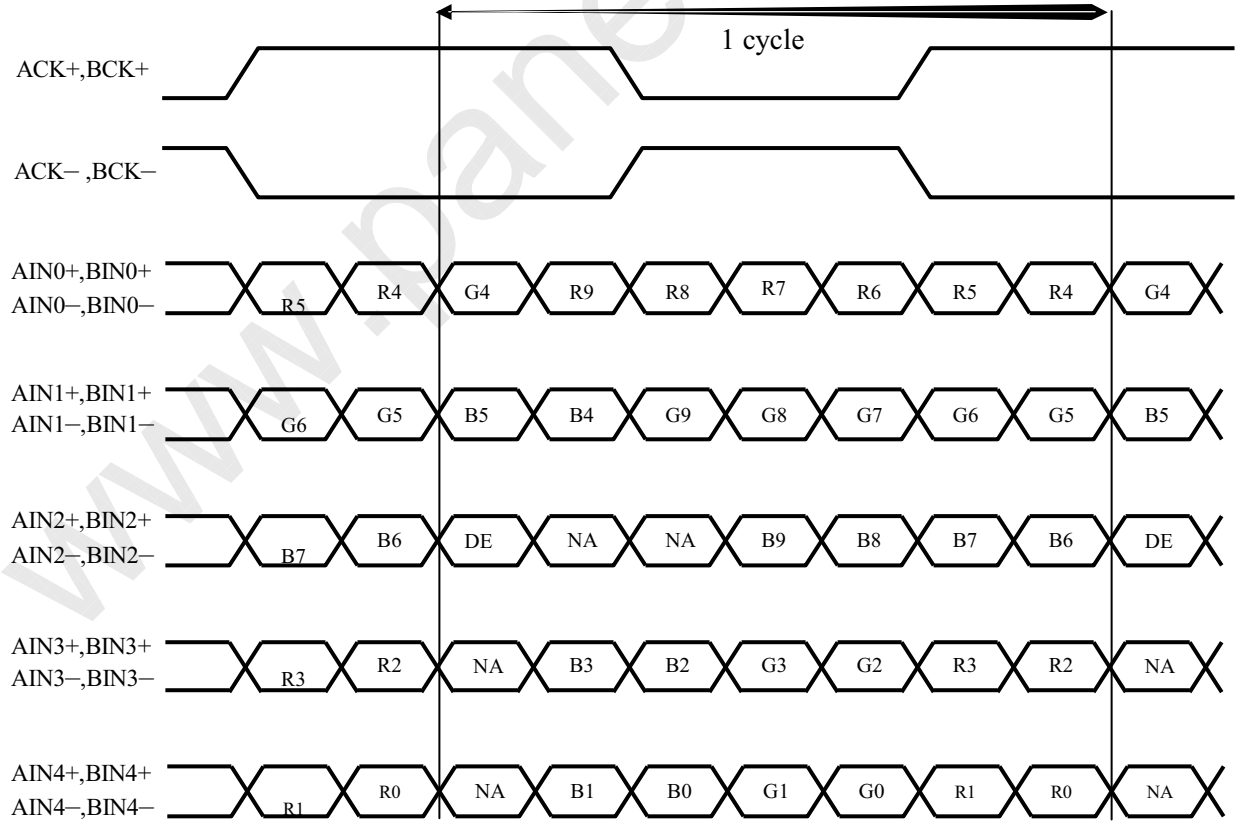
**SELLVDS= Low (GND) or OPEN** ▲A




**SELLVDS= High (3.3V)**




DE: Display Enable, NA: Not Available (Fixed Low)

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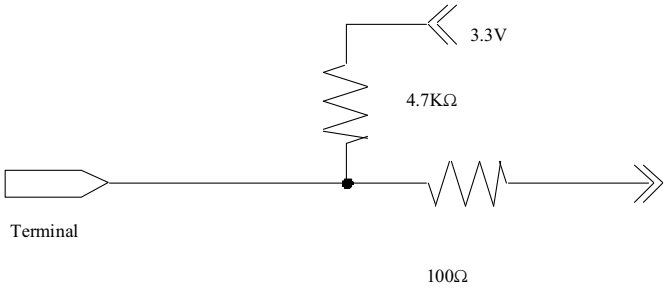
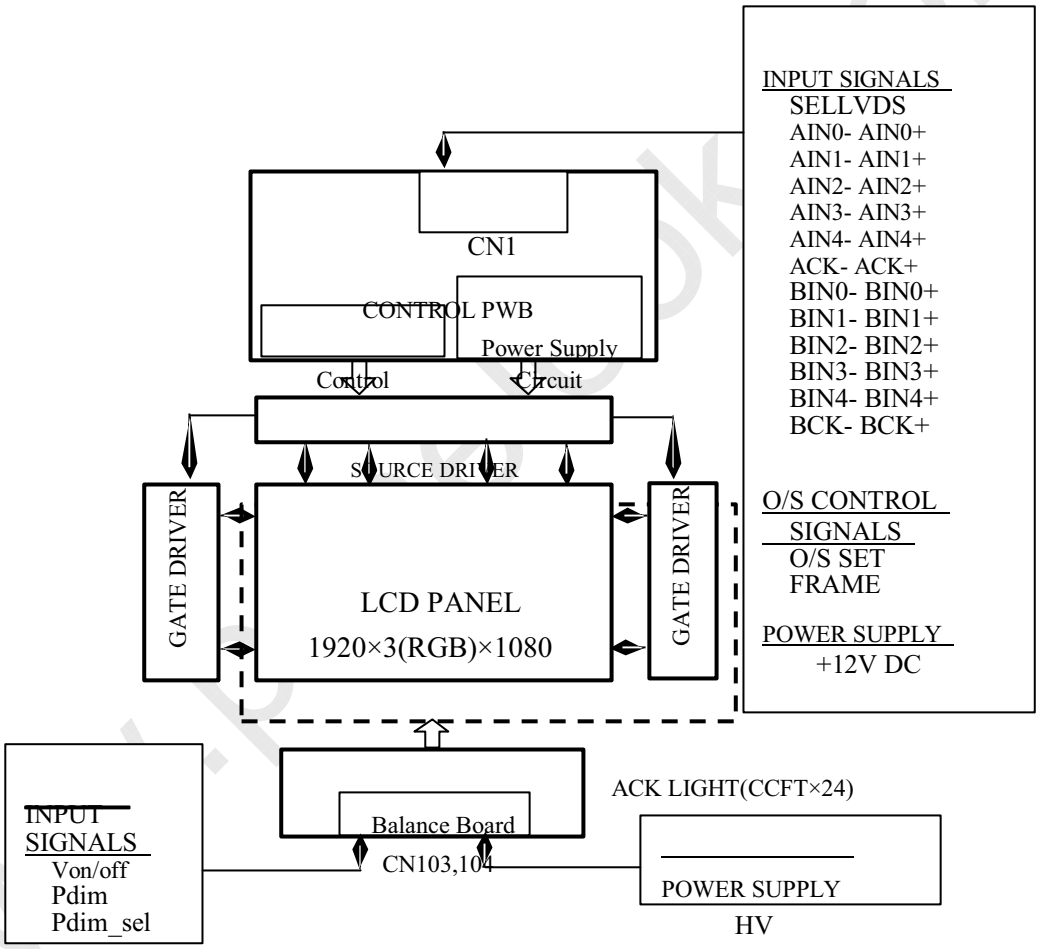
[Note 3] The equivalent circuit figure of the terminal




4.2. Interface block diagram

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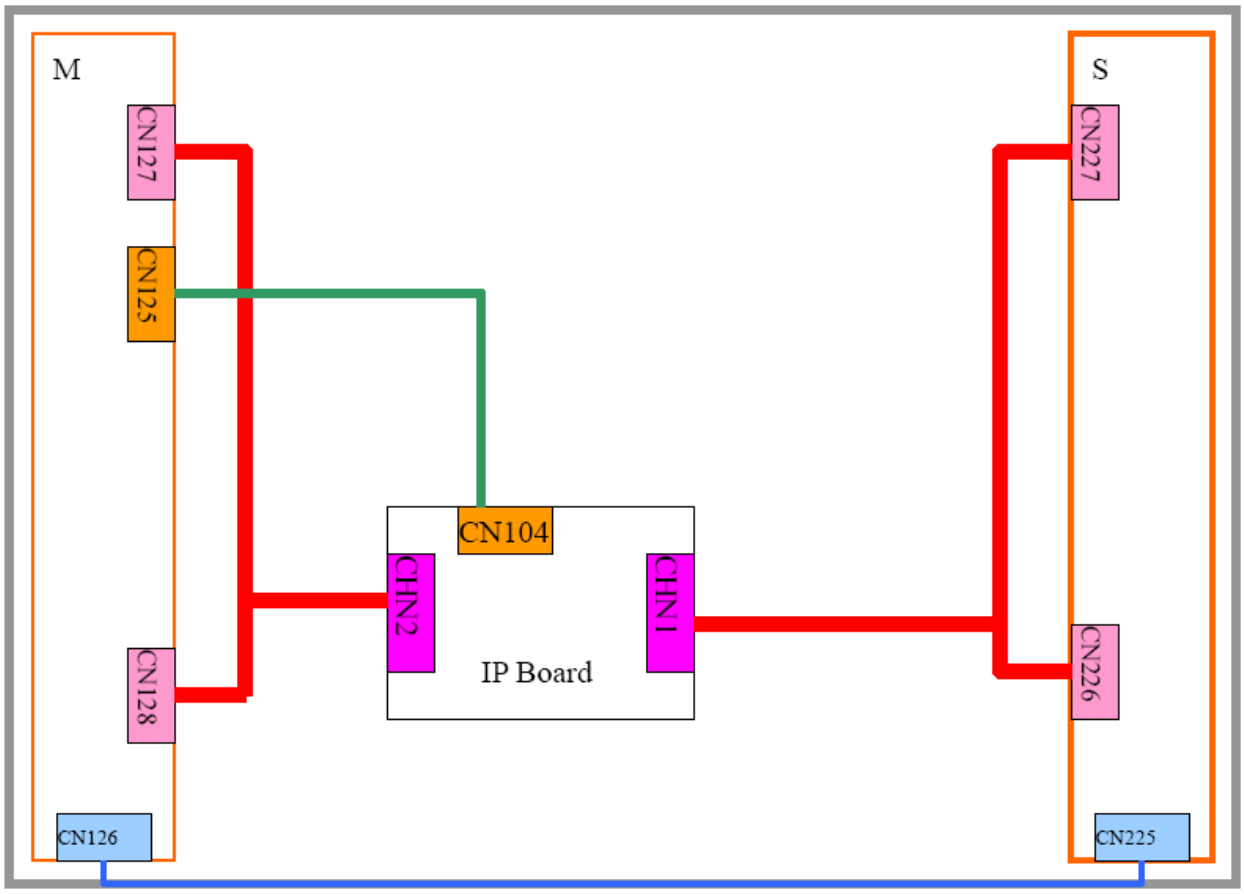
## 5. Measurement

To test Inverter need to warm up 30 minutes in the beginning, for lamp stability.

### 5.1 Block diagram




### 5.2 Test instrument

| Item | Function | Instrument Type |
|---|---|---|
| 1 | A ・DC CURRENT METER | FLUKE45 or equivalent |
| 2 | A ・RMS CURRENT METER | 2016(YOKOGAWA) or FLUKE45 or P6022 AC Current Probe(Tektronix) or equivalent |
| 3 | V ・DIGITAL MULTI-METER | FLUKE45 or equivalent |
| 4 | V ・RMS VOLTAGE METER | TDS 360 (Tektronix) or equivalent， PROBE 1137A(HP) or equivalent |
| 5 | F ・FERQUENCY COUNTER | 5316A(HP) or equivalent |
| 6 | O ・OSCILLOSCOPE | TDS 3012B (Tektronix) |



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## 5.1 Interface connectors on the inverter

☐.1High voltage connector:

(CHN1~CHN2 and CN127~CN128 and CN226~CN227): JST_SM02B-BDAS-3-TB-2PIN or equivalent

(CHN101~CHN112 and CN113~CN124):Cvilux CP042CP1MC0

| Connector | PIN | SYMBOL | Description | I/O |
|---|---|---|---|---|
| CHN1 | 1 | HV+ | High Voltage | Output |
| | 2 | HV- | High Voltage | Output |
| CHN2 | 1 | HV+ | High Voltage | Output |
| | 2 | HV- | High Voltage | Output |
| CN104<br>CN101 | 1 | HV- | High Voltage | Input |
| | 2 | HV+ | High Voltage | Input |
| CN203<br>CN201 | 1 | HV- | High Voltage | Input |
| | 2 | HV+ | High Voltage | Input |
| CHN101~CHN112 | 1 | HV+ | High Voltage | Output |
| | 2 | HV- | High Voltage | Output |
| CN113~CN124 | 1 | HV+ | High Voltage | Output |
| | 2 | HV- | High Voltage | Output |

5.2 Feedback connector:

(CN114 ) : E&T_7151-E05N-00-R or equivalent

| CN114<br>Pin NO | Name | Description |
|---|---|---|
| 1 | FB | |
| 2 | FB | |
| 3 | NC | |
| 4 | GND | |
| 5 | GND | |
| 6 | LD | Lamp detected |
| 7 | VCC | Supply voltage |

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5.3. The back light system characteristics

The back light system is direct type with 24 CCFTs (Cold Cathode Fluorescent Tube).

The characteristics of the lamp are shown in the following table. The value mentioned below is at the case of one CCFT.

| Item | Symbol | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| Life time | $T_L$ | - | 60000 | - | Hour | [Note] |

[Note]

- Lamp life time is defined as the time when brightness becomes 50% of the original value in the continuous operation under the condition of Ta=25°C and brightness control=100%.
- Above value is applicable when the long side of LCD module is placed horizontally (Landscape position). (Lamp lifetime may vary if LCD module is in portrait position due to the change of mercury density inside the lamp.)

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## 6. Electrical Characteristics

6.1. Control circuit driving

| Parameter | | Symbol | Min. | Typ. | Ta=25 °C Max. | Uniit | Remark |
|---|---|---|---|---|---|---|---|
| +12V supply voltage | Supply voltage | Vcc | 11.4 | 12 | 12.6 | V | [Note 1] |
| | Current dissipation | Icc | - | 0.8 | 2.0 | A | [Note 2] |
| | Inrush current | $I_{RUSH}$ | - | 4.6 | - | A | |
| | | $T_{RUSH}$ | - | 0.3 | - | ms | [Note 7] |
| Permissible input ripple voltage | | $V_{RP}$ | - | - | 100 | $mV_{P-P}$ | Vcc = +12.0V |
| Differential input threshold voltage | High | $V_{TH}$ | - | - | 100 | mV | $V_{CM}$ = +1.2V |
| | Low | $V_{TL}$ | -100 | - | - | mV | [Note 6] |
| Input Low voltage | | $V_{IL}$ | 0 | - | 1.0 | V | [Note 3] |
| Input High voltage | | $V_{IH}$ | 2.3 | - | 3.3 | V | |
| Input leak current (Low) | | $I_{IL1}$ | - | - | 400 | μA | $V_I$ = 0V [Note 4] |
| Input leak current (High) | | $I_{IL2}$ | - | - | 40 | μA | $V_I$ = 0V [Note 5] |
| | | $I_{IH1}$ | - | - | 40 | μA | $V_I$ = 3.3V [Note 4] |
| Terminal resistor | | $I_{IH2}$ | - | - | 400 | μA | $V_I$ = 3.3V [Note 5] |
| | | $R_T$ | - | 100 | - | Ω | Differential input |

[Note]$V_{CM}$: Common mode voltage of LVDS driver.

[Note 1]

Input voltage sequences

0 < t1 ≦ 20ms

10 < t2 ≦ 20ms

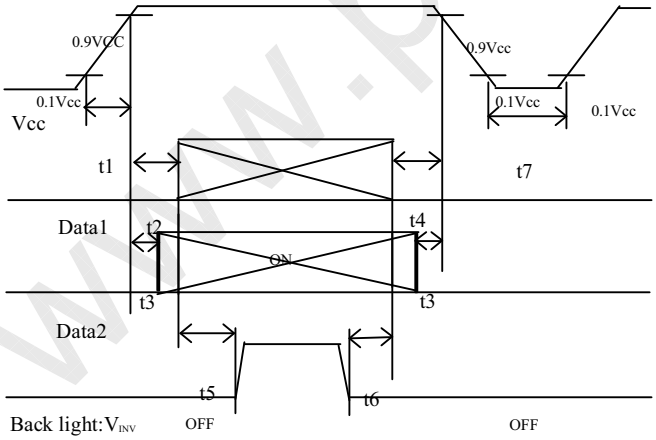
10 < t3 ≦ 50ms

0 < t4 ≦ 1s

t5 ≧ 200ms

t6 ≧ 0

t7 ≧ 300ms



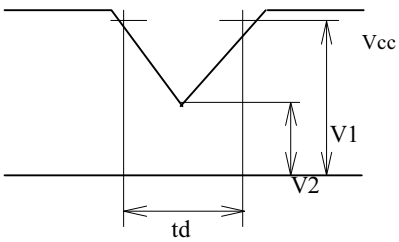

Dip conditions for supply voltage

a) 6.5V Vcc < 10.8V

td ≦ 10ms

b) Vcc < 6.5V

Dip conditions for supply voltage is based on input voltage sequence.




V1:10.8V
V2:6.5V

※ Data1: ACK±, AIN0±, AIN1±, AIN2±, AIN3±, AIN4±,BCK±, BIN0±, BIN1±, BIN2±, BIN3±, BIN4

*$V_{CM}$ voltage pursues the sequence mentioned above

※ Data2: SELLVDS, FRAME, O/S_SET

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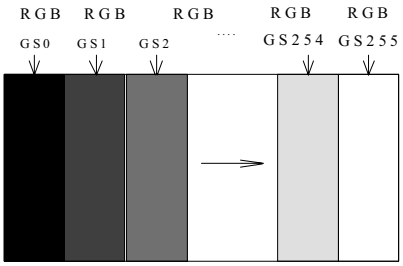
[Note]About the relation between data input and back light lighting, please base on the above-mentioned input sequence. When back light is switched on before panel operation or after a panel operation stop, it may not display normally. But this phenomenon is not based on change of an incoming signal, and does not give damage to a liquid crystal display.

[Note 2] Typical current situation: 256 gray-bar patterns. (Vcc = +12.0V)

The explanation of RGB gray scale is seen in section 8.




Vcc=+12.0V
CK=74.25MHz
Th=14.8μs

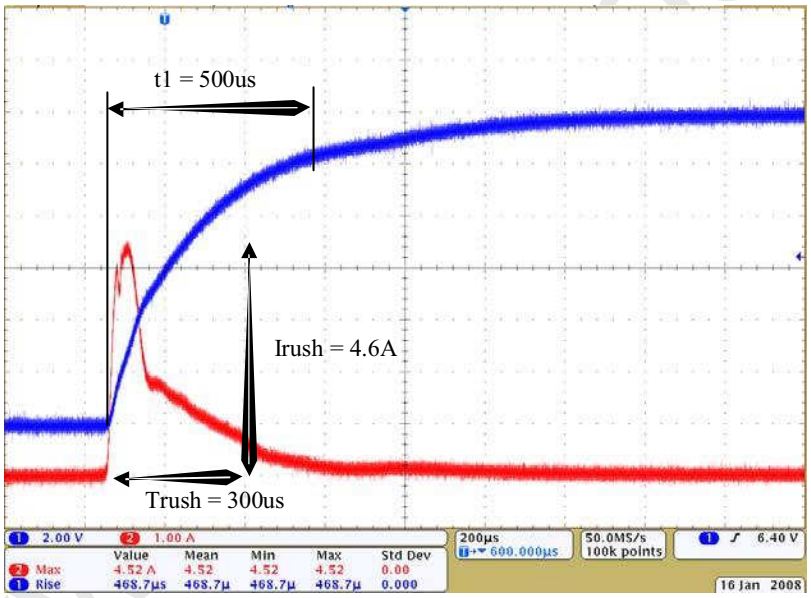
[Note 3] SELLVDS, FRAME, O/S_SET

[Note 4] O/S_SET

[Note 5] FRAME, SELLVDS

[Note 6] ACK±, AIN0±, AIN1±, AIN2±, AIN3±, AIN4±,BCK±, BIN0±, BIN1±, BIN2±, BIN3±, BIN4

[Note 7] Vcc12V inrush current waveform

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## 7. Timing characteristics of input signals

7.1. Timing characteristics

Timing diagrams of input signal are shown in Fig.2.

| Parameter | | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|
| Clock | Frequency | 1/Tc | 67 | 74.25 | 76 | MHz | |
| Data enable signal | Horizontal period | TH | 1050 | 1100 | 1200 | clock | |
| | | | 14.2 | 14.8 | 16.1 | µs | |
| | Horizontal period (High) | THd | 960 | 960 | 960 | clock | |
| | Vertical period | TV | 1109 | 1125 | 1200 | line | |
| | Vertical period (High) | TVd | 1080 | 1080 | 1080 | line | |

[Note]-When vertical period is very long, flicker and etc. may occur.

-Please turn off the module after it shows the black screen.

-Please make sure that length of vertical period should become of an integral multiple of horizontal length of period. Otherwise, the screen may not display properly.

-As for your final setting of driving timing, we will conduct operation check test at our side, please inform your final setting.

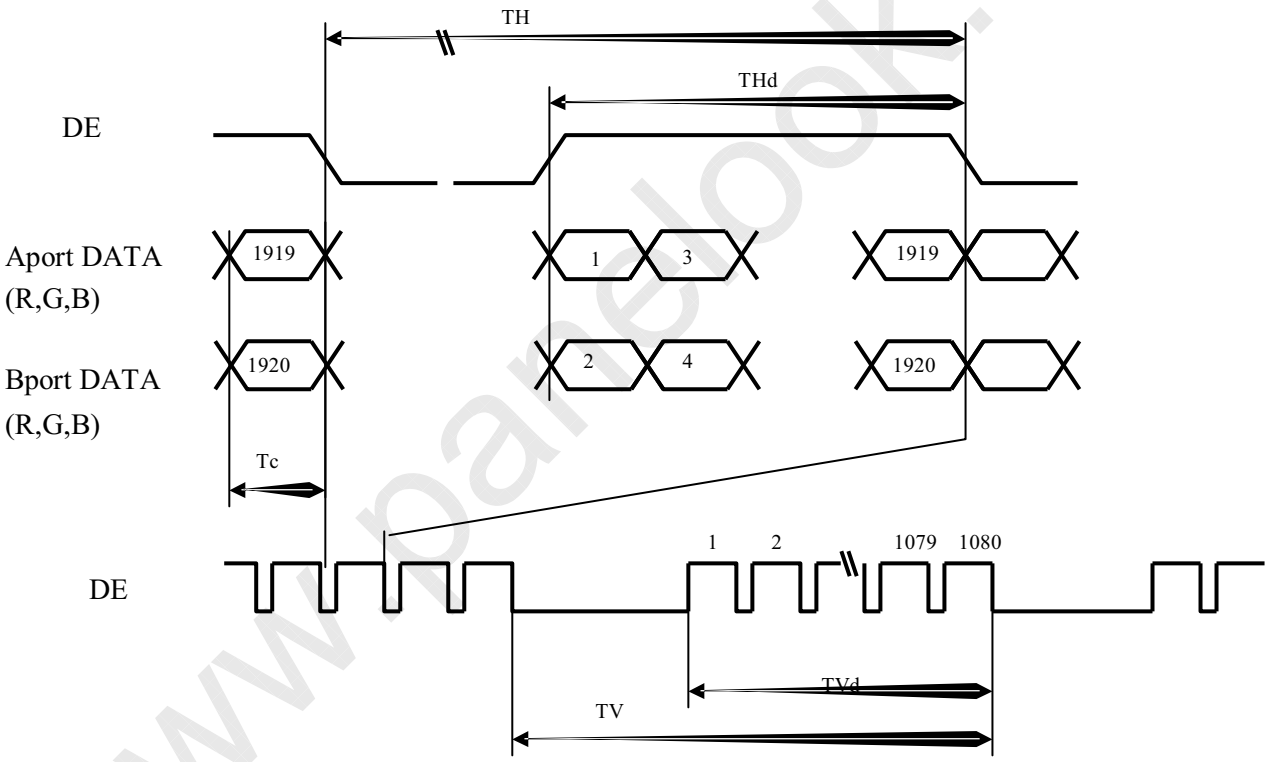


Fig.2 Timing characteristics of input signals

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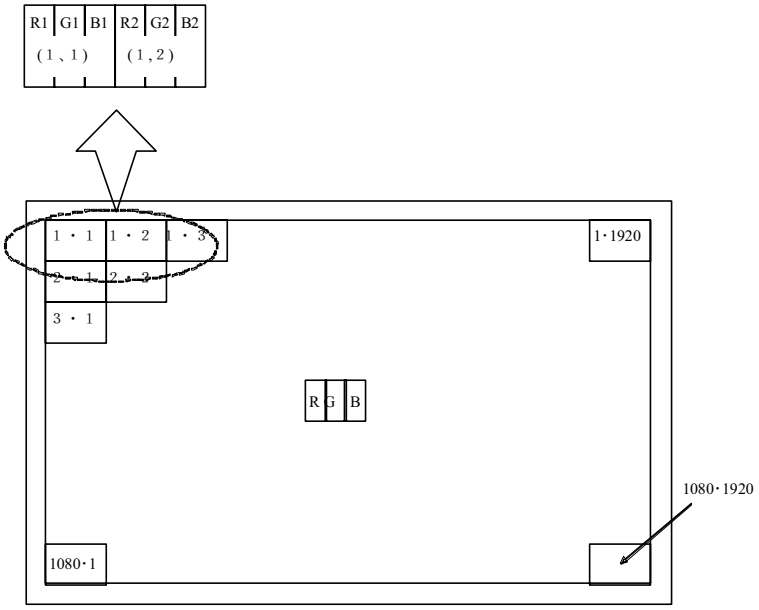
7.2. Input data signal and display position on the screen




Display position of Dat (V,H)

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## 8. Input Signal, Basic Display Colors and Gray Scale of Each Color

| | Colors & Gray scale | Gray Scale | Data signal R0 R1 R2 R3 R4 R5 R6 R7 R8 R9 G0 G1 G2 G3 G4 G5 G6 G7 G8 G9 B0 B1 B2 B3 B4 B5 B6 B7 B8 B9 |
|---|---|---|---|
| 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 0 0 0 0 0 0 |
| | Blue | – | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 |
| | Green | – | 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 |
| | Cyan | – | 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 |
| | Red | – | 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| | Magenta | – | 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 1 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 1 1 1 1 1 0 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 1 1 1 1 1 1 |
| Gray Scale of Red | Black | GS0 | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| | Darker | GS1 | 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| | | GS2 | 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| | | ↓ | ↓ ↓ ↓ |
| | | ↓ | ↓ ↓ ↓ |
| | Brighter | GS1021 | 1 0 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| | | GS1022 | 0 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| | Red | GS1023 | 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| Gray Scale of Green | Black | GS0 | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| | Darker | GS1 | 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| | | GS2 | 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| | | ↓ | ↓ ↓ ↓ |
| | | ↓ | ↓ ↓ ↓ |
| | Brighter | GS1021 | 0 0 0 0 0 0 0 0 0 0 1 0 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 |
| | | GS1022 | 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 |
| | Green | GS1023 | 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 |
| Gray Scale of Blue | Black | GS0 | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| | Darker | GS1 | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 |
| | | GS2 | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 |
| | | ↓ | ↓ ↓ ↓ |
| | | ↓ | ↓ ↓ ↓ |
| | Brighter | GS1021 | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 1 1 1 1 |
| | | GS1022 | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 |
| | Blue | GS1023 | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 |

0: Low level voltage, 1: High level voltage.

Each basic color can be displayed in 1024 gray scales from 10 bits data signals. According to the combination of total 30 bits data signals, the TBD-color display can be achieved on the screen.

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## 9. Optical characteristics

Ta=25°C, Vcc=12.0V, $V_{INV}$=24.0V, $V_{BRT}$=100%, Timing:60Hz(typ. value)

| Parameter | | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| Viewing angle range | Horizontal | θ21<br>θ22 | CR≧10 | 70 | 88 | - | Deg. | [Note1,4] |
| | Vertical | θ11<br>θ12 | | 70 | 88 | - | Deg. | |
| Contrast ratio | | CRn | θ=0 deg. | 1000 | 1500 | - | | [Note2,4] |
| Response time | | $\tau_r$<br>$\tau_d$ | | - | 6 | - | ms | [Note3,4,5] |
| Chromaticity | White | x | | 0.242 | 0.272 | 0.302 | - | [Note4] |
| | | y | | 0.247 | 0.277 | 0.307 | - | |
| | Red | x | | 0.610 | 0.640 | 0.670 | - | |
| | | y | | 0.300 | 0.330 | 0.360 | - | |
| | Green | x | | 0.250 | 0.280 | 0.310 | - | |
| | | y | | 0.570 | 0.600 | 0.630 | - | |
| | Blue | x | | 0.120 | 0.150 | 0.180 | - | |
| | | y | | 0.030 | 0.060 | 0.090 | - | |
| Luminance | | White | | 360 | 450 | - | - | |
| Luminance uniformity | White | δw | | - | - | 1.25 | $cd/m^2$ | [Note 6] |

Measurement condition: Set the value of $V_{BRT}$ to maximum luminance of white.
*The measurement shall be executed 60 minutes after lighting at rating.

[Note]The optical characteristics are measured using the following equipment.

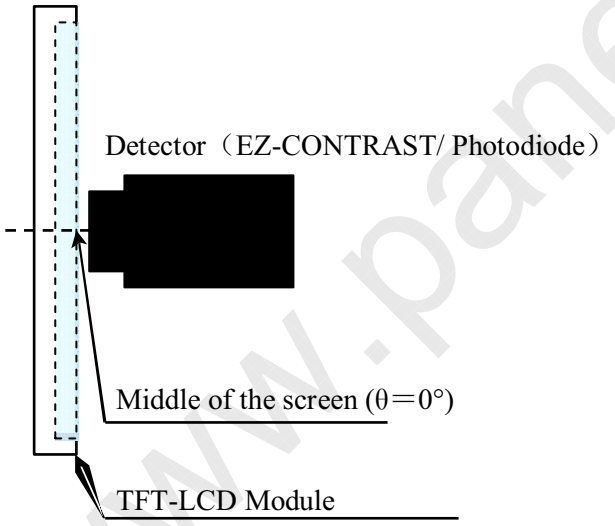


Fig.4-1 Measurement of viewing angle range and Response time.
Viewing angle range: EZ-CONTRAST
Response time: Photodiode

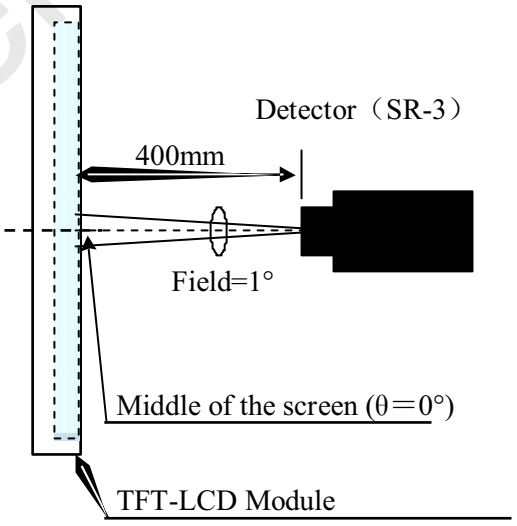


Fig.4-2 Measurement of Contrast, Luminance, Chromaticity.

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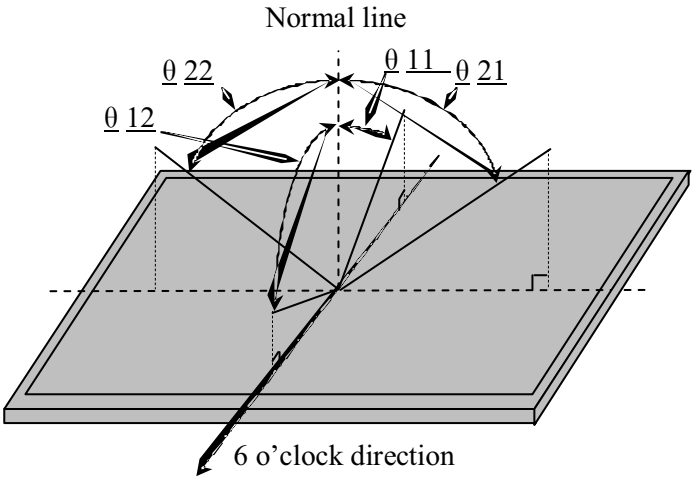
[Note 1]Definitions of viewing angle range :




[Note 2]Definition of contrast ratio :

The contrast ratio is defined as the following.

$$\text{Contrast Ratio} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

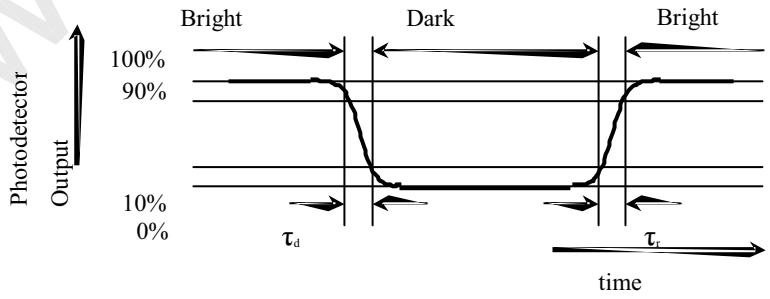
[Note 3]Definition of response time

The response time ($\tau_d$ and $\tau_r$) is defined as the following figure and shall be measured by switching the input signal for "any level of gray (0%, 25%, 50%, 75% and 100%)" and "any level of gray (0%, 25%, 50%, 75% and 100%)".

| | 0% | 25% | 50% | 75% | 100% |
|---|---|---|---|---|---|
| 0% | | tr:0%-25% | tr:0%-50% | tr:0%-75% | tr:0%-100% |
| 25% | td: 25%-0% | | tr: 25%-50% | tr25%-75% | tr: 25%-100% |
| 50% | td: 50%-0% | td: 50%-25% | | tr: 50%-75% | tr: 50%-100% |
| 75% | td: 75%-0% | td: 75%-25% | td: 75%-50% | | tr: 75%-100% |
| 100% | td: 100%-0% | td: 100%-25% | td: 100%-50% | td:100%-75% | |

t*:x-y...response time from level of gray(x) to level of gray(y)

$\tau_r = \Sigma(tr:x\text{-}y)/10$ , $\tau_d = \Sigma(td:x\text{-}y)/10$




[Note 4]This shall be measured at center of the screen.

[Note 5] This value is valid when O/S driving is used at typical input time value.

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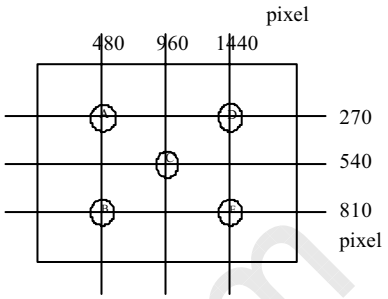
[Note 6]Definition of white uniformity ;

White uniformity is defined as the following with five measurements. (A~ E)

$$\delta_W = \frac{\text{Maximum luminance of five points (brightness)}}{\text{Minimum luminance of five points (brightness)}}$$




## 10. Handling Precautions of the module

a) Be sure to turn off the power supply when inserting or disconnecting the cable.

b) This product is using the parts (inverter, CCFT etc), which generate the high voltage. Therefore, during operating, please don't touch these parts.

c) Brightness control voltage is switched for "ON" and "OFF", as shown in Fig.4. Voltage difference generated by this switching, $\Delta V_{INV}$, may affect a sound output, etc. when the power supply is shared between the inverter and its surrounding circuit. So, separate the power supply of the inverter circuit with the one of its surrounding circuit.

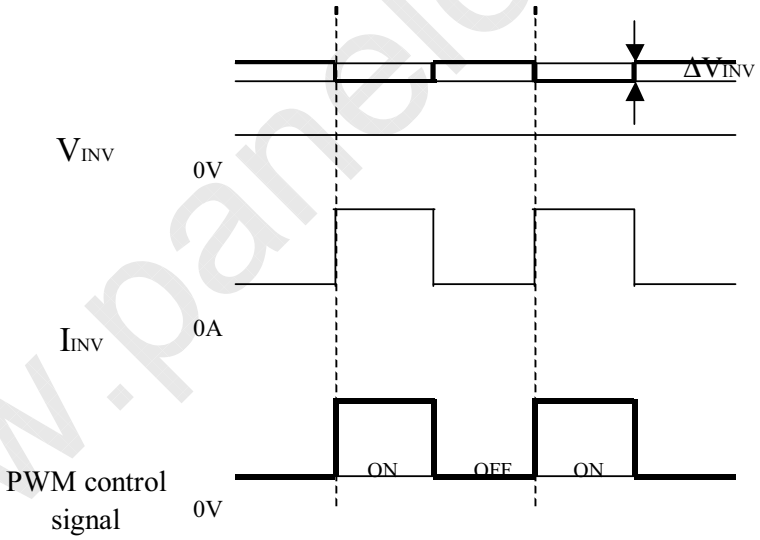



Fig.4 Brightness control voltage.

*Since inverter board's GND is not connected to the frame of the LCD module, please connect it with the Customer's GND of inverter power supply.

d) Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.

e) Since the front polarizer is easily damaged, pay attention not to scratch it.

f) Since long contact with water may cause discoloration or spots, wipe off water drop immediately.

g) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.

h) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.

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i) Since CMOS LSI is used in this module, take care of static electricity and take the human earth into consideration when handling.

j) The module has some printed circuit boards (PCBs) on the back side, take care to keep them form any stress or pressure when handling or installing the module; otherwise some of electronic parts on the PCBs may be damaged.

k) Observe all other precautionary requirements in handling components.

l) When some pressure is added onto the module from rear side constantly, it causes display non-uniformity issue, functional defect, etc. So, please avoid such design.

m) When giving a touch to the panel at power on supply, it may cause some kinds of degradation. In that case, once turn off the power supply, and turn on after several seconds again, and that is disappear.

n) When handling LCD modules and assembling them into cabinets, please be noted that long-term storage in the environment of oxidization or deoxidization gas and the use of such materials as reagent, solvent, adhesive, resin, etc. which generate these gasses, may cause corrosion and discoloration of the LCD modules.

o) This LCD module is designed to prevent dust from entering into it. However, there would be a possibility to have a bad effect on display performance in case of having dust inside of LCD module. Therefore, please ensure to design your TV set to keep dust away around LCD module.

## 11. Packing form

a) Piling number of cartons:2 maximum

b) Packing quantity in one carton:3pcs

c) Carton size:1320(W)× 300(D) × 830(H)

d) Total mass of one carton filled with full modules: 75kg(Max)

## 12. Reliability test item

| No. | Test item | Condition |
|---|---|---|
| 1 | High temperature storage test | Ta=60°C 240h |
| 2 | Low temperature storage test | Ta=-25°C 240h |
| 3 | High temperature and high humidity operation test | Ta=40°C ; 95%RH 240h<br>(No condensation) |
| 4 | High temperature operation test | Ta=50°C 240h |
| 5 | Low temperature operation test | Ta=0°C 240h |
| 6 | Vibration test<br>(non-operation) | Frequency: 10~57Hz/Vibration width (one side): 0.075mm<br>: 58~500Hz/Acceleration: 9.8 m/s$^2$<br>Sweep time: 11 minutes<br>Test period: 3 hours (1h for each direction of X, Y, Z) |
| 7 | Shock test<br>(non-operation) | Maximum acceleration: 294m/s$^2$<br>Pulse width: 11ms, sinusoidal half wave<br>Direction: +/-X, +/-Y, +/-Z, once for each direction. |
| 8 | ESD | * At the following conditions, it is a thing without incorrect operation and destruction.<br>(1)Non-operation: Contact electric discharge ±10kV<br>Non-contact electric discharge ±20kV<br>(2)Operation Contact electric discharge ±8kV<br>Non-contact electric discharge ±15kV<br>Conditions: 150pF, 330ohm |

[Result evaluation criteria]

Under the display quality test condition with normal operation state, there shall be no change, which may affect practical display function.

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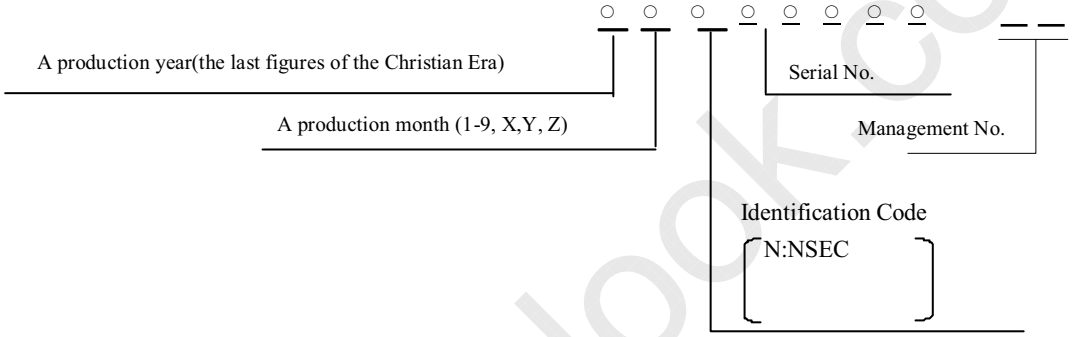
## 13. Others

1) Lot No. Label ;

The label that displays SHARP, product model (LK520D1LH00), a product number is stuck on the back of the module.

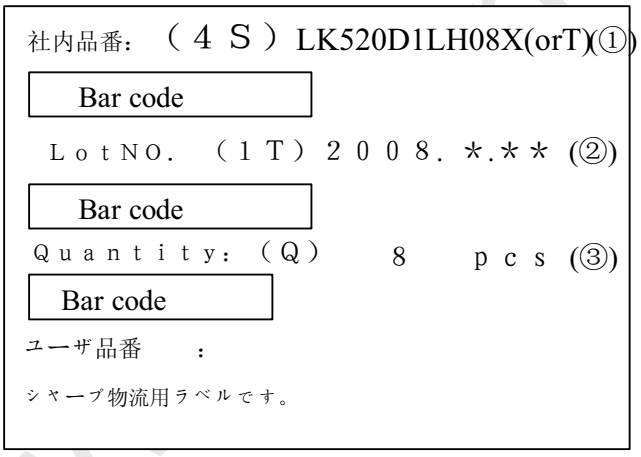
【LK520D1LH00X,T】NSEC PRODUCTION


How to express Lot No.




2) Packing Labe

【LK520D1LH00】




① Management No.
② Lot No. (Date)
③ Quantity

3) Adjusting volume has been set optimally before shipment, so do not change any adjusted value.
If adjusted value is changed, the specification may not be satisfied.

4) Disassembling the module can cause permanent damage and should be strictly avoided.

5) Please be careful since image retention may occur when a fixed pattern is displayed for a long time.

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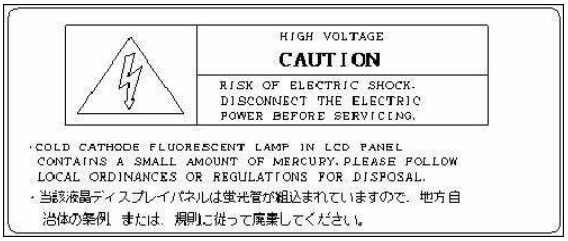
6) The chemical compound, which causes the destruction of ozone layer, is not being used.

7) Cold cathode fluorescent lamp in LCD PANEL contains a small amount of mercury. Please follow local ordinances or regulations for disposal. This sentence is displayed on the backside of the module.




8) When any question or issue occurs, it shall be solved by mutual discussion.

9) This module is corresponded to RoHS.

## 14. Carton storage condition

| | |
|---|---|
| | TemperatureC to 40°C |
| Humidity | 95%RH or less |
| Reference condition | : 20°C to 35°C, 85%RH or less (summer) |
| | : 5°C to 15°C, 85%RH or less (winter) |
| | • the total storage time (40°C,95%RH) : 240H or less |
| Sunlight | Be sure to shelter a product from the direct sunlight. |
| Atmosphere | Harmful gas, such as acid and alkali which bites electronic components and/or wires must not be detected. |
| Notes | Be sure to put cartons on palette or base, don't put it on floor, and store them with removing from wall<br>Please take care of ventilation in storehouse and around cartons, and control changing temperature is within limits of natural environment |
| Storage life | 1 year |

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