

NEC

TFT MONOCHROME LCD MODULE

NL256204AM15-01

51cm (20.1 Type)

QSXGA

PRELIMINARY DATA SHEET

(1st edition)

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Please confirm the delivery specification before starting
to design your system.**

INTRODUCTION

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Anti-radioactive design is not implemented in this product.

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1. OUTLINE

NL256204AM15-01 is a TFT (thin film transistor) active matrix monochrome liquid crystal display (LCD) comprising amorphous silicon TFT attached to each signal electrode, a driving circuit and a backlight with an inverter.

This product has a 51cm (20.1 inches) display area by a diagonal, and contains 2560×2048 pixels in it. Also it can display 256 gray scale per one sub-pixel.

2. FEATURES

- Ultra-wide viewing angle (with lateral electric field) (Super Advanced SFT Panel)
- High resolution
- Low reflection
- LVDS interface
- High luminance
- Small fool print
- Incorporated direct type backlight (twelve lamps in backlight unit with an inverter)
- Replaceable backlight unit (part No. : TBD)
- Replaceable inverter (part No. : TBD)

3. APPLICATION

- EWS monitors
- Monitors for CAD system
- Monitors for medical system

4. PRINCIPLE AND STRUCTURE

A monochrome TFT (thin film transistor) LCD module is composed of a TFT liquid crystal panel structure, LSIs for driving the TFT array, and a backlight assembly. The TFT liquid crystal panel structure is injected liquid crystal material into the narrow gap between a TFT array glass substrate. Also, LCD module is connected the driver LSIs with a TFT liquid crystal panel structure, and then the backlight assembly is attached to the backside of the panel.

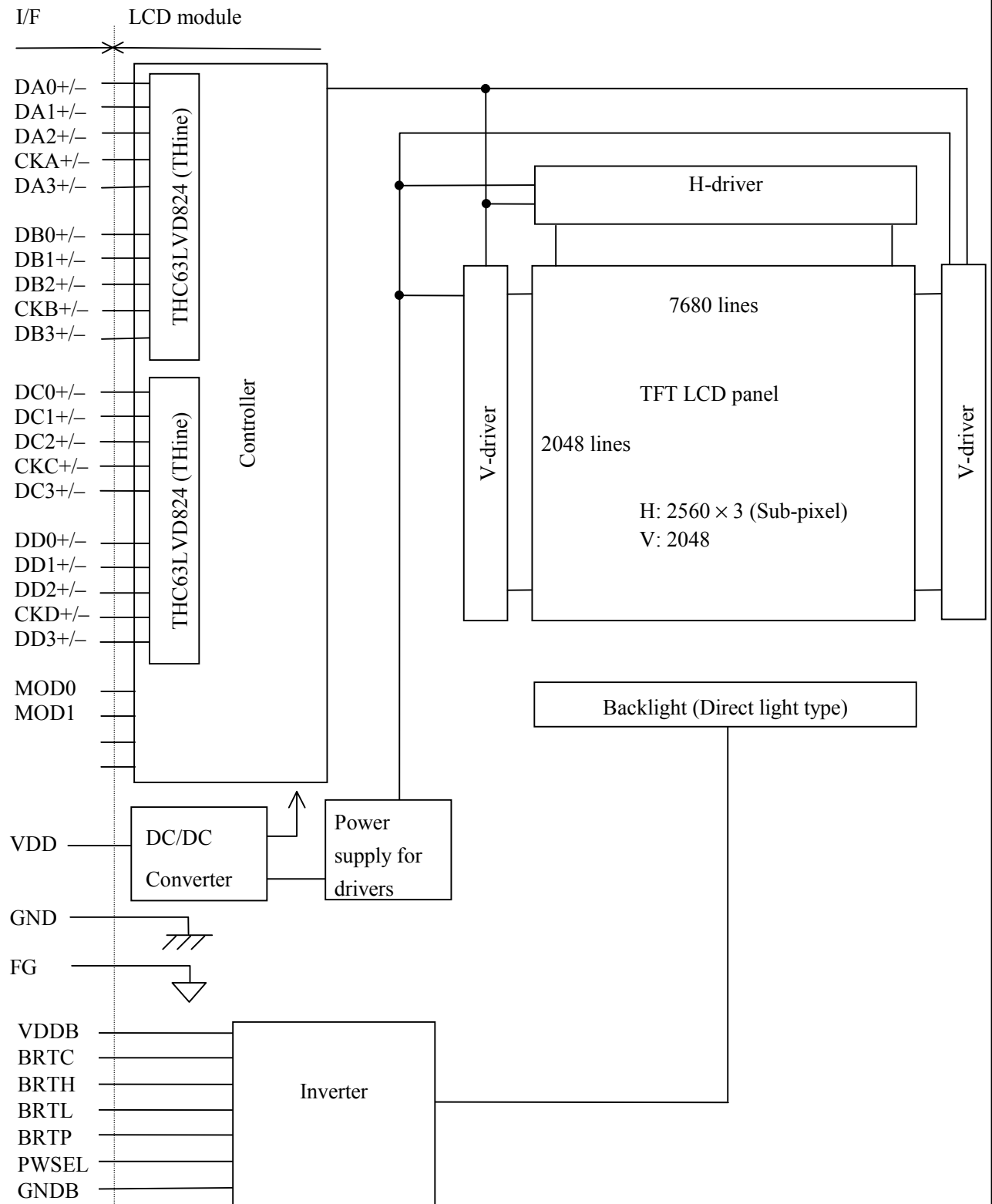
Gray scale data signals from a source system are modulated into a form suitable for active matrix addressing by the onboard signal processor and sent to the driver LSIs which in turn addresses the individual TFT cells.

Working as an electro-optical switch, each TFT cell regulates transmitted light from the backlight assembly when worked by the data source.

5. OUTLINE OF CHARACTERISTICS (at room temperature)

| | |
|--|---|
| Display area | 399.36 (H) × 319.49 (V) mm |
| Drive system | a-Si TFT active matrix |
| Display gray scale | 256 |
| Number of pixels | 2560 (H) × 2048 (V) |
| Pixel arrangement | Sub-pixel Vertical stripe |
| Pixel pitch | 0.156 (H) × 0.156 (V) mm |
| Module size (Include an i-guard sensor) | 423.4 (H, Typ.) × 346.5 (V, Typ.) × 43.5 (D, Typ.) mm |
| Weight | 2600 g (Typ.) |
| Contrast ratio | 600:1(Typ.) |
| Viewing angle (more than the contrast ratio of 10:1) | <ul style="list-style-type: none"> - Horizontal: 85° (Typ., left side, right side) - Vertical: 85° (Typ., up side, down side) |
| Designed viewing direction | - Optimum grayscale (γ =DICOM): perpendicular |
| Polarizer Pencil-hardness | 3 H (Min., at JIS K5400) |
| Response time | 30 ms (Typ.), (Ton + Toff) |
| Luminance | 850 cd/m ² (Typ.) |
| Polarizer type | (Antiglare) |
| Signal system | 4 ports LVDS interface (THC63LV824×2pcs, THine Electronics, Inc.) RGB 8-bit signals, Data enable signal (DE) THC63LVD823 (THine Electronics, Inc.) are preferable. |
| Supply voltage | 12V (Logic, LCD driving), 12V (Backlight) |
| Backlight | Direct light type: twelve cold cathode fluorescent lamps with an inverter [Replaceable parts] <ul style="list-style-type: none"> - Backlight unit: TBD - Inverter: TBD |
| Power consumption | 75.6 W (Typ.) (at maximum luminance) |

6. BLOCK DIAGRAM



Note1: GND is signal ground for logic and LCD driving. GND is not connected to FG (Frame Ground) and GNDB (Backlight ground) in the LCD module. These grounds should be connected in customer equipment.

7. GENERAL SPECIFICATIONS

| Parameter | Specification | Unit |
|--------------------|--|------------|
| Module size | 423.4 (H) × 346.5 (V) × 43.5 (D) (Include an i-guard sensor) | mm |
| Display area | 399.36 (H) × 319.488 (V) [Diagonal display size: 51cm (Type 20.1)] | mm |
| Number of pixels | 2560 (H) × 2048 (V) | pixel |
| Dot pitch | 0.052 (H) × 0.156 (V) | mm |
| Pixel pitch | 0.156 (H) × 0.156 (V) | mm |
| Pixel arrangement | 3 sub-pixel vertical stripe | - |
| Display gray scale | 256 (per one sub-pixel) | gray scale |
| Weight | 2600 (Typ.) | g |

8. ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Rating | Unit | Remarks |
|--|--------|---------------|------------------|---------------------------|
| Supply voltage | VDD | -0.3 to +15.0 | V | Ta = 25°C |
| | VDDDB | -0.3 to +15.0 | V | |
| LVDS input voltage (LCD) | Vi | -0.3 to 3.6 | V | Ta = 25°C, VDD=12V |
| Control logic input voltage (MOD0,MOD1,MOD2) | ViC | -0.3 to +3.9 | V | |
| Backlight logic input voltage (BRTC,BRTP,PWSEL) | ViB1,2 | -0.3 to +5.5 | V | |
| BRTL input voltage (BRTL) | ViB3 | -0.3 to +1.5 | V | VDDDB=12V |
| Storage temperature | Tst | -20 to +60 | °C | - |
| Operating temperature | TopF | 0 to +55 | °C | Module surface Note1 |
| | TopR | 0 to +55 | °C | Module rear surface Note2 |
| Relative humidity Note3 | RH | ≤ 95 | % | Ta≤40°C |
| | | ≤ 85 | % | 40°C<Ta≤50°C |
| | | ≤ 70 | % | 50°C<Ta≤55°C |
| Absolute humidity Note3 | AH | ≤ 73 Note4 | g/m ³ | Ta>55°C |

Note1: Measured at the LCD panel surface center (including self-heat)

Note2: Measured at center of the rear shield (including self-heat)

Note3: No condensation

Note4: Ta = 55°C, RH = 70%

9. ELECTRICAL CHARACTERISTICS

(1) Controller / LCD driving

(Ta = 25°C)

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remarks |
|--|--------|------|-----------------|---------------|------|---|
| Supply voltage | VDD | 10.8 | 12.0 | 13.2 | V | - |
| Ripple voltage | VRP | - | - | 100 | mV | for VDD |
| Differential input "L" Threshold voltage | ViTL | -100 | - | - | mV | at VCM=1.2V VCM: Common mode voltage for LVDS driver |
| Differential input "H" Threshold voltage | ViTH | - | - | +100 | mV | |
| Input voltage width | Vi | 0 | - | 2.4 | V | - |
| Terminating resistor | RT | - | 100 | - | Ω | - |
| Logic input "L" level | ViCL | 0 | - | 0.8 | V | MOD0,MOD1,MOD2 |
| Logic input "L" current | IiCL | -10 | - | -10 | μA | |
| Supply current | IDD | - | (2300) Note1 | 2700 Note2 | mA | at VDD=12.0V, MODE1 is selected. |

Note1: Checkered flag pattern (by EIAJ ED-2522)

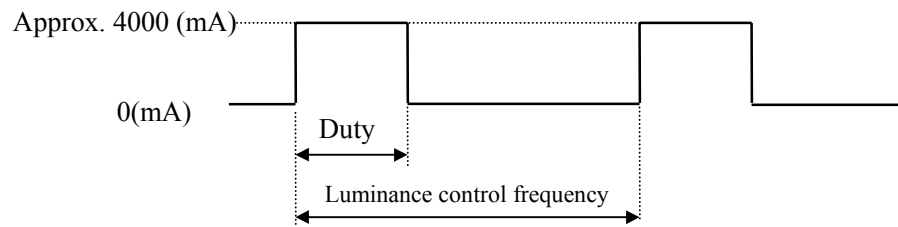
Note2: Pattern for maximum current

(2) Backlight

(Ta = 25°C)

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remarks |
|-------------------------|--------|------|------|------|------|---------------------------------|
| Supply voltage | VDDB | - | 12.0 | - | V | backlight power supply |
| Logic input "L" level | ViBL1 | 0 | - | 0.8 | V | for BRTP |
| Logic input "H" level | ViBH1 | 2 | - | 5.25 | V | |
| Logic input "L" level | ViBL2 | 0 | - | 0.8 | V | for BRTC, PWSEL |
| Logic input "H" level | ViBH2 | 2 | - | 5.25 | V | |
| Logic input "L" current | IiBL1 | -1.6 | - | - | mA | for BRTP |
| Logic input "H" current | IiBH1 | - | - | 3.5 | mA | |
| Logic input "L" current | IiBL2 | -610 | - | - | μA | for BRTC, PWSEL |
| Logic input "H" current | IiBH2 | - | - | 440 | μA | |
| Supply current | IDDB | - | 4000 | 4800 | mA | VDDB=12.0V at Max. luminance |

(3) Inverter current wave



Maximum luminance control : 100%

Minimum luminance control : 20%

Luminance control frequency : 285Hz (Typ.)

Note1: The power supply lines (VDDDB and GNDB) have large ripple voltage while dimming. There is the possibility that the ripple voltage produces an acoustic noise and signal wave noise in a system circuit (e.g. audio circuit). If the noise occurred in a circuit system, put an aluminum electrolytic capacitor (5,000 to 6,000 μ F) between the power source lines (VDDDB and GNDB), and the capacitor will be able to reduce the noise.

Note2: Luminance control frequency indicate the input pulse frequency, when select the external pulse control. See '11.INTERFACE PIN CONECTIONS AND FUNCTIONS, (4) External pulse control for luminance'.

(4) Fuses

| Parameter | Fuse | | Rating | Fusing current | Remarks |
|-----------|------------|-----------------|--------|----------------|---------|
| | Type | Supplier | | | |
| VDD | (CCF1NTE8) | KOA Corporation | (8A) | TBD A | Note1 |
| | | | (60V) | | |
| VDDB | (R451007) | Littelfuse Inc. | (7A) | TBD A | |
| | | | (63V) | | |

Note1: The power supply capacity should be more than the fusing current. If the power supply capacity is less than the fusing current, the fuse may not blow for a short time, and then nasty smell, smoking and so on may occur.

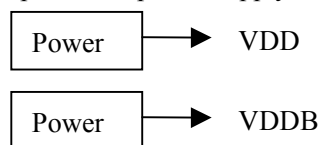
(5) Ripple of supply supply voltage

| Supply voltage | | VDD (for logic and LCD driver) | VDDB (for backlight) |
|------------------|-------|-----------------------------------|-------------------------|
| Acceptable level | Note1 | $\leq 100\text{mVp-p}$ | $\leq 200\text{mVp-p}$ |

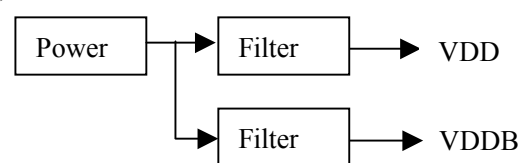
Note1: The acceptable level of ripple voltage includes spike noise.

Example of the power supply connection

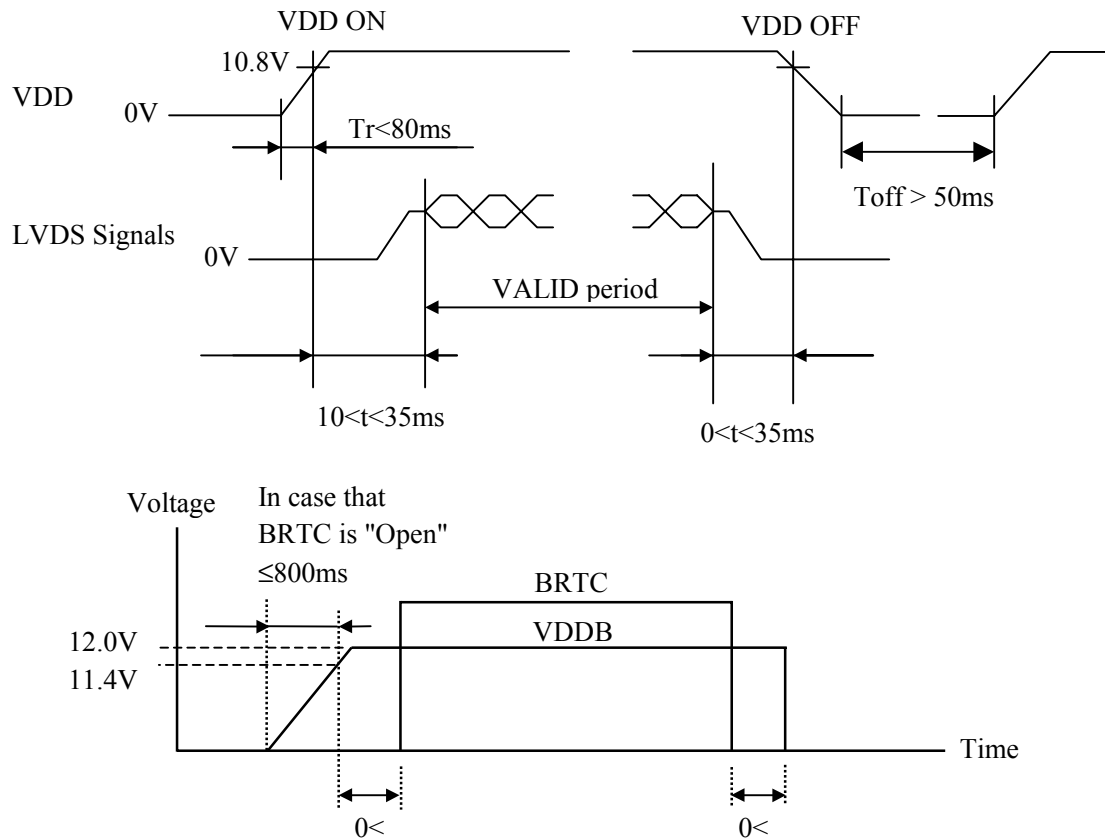
a) Separate the power supply



b) Put in the filter



10. POWER SUPPLY VOLTAGE SEQUENCE



Note1: LVDS signals should be measured at the terminal of 100Ω resistor.

Note2: In terms of voltage variation (voltage drop) while VDD rising edge is below 10.8V, a protection circuit may work, and then this product may not work.

Note3: The backlight power supply voltage should be inputted within the valid period of LVDS signals, in order to avoid unstable data display.

Note4: Rising time of backlihgth power supply (12V) should be less the 800ms, otherwise, the protection circuit will work, and backlight will be turned off.

Note5: When "L" period of BRTP is more than 50 ms, the backlight will be turned off by safety circuit.

Note6: PWSEL must not be "H" while VDDDB is 0V or BRTC is "L".

11. INTERFACE PIN CONNECTIONS AND FUNCTIONS

(1) Interface connector for signal and power

CN1 socket: FI-W41P-HF

Adaptable plug: FI-W41S

Supplier: Japan Aviation Electronics Industry Limited (JAE)

| Pin No. | Symbol | Function | Description |
|---------|--------|--------------------|-------------------------------|
| 1 | GND | ground | signal ground |
| 2 | CSR | Chip Select R | LUT control signal |
| 3 | CSL | Chip Select L | |
| 4 | SCLK | Serial Clock | |
| 5 | SDAT | Serial Data | |
| 6 | MOD0 | mode select | LVDS transmission mode select |
| 7 | MOD1 | | |
| 8 | BSEL0 | bit mapping select | LVDS bit mapping select |
| 9 | BSEL1 | | |
| 10 | TEST | test terminal | keep connect Open |
| 11 | GND | ground | signal ground |
| 12 | DB3+ | pixel data B3 | LVDS differential signal |
| 13 | DB3- | | |
| 14 | GND | ground | signal ground |
| 15 | CKB+ | pixel clock B | LVDS differential signal |
| 16 | CKB- | | |
| 17 | GND | ground | signal ground |
| 18 | DB2+ | pixel data B2 | LVDS differential signal |
| 19 | DB2- | | |
| 20 | GND | ground | signal ground |

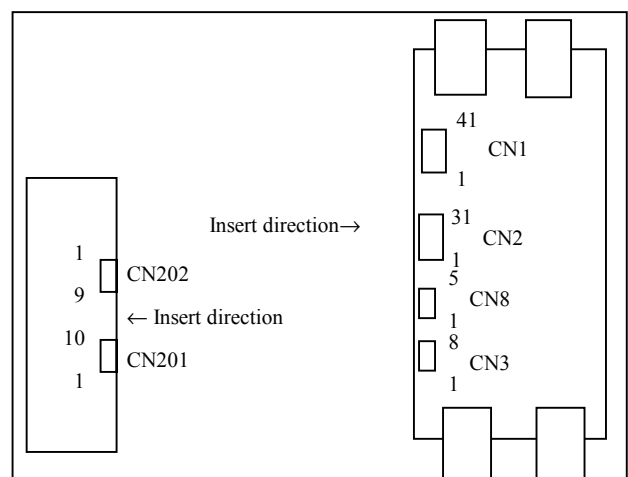
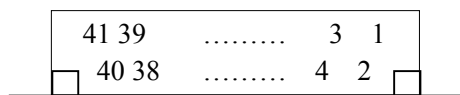
| Pin No. | Symbol | Function | Description |
|---------|--------|---------------|--------------------------|
| 21 | DB1+ | pixel data B1 | LVDS differential signal |
| 22 | DB1- | | |
| 23 | GND | ground | signal ground |
| 24 | DB0+ | pixel data B0 | LVDS differential signal |
| 25 | DB0- | | |
| 26 | GND | ground | signal ground |
| 27 | DA3+ | pixel data A3 | LVDS differential signal |
| 28 | DA3- | | |
| 29 | GND | ground | signal ground |
| 30 | CKA+ | pixel clock A | LVDS differential signal |
| 31 | CKA- | | |
| 32 | GND | ground | signal ground |
| 33 | DA2+ | pixel data A2 | LVDS differential signal |
| 34 | DA2- | | |
| 35 | GND | ground | signal ground |
| 36 | DA1+ | pixel data A1 | LVDS differential signal |
| 37 | DA1- | | |
| 38 | GND | ground | signal ground |
| 39 | DA0+ | pixel data A0 | LVDS differential signal |
| 40 | DA0- | | |
| 41 | GND | ground | signal ground |

Note1: GND is signal ground for Controller. GND is not connected to FG (Frame Ground) and GNDB (Backlight ground) in the LCD module. These grounds should be connected to system ground in customer equipment.

Note2: Use 100Ω twist pair wires for the cable.

Note3: All GND terminals should be used.

CN1: Figure of socket



CN2 socket: FI-W31P-HF

Adaptable plug: FI-W31S

Supplier: Japan Aviation Electronics Industry Limited (JAE)

| Pin No. | Symbol | Function | Description |
|---------|--------|---------------|--------------------------|
| 1 | GND | ground | signal ground |
| 2 | DD3+ | pixel data D3 | LVDS differential signal |
| 3 | DD3- | | |
| 4 | GND | ground | signal ground |
| 5 | CKD+ | pixel clock D | LVDS differential signal |
| 6 | CKD- | | |
| 7 | GND | ground | signal ground |
| 8 | DD2+ | pixel data D2 | LVDS differential signal |
| 9 | DD2- | | |
| 10 | GND | Ground | signal ground |
| 11 | DD1+ | pixel data D1 | LVDS differential signal |
| 12 | DD1- | | |
| 13 | GND | Ground | signal ground |
| 14 | DD0+ | pixel data D0 | LVDS differential signal |
| 15 | DD0- | | |

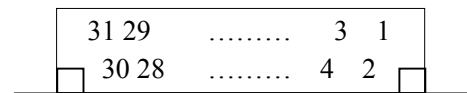
| Pin No. | Symbol | Function | Description |
|---------|--------|---------------|--------------------------|
| 16 | GND | Ground | signal ground |
| 17 | DC3+ | pixel data C3 | LVDS differential signal |
| 18 | DC3- | | |
| 19 | GND | Ground | signal ground |
| 20 | CKC+ | pixel clock C | LVDS differential signal |
| 21 | CKC- | | |
| 22 | GND | Ground | signal ground |
| 23 | DC2+ | pixel data C2 | LVDS differential signal |
| 24 | DC2- | | |
| 25 | GND | Ground | signal ground |
| 26 | DC1+ | pixel data C1 | LVDS differential signal |
| 27 | DC1- | | |
| 28 | GND | Ground | signal ground |
| 29 | DC0+ | pixel data C0 | LVDS differential signal |
| 30 | DC0- | | |
| 31 | GND | Ground | signal ground |

Note1: GND is signal ground for Controller. GND is not connected to FG (Frame Ground) and GNDB (Backlight ground) in the LCD module. These grounds should be connected to system ground in customer equipment.

Note2: Use 100Ω twist pair wires for the cable.

Note3: All GND terminals should be used.

CN2: Figure of socket



CN3 socket: IL-Z-8PL-SMTY

Adaptable plug: IL-Z-8S-S125C

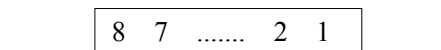
Supplier: Japan Aviation Electronics Industry Limited (JAE)

| Pin No. | Symbol | Function | Description |
|---------|--------|------------------|---------------|
| 1 | VDD | 12V power supply | +12V±10% |
| 2 | VDD | | |
| 3 | VDD | | |
| 4 | VDD | | |
| 5 | GND | ground | signal ground |
| 6 | GND | | |
| 7 | GND | | |
| 8 | GND | | |

Note1: GND is signal ground for Controller. GND is not connected to FG (Frame Ground) and GNDB (Backlight ground) in the LCD module. These grounds should be connected to system ground in customer equipment.

Note2: All GND and VDD terminals should be used.

CN3: Figure of socket



CN8 socket: IL-Z-5PL-SMTY

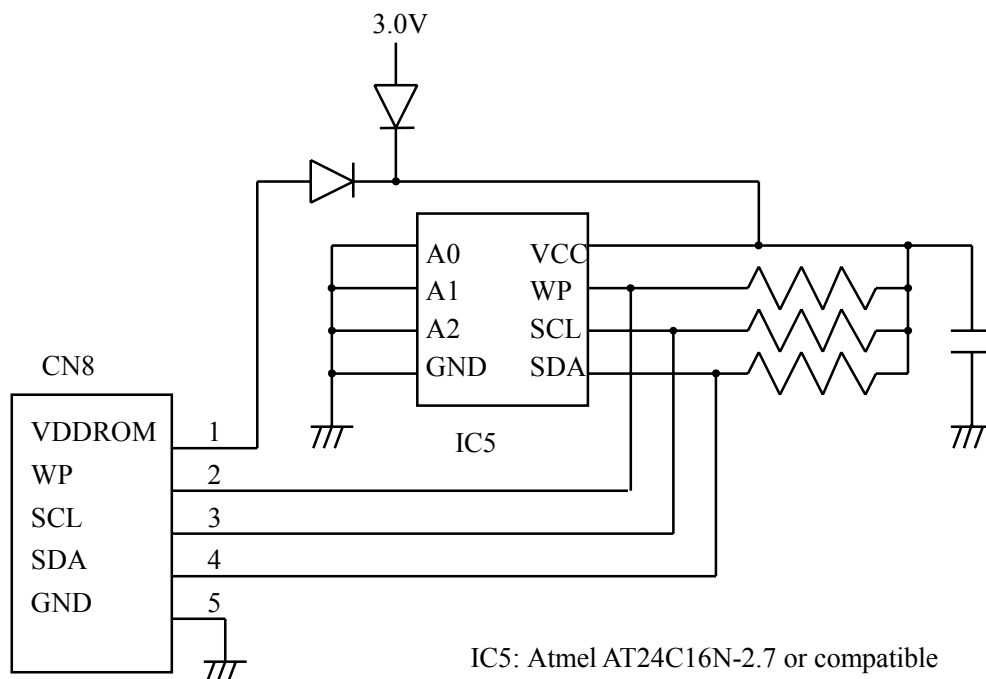
Adaptable plug: IL-Z-5S-S125C

Supplier: Japan Aviation Electronics Industry Limited (JAE)

| Pin No. | Symbol | Function | Description |
|---------|--------|-------------------------|--|
| 1 | VDDROM | Power supply for E2PROM | +2.7 to +5.0V |
| 2 | WP | Write protect | Write protect for E2PROM “Open” Write protect “L” Write enable |
| 3 | SCL | Serial clock | I2C Serial clock |
| 4 | SDA | Serial data | I2C Serial Data |
| 5 | GND | ground | Signal ground |

Note1: GND is signal ground for Controller. GND is not connected to FG (Frame Ground) and GNDB (Backlight ground) in the LCD module. These grounds should be connected to system ground in customer equipment.

CN8: Figure of socket



Block Diagram

(2) Connector for backlight unit

CN201 socket: DF3-8P-2H
 Adaptable plug: DF3-8S-2C
 Supplier: HIROSE ELECTRIC Co.,Ltd.

| Pin No. | Symbol | Function | Description |
|---------|--------|----------------------|-------------|
| 1 | GNDB | Ground for backlight | Note1 |
| 2 | GNDB | | |
| 3 | GNDB | | |
| 4 | GNDB | | |
| 5 | VDDDB | 12V power supply | +12V |
| 6 | VDDDB | | |
| 7 | VDDDB | | |
| 8 | VDDDB | | |

Note1: GNDB should be connected to system ground in customer equipment.

Note2: All GNDB and VDDDB terminals should be used

CN201: Figure of socket

| | | | | |
|---|---|-------|---|---|
| 1 | 2 | | 7 | 8 |
|---|---|-------|---|---|

CN202 socket: IL-Z-9PL1-SMTY
 Adaptable plug: IL-Z-9S-S125C3
 Supplier: Japan Aviation Electronics Industry Limited (JAE)

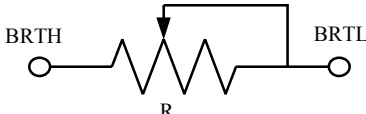
| Pin No. | Symbol | Function | Description |
|---------|--------|---------------------------------|---|
| 1 | GNDB | Ground for backlight | Note1 |
| 2 | GNDB | | |
| 3 | N.C. | Non-connection | Keep the terminal open |
| 4 | BRTC | Backlight ON/OFF control signal | "H" or "Open": Backlight on "L": Backlight off |
| 5 | BRTH | Luminance control signal | - |
| 6 | BRTL | Luminance control signal | |
| 7 | BRTP | Luminance control signal | |
| 8 | GNDB | Ground for backlight | Note1 |
| 9 | PWSEL | Luminance control select signal | - |

Note1: All GNDB terminals should be used.

CN202: Figure of socket

| | | | | |
|---|---|-------|---|---|
| 9 | 8 | | 2 | 1 |
|---|---|-------|---|---|

(3) Luminance control

| Control method | Function and adjustment | PWSEL | BRTP signal |
|----------------------------|--|---------------|-------------|
| PWM | Luminance controlled by BRTP signal. See "(4) External pulse control for luminance". | "L" | Input |
| Variable resistor Note1 | <p>The variable resistor for luminance control should be 10kΩ type, and zero point of the resistor corresponds to the minimum of luminance.</p>  <p>Max. luminance (100%): R=10kΩ Min. luminance (30%): R=0Ω Mating variable resistor: 10kΩ \pm5%,B curve, 1/10W</p> | "H" or "OPEN" | "OPEN" |
| Voltage Note1 | BRTH should be fixed to 0V, and input to BRTL as follows. Max. Luminance (100%): 1V(Typ.) Min. Luminance (30%): 0V | | |

Note1: Luminance control may be overlap noises on the display image depending on input signal timing.
In this case, keep off the interference between input signal and backlight driving signal, by PWM method.

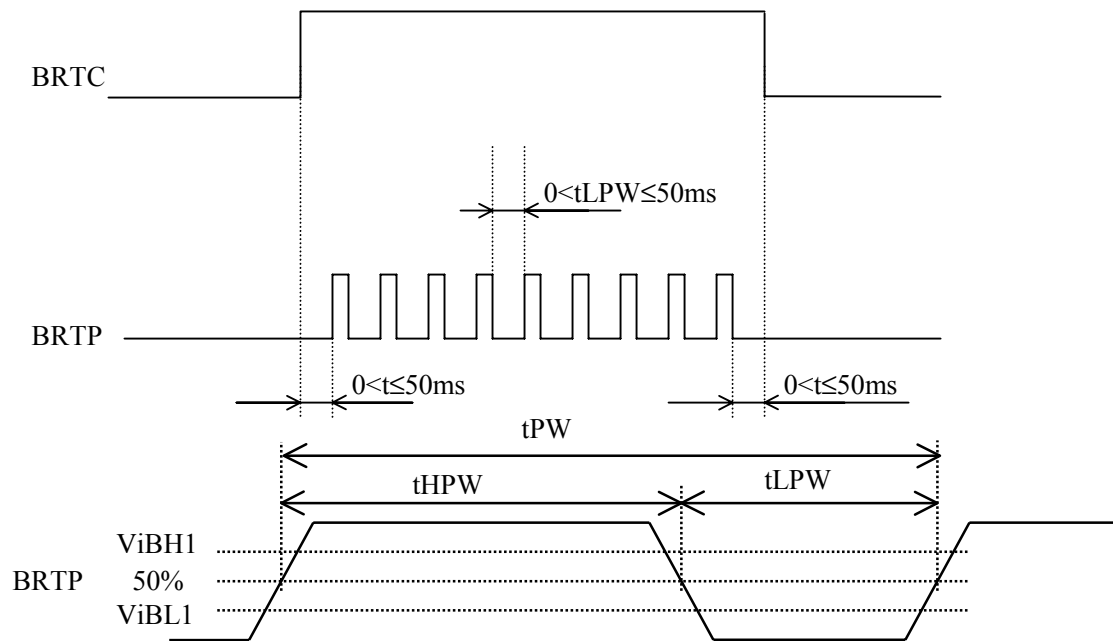
(4) External pulse control for luminance

Luminance control with external pulse is valid, when PWSWL is "L" and external pulse signal is inputted to BRTP. This luminance control is controlled by duty ratio, and luminance is as follows.

Duty ratio=100%: Max. luminance

Duty ratio=20%: Min. luminance

In case of BRTC = High or Open, the inverter will stop work when BRTP terminal is fixed to Low in the condition of PWSEL = Low. In this case, backlight will not turn on, even if external pulse signal is put to BRTP again. This is no damage. Inverter will start to work when power is supplied again.



| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remarks |
|-----------------|------------|------|-----------|------|------|---------|
| Frequency | $1/tPW$ | 185 | - | 325 | Hz | Note1 |
| "L" period | $tLPW$ | - | - | 50 | ms | Note2 |
| Pulse-width | $tHPW/tPW$ | 20 | - | 100 | % | Note3 |
| Luminance ratio | - | - | 30 to 100 | - | % | - |
| Input voltage | $ViBL1$ | 0 | - | 0.8 | V | - |
| | $ViBH1$ | 2.0 | - | 5.25 | V | - |

Note1: See the following formula for luminance control frequency.

$$\text{Luminance control frequency} = V_{\text{sync frequency}} \times (n+0.25) \text{ [or } (n + 0.75)]$$

Note2: In case $tLPW$ exceeds 50ms, backlight will turn off by its protection circuits.

Note3: Max. Luminance at 100%

Attention: External pulse control for luminance may be disturbed the display image when set up frequency is interfered with internal signal frequency.

(5) LVDS data transmission mode

LVDS data transmission mode is selectable with MOD0, and MOD1 terminal.

| MOD0 to 1 Terminal Note1 | | mode name | data transmission chart |
|--------------------------------|---|--|-------------------------|
| 1 | 0 | | |
| H | H | mode 0 L/R transmission mode | |
| H | L | mode 1 4divided transmission mode | |
| L | H | Reserved | --- |
| L | L | Reserved | --- |

Note1: "H" must be "OPEN"

12. METHOD OF CONNECTION FOR LVDS TRANSMITTER

LVDS data bit mapping mode is selectable with BSEL0, and BSEL1 terminal.

| | Bit mapping | | | Transmitter Pin Assign | | | Output Connector | | CN1 | |
|--------------|-------------|-------|-------|------------------------|-------------------|--------------|------------------|------|----------|-------------|
| | BSEL[1:0] | | | Singl type LVDS Tx | Dual type LVDS TX | | | | Pin No. | Signal name |
| | [H:H] | [H:L] | [L:H] | | Thine THC63LVD823 | NS DS90C387 | | | | |
| pixel data A | L2 | L7 | L0 | TA0 | R12 | R10 | ATA-ATA+ | | | |
| | L3 | L6 | L1 | TA1 | R13 | R11 | | | | |
| | L4 | L5 | L2 | TA2 | R14 | R12 | | | 40 | DA0- |
| | L5 | L4 | L3 | TA3 | R15 | R13 | | | 39 | DA0+ |
| | L6 | L3 | L4 | TA4 | R16 | R14 | | | | |
| | L7 | L2 | L5 | TA5 | R17 | R15 | | | | |
| | C2 | C7 | C0 | TA6 | G12 | G10 | ATB-ATB+ | | | |
| | C3 | C6 | C1 | TB0 | G13 | G11 | | | | |
| | C4 | C5 | C2 | TB1 | G14 | G12 | | | | |
| | C5 | C4 | C3 | TB2 | G15 | G13 | | | 37 | DA1- |
| | C6 | C3 | C4 | TB3 | G16 | G14 | | | 36 | DA1+ |
| | C7 | C2 | C5 | TB4 | G17 | G15 | | | | |
| | R2 | R7 | R0 | TB5 | B12 | B10 | ATC-ATC+ | | | |
| | R3 | R6 | R1 | TB6 | B13 | B11 | | | | |
| | R4 | R5 | R2 | TC0 | B14 | B12 | | | | |
| | R5 | R4 | R3 | TC1 | B15 | B13 | | | | |
| | R6 | R3 | R4 | TC2 | B16 | B14 | | | 34 | DA2- |
| | R7 | R2 | R5 | TC3 | B17 | B15 | | | 33 | DA2+ |
| | Hsync | Hsync | Hsync | TC4 | HSYNC | HSYNC | ATD-ATD+ | | | |
| | Vsync | Vsync | Vsync | TC5 | VSYNC | VSYNC | | | | |
| | DE | DE | DE | TC6 | DE | DE | | | | |
| | L0 | L1 | L6 | TD0 | R10 | R16 | | | | |
| | L1 | L0 | L7 | TD1 | R11 | R17 | | | 28 | DA3- |
| | C0 | C1 | C6 | TD2 | G10 | G16 | | | 27 | DA3+ |
| C1 | C0 | C7 | TD3 | G11 | G17 | ATCLK-ATCLK+ | | | | |
| R0 | R1 | R6 | TD4 | B10 | B16 | | | | | |
| R1 | R0 | R7 | TD5 | B11 | B17 | | | | | |
| NC | NC | NC | TD6 | - | - | | | 31 | CKA- | |
| CLK | CLK | CLK | CLK | CLK | CLK | | | 30 | CKA+ | |
| pixel data B | L2 | L7 | L0 | TA0 | R22 | | | R20 | BTA-BTA+ | |
| | L3 | L6 | L1 | TA1 | R23 | R21 | | | | |
| | L4 | L5 | L2 | TA2 | R24 | R22 | 25 | DB0- | | |
| | L5 | L4 | L3 | TA3 | R25 | R23 | 24 | DB0+ | | |
| | L6 | L3 | L4 | TA4 | R26 | R24 | | | | |
| | L7 | L2 | L5 | TA5 | R27 | R25 | | | | |
| | C2 | C7 | C0 | TA6 | G22 | G20 | BTB-BTB+ | | | |
| | C3 | C6 | C1 | TB0 | G23 | G21 | | | | |
| | C4 | C5 | C2 | TB1 | G24 | G22 | | | | |
| | C5 | C4 | C3 | TB2 | G25 | G23 | | | 22 | DB1- |
| | C6 | C3 | C4 | TB3 | G26 | G24 | | | 21 | DB1+ |
| | C7 | C2 | C5 | TB4 | G27 | G25 | | | | |
| | R2 | R7 | R0 | TB5 | B22 | B20 | BTC-BTC+ | | | |
| | R3 | R6 | R1 | TB6 | B23 | B21 | | | | |
| | R4 | R5 | R2 | TC0 | B24 | B22 | | | | |
| | R5 | R4 | R3 | TC1 | B25 | B23 | | | | |
| | R6 | R3 | R4 | TC2 | B26 | B24 | | | 19 | DB2- |
| | R7 | R2 | R5 | TC3 | B27 | B25 | | | 18 | DB2+ |
| | Hsync | Hsync | Hsync | TC4 | HSYNC | HSYNC | BTD-BTD+ | | | |
| | Vsync | Vsync | Vsync | TC5 | VSYNC | VSYNC | | | | |
| | DE | DE | DE | TC6 | DE | DE | | | | |
| | L0 | L1 | L6 | TD0 | R20 | R26 | | | | |
| | L1 | L0 | L7 | TD1 | R21 | R27 | | | 13 | DB3- |
| | C0 | C1 | C6 | TD2 | G20 | G26 | | | 12 | DB3+ |
| C1 | C0 | C7 | TD3 | G21 | G27 | BTCLK-BTCLK+ | | | | |
| R0 | R1 | R6 | TD4 | B20 | B26 | | | | | |
| R1 | R0 | R7 | TD5 | B21 | B27 | | | | | |
| NC | NC | NC | TD6 | - | - | | | 16 | CKB- | |
| CLK | CLK | CLK | CLK | CLK | CLK | | | 15 | CKB+ | |

| | BSEL[1:0] | | | Singl type LVDS Tx | Dual type LVDS TX | | Output Connector | CN2 | |
|--------------------|-----------|-------|-------|-----------------------|----------------------|----------------|---------------------|---------|----------------|
| | [H:H] | [H:L] | [L:H] | | Thine THC63LVD823 | NS DS90C387 | | Pin No. | Signal name |
| pixel data C | L2 | L7 | L0 | TA0 | R12 | R10 | CTA- CTA+ | | |
| | L3 | L6 | L1 | TA1 | R13 | R11 | | | |
| | L4 | L5 | L2 | TA2 | R14 | R12 | | 30 | DC0- |
| | L5 | L4 | L3 | TA3 | R15 | R13 | | 29 | DC0+ |
| | L6 | L3 | L4 | TA4 | R16 | R14 | | | |
| | L7 | L2 | L5 | TA5 | R17 | R15 | | | |
| | C2 | C7 | C0 | TA6 | G12 | G10 | CTB- CTB+ | | |
| | C3 | C6 | C1 | TB0 | G13 | G11 | | | |
| | C4 | C5 | C2 | TB1 | G14 | G12 | | | |
| | C5 | C4 | C3 | TB2 | G15 | G13 | | 27 | DC1- |
| | C6 | C3 | C4 | TB3 | G16 | G14 | | 26 | DC1+ |
| | C7 | C2 | C5 | TB4 | G17 | G15 | | | |
| | R2 | R7 | R0 | TB5 | B12 | B10 | CTC- CTC+ | | |
| | R3 | R6 | R1 | TB6 | B13 | B11 | | | |
| | R4 | R5 | R2 | TC0 | B14 | B12 | | | |
| | R5 | R4 | R3 | TC1 | B15 | B13 | | 24 | DC2- |
| | R6 | R3 | R4 | TC2 | B16 | B14 | | 23 | DC2+ |
| | R7 | R2 | R5 | TC3 | B17 | B15 | | | |
| | Hsync | Hsync | Hsync | TC4 | HSYNC | HSYNC | CTD- CTD+ | | |
| | Vsync | Vsync | Vsync | TC5 | VSYN | VSYN | | | |
| | DE | DE | DE | TC6 | DE | DE | | | |
| | L0 | L1 | L6 | TD0 | R10 | R16 | | | |
| | L1 | L0 | L7 | TD1 | R11 | R17 | | 18 | DC3- |
| | C0 | C1 | C6 | TD2 | G10 | G16 | | 17 | DC3+ |
| Pixel data D | C1 | C0 | C7 | TD3 | G11 | G17 | DTA- DTA+ | | |
| | R0 | R1 | R6 | TD4 | B10 | B16 | | | |
| | R1 | R0 | R7 | TD5 | B11 | B17 | | | |
| | NC | NC | NC | TD6 | - | - | | | |
| | CLK | CLK | CLK | CLK | CLK | CLK | | 21 | CKC- |
| | | | | | | | | 20 | CKC+ |
| | L2 | L7 | L0 | TA0 | R22 | R20 | DTB- DTB+ | | |
| | L3 | L6 | L1 | TA1 | R23 | R21 | | | |
| | L4 | L5 | L2 | TA2 | R24 | R22 | | 15 | DD0- |
| | L5 | L4 | L3 | TA3 | R25 | R23 | | 14 | DD0+ |
| | L6 | L3 | L4 | TA4 | R26 | R24 | | | |
| | L7 | L2 | L5 | TA5 | R27 | R25 | DTC- DTC+ | | |
| | C2 | C7 | C0 | TA6 | G22 | G20 | | | |
| | C3 | C6 | C1 | TB0 | G23 | G21 | | | |
| | C4 | C5 | C2 | TB1 | G24 | G22 | | 12 | DD1- |
| | C5 | C4 | C3 | TB2 | G25 | G23 | | 11 | DD1+ |
| | C6 | C3 | C4 | TB3 | G26 | G24 | DTD- DTD+ | | |
| | C7 | C2 | C5 | TB4 | G27 | G25 | | | |
| | R2 | R7 | R0 | TB5 | B22 | B20 | | | |
| | R3 | R6 | R1 | TB6 | B23 | B21 | | | |
| | R4 | R5 | R2 | TC0 | B24 | B22 | | | |
| | R5 | R4 | R3 | TC1 | B25 | B23 | DTCLK- DTCLK+ | 9 | DD2- |
| | R6 | R3 | R4 | TC2 | B26 | B24 | | 8 | DD2+ |
| | R7 | R2 | R5 | TC3 | B27 | B25 | | | |
| | Hsync | Hsync | Hsync | TC4 | HSYNC | HSYNC | | | |
| | Vsync | Vsync | Vsync | TC5 | VSYN | VSYN | | | |
| | DE | DE | DE | TC6 | DE | DE | DTCLK- DTCLK+ | | |
| | L0 | L1 | L6 | TD0 | R20 | R26 | | | |
| | L1 | L0 | L7 | TD1 | R21 | R27 | | 3 | DD3- |
| | C0 | C1 | C6 | TD2 | G20 | G26 | | 2 | DD3+ |
| | C1 | C0 | C7 | TD3 | G21 | G27 | | | |
| | R0 | R1 | R6 | TD4 | B20 | B26 | | | |
| | R1 | R0 | R7 | TD5 | B21 | B27 | | | |
| | NC | NC | NC | TD6 | - | - | | | |
| | CLK | CLK | CLK | CLK | CLK | CLK | | 6 | CKD- |
| | | | | | | | | 5 | CKD+ |

13. DISPLAY GRAYSCALES vs. INPUT DATA SIGNALS

| Display colors | | Data signal (0: Low level, 1: High level) | | | | | | | | | | | | | | | | | | | | | | | |
|------------------|--------|---|---|---|---|---|---|---|---|---------------------------------|---|---|---|---|---|---|---|---------------------------------|---|---|---|---|---|---|--|
| | | LA7 LA6 LA5 LA4 LA3 LA2 LA1 LA0 | | | | | | | | CA7 CA6 CA5 CA4 CA3 CA2 CA1 CA0 | | | | | | | | RA7 RA6 RA5 RA4 RA3 RA2 RA1 RA0 | | | | | | | |
| | | LB7 LB6 LB5 LB4 LB3 LB2 LB1 LB0 | | | | | | | | CB7 CB6 CB5 CB4 CB3 CB2 CB1 CB0 | | | | | | | | RB7 RB6 RB5 RB4 RB3 RB2 RB1 RB0 | | | | | | | |
| | | LC7 LC6 LC5 LC4 LC3 LC2 LC1 LC0 | | | | | | | | CC7 CC6 CC5 CC4 CC3 CC2 CC1 CC0 | | | | | | | | RC7 RC6 RC5 RC4 RC3 RC2 RR1 RR0 | | | | | | | |
| | | LD7 LD6 LD5 LD4 LD3 LD2 LD1 LD0 | | | | | | | | CD7 CD6 CD5 CD4 CD3 CD2 CD1 CD0 | | | | | | | | RD7 RD6 RD5 RD4 RD3 RD2 RD1 RD0 | | | | | | | |
| Left grayscale | 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 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | dark | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | ↑ | : | | | | | | | | : | | | | | | | | | : | | | | | | |
| | ↓ | : | | | | | | | | : | | | | | | | | | : | | | | | | |
| | bright | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Center grayscale | 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 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | ↑ | : | | | | | | | | : | | | | | | | | : | | | | | | | |
| | ↓ | : | | | | | | | | : | | | | | | | | : | | | | | | | |
| | bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | White | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Right grayscale | 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 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | |
| | dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | |
| | ↑ | : | | | | | | | | : | | | | | | | | : | | | | | | | |
| | ↓ | : | | | | | | | | : | | | | | | | | : | | | | | | | |
| | bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | | |
| | White | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | | |

Note1: The combination of 8-bit signals results in equivalent to 256 grayscale.

14. 10BIT LOOK UP TABLE FOR GAMMA ADJUSTMENT

Table1: Serial data Composition

| DATA | DATA name | Function | Remarks |
|------|-----------|-------------------|-------------|
| D31 | CMD5 | Control Command | See table2. |
| D30 | CMD4 | Control Command | |
| D29 | CMD3 | Control Command | |
| D28 | CMD2 | Control Command | |
| D27 | CMD1 | Control Command | |
| D26 | CMD0 | Control Command | |
| D25 | ADD9 | LUT Address (MSB) | See table3. |
| D24 | ADD8 | LUT Address | |
| D23 | ADD7 | LUT Address | |
| D22 | ADD6 | LUT Address | |
| D21 | ADD5 | LUT Address | |
| D20 | ADD4 | LUT Address | |
| D19 | ADD3 | LUT Address | |
| D18 | ADD2 | LUT Address | |
| D17 | ADD1 | LUT Address | |
| D16 | ADD0 | LUT Address (LSB) | |
| D15 | Dummy | Dummy Data "0" | See table4. |
| D14 | Dummy | Dummy Data "0" | |
| D13 | Dummy | Dummy Data "0" | |
| D12 | Dummy | Dummy Data "0" | |
| D11 | Dummy | Dummy Data "0" | |
| D10 | Dummy | Dummy Data "0" | |
| D9 | DATA9 | LUT Data (MSB) | |
| D8 | DATA8 | LUT Data | |
| D7 | DATA7 | LUT Data | |
| D6 | DATA6 | LUT Data | |
| D5 | DATA5 | LUT Data | |
| D4 | DATA4 | LUT Data | |
| D3 | DATA3 | LUT Data | |
| D2 | DATA2 | LUT Data | |
| D1 | DATA1 | LUT Data | |
| D0 | DATA0 | LUT Data (LSB) | |

Table2: Command table (CMD5 to CMD0 : 6bit)

| DATA name | Parameter | Remarks |
|-----------|---|--|
| CMD5 | Must be set "1" for normal operation | - |
| CMD4 | Must be set "1" for normal operation | - |
| CMD3 | "1": Word write "0": Sequential write | - |
| CMD2 | Must be set "1" for normal operation | - |
| CMD1 | "1": Single sub pixel data write "0": Three sub pixel data write | "1": Use ADD9,ADD8 "0": Not use ADD9,ADD8 |
| CMD0 | Must be set "0" for normal operation | - |

Table2: Address table (ADD9 to ADD0 : 10bit)

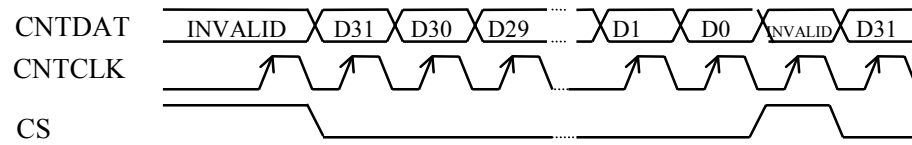
| DATA name | Parameter | Remarks |
|-----------|---|---|
| ADD9 | Sub pixel Select ADD9:8= 0:0 Left 0:1 Center 1:0 Right 1:1 Command | - |
| ADD8 | | |
| ADD7 | | |
| ADD6 | | |
| ADD5 | | |
| ADD4 | LUT Address (=Input Data) 256 address 00h – FFh | If ADD9:8 = 1:1. Must be set ADD7:0 = 00h. |
| ADD3 | | |
| ADD2 | | |
| ADD1 | | |
| ADD0 | | |

Table3: Data table (DATA15 to DATA0 : 16bit)

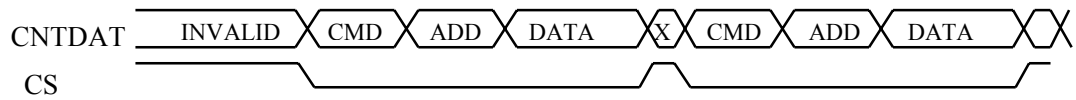
| DATA | DATA name | Parameter | Remarks |
|------|-----------|-------------------------------|---|
| D15 | Dummy | Dummy Data Must be set "0" | - |
| D14 | Dummy | | |
| D13 | Dummy | | |
| D12 | Dummy | | |
| D11 | Dummy | | |
| D10 | Dummy | | |
| D9 | DATA9 | 10bit LUT Data 000h – 3FFh | Set ADD9:0=300h DATA9:0=000h : Disable LUT (default) DATA9:0=001h : Enable LUT |
| D8 | DATA8 | | |
| D7 | DATA7 | | |
| D6 | DATA6 | | |
| D5 | DATA5 | | |
| D4 | DATA4 | | |
| D3 | DATA3 | | |
| D2 | DATA2 | | |
| D1 | DATA1 | | |
| D0 | DATA0 | | |

15. LUT SERIAL COMMUNICATION TIMINGS

Write timing



Word write mode

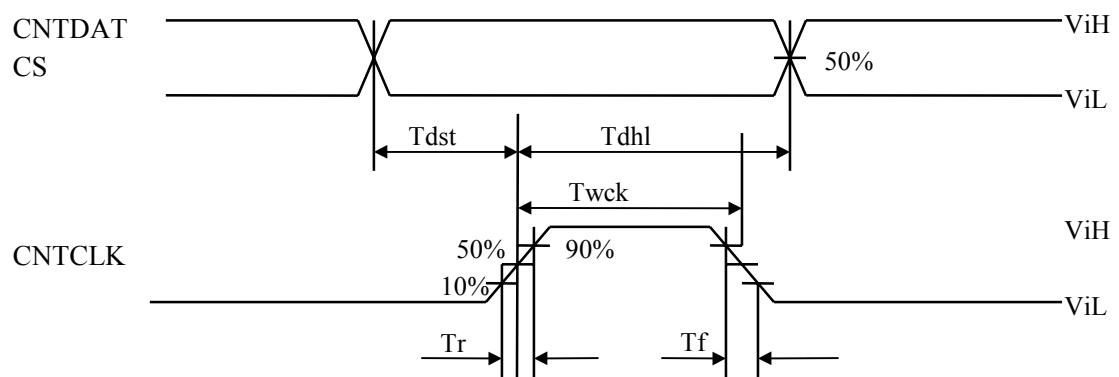


Sequential write mode



| Parameter | Symbol | Min. | Max. | Unit | Remarks |
|---------------------|--------|------|------|------|-----------|
| CLK pulse-width | Twck | 50 | - | ns | CNTCLK |
| CLK frequency | Fclk | - | 5 | MHz | |
| DATA,CS set-up-time | Tdst | 50 | - | ns | CNTDAT,CS |
| DATA,CS hold-time | Tdhl | 50 | - | ns | |

SERIAL COMMUNICATION WAVEFORM



16. INPUT SIGNAL TIMINGS

(1) Input signal specifications

| | Parameter | Symbol | Min. | Typ. | Max. | Unit | Remarks |
|-------|-----------------|-------------|-------------|----------------|-----------|-----------|-----------------------|
| CLK | Frequency | 1/ tc | 80.0 - | 83.26 12.01 | 85.0 - | MHz ns | - |
| | Duty | tc / tcl | Note1 | | | - | - |
| | Rise, fall | terf | | | | ns | - |
| Hsync | Period | th | 7.72 660 | 8.071 672 | - 690 | μs CLK | Typ=123.9kHz Note3 |
| | Display period | thd | 640 | | | CLK | - |
| | Blank | thp+thb+thf | 20 | 32 | 50 | CLK | - |
| Vsync | Period | tv | - 2053 | 16.667 2064 | - - | ms H | Typ=60.0Hz |
| | Display period | tvd | 2048 | | | H | - |
| | Blank | tvb+tvf | 5 | 16 | - | H | - |
| DE | CLK-DE set-up | tdes | Note1 | | | ns | - |
| | CLK-DE hold | tdeh | | | | ns | - |
| | Raise,fall | tderf | | | | ns | - |
| DATA | CLK-DATA set-up | tds | Note1 | | | ns | - |
| | CLK-DATA hold | tdh | | | | ns | - |
| | Rise, fall | tdrf | | | | ns | - |

Note1: Timing specifications are defined by the input signals of LVDS transmitter.

THC63LVD823 (THine) or equivalent products are recommended for LVDS transmitter.

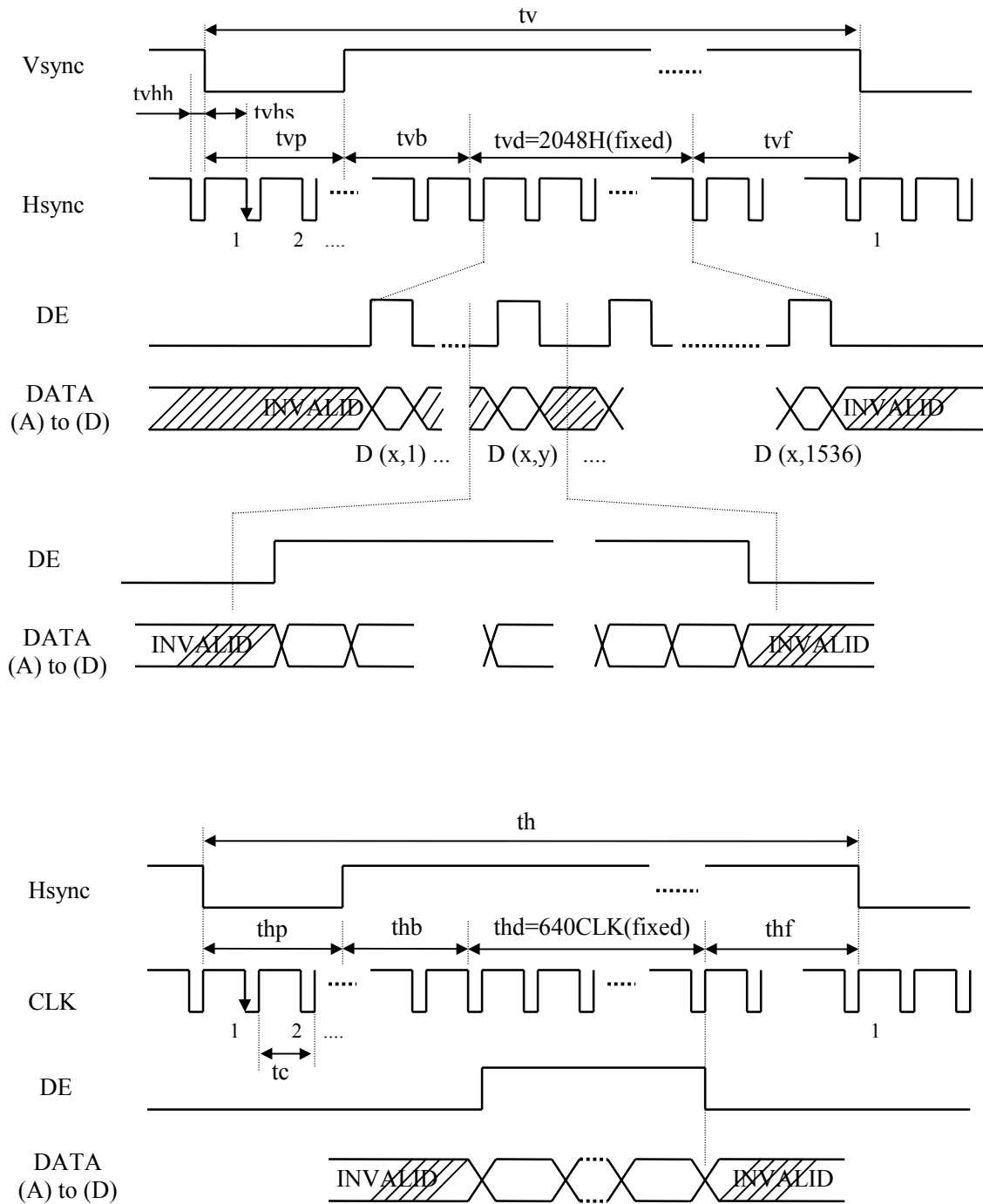
Note2: Both of “time” and “CLK number” of the “th” must keep the Minimum value of specification.

Note3: "th" (CLK number) should be fixed to 2n (n= natural number: 1,2,3...). In case "th" is not the specified value, it may cause display deterioration.

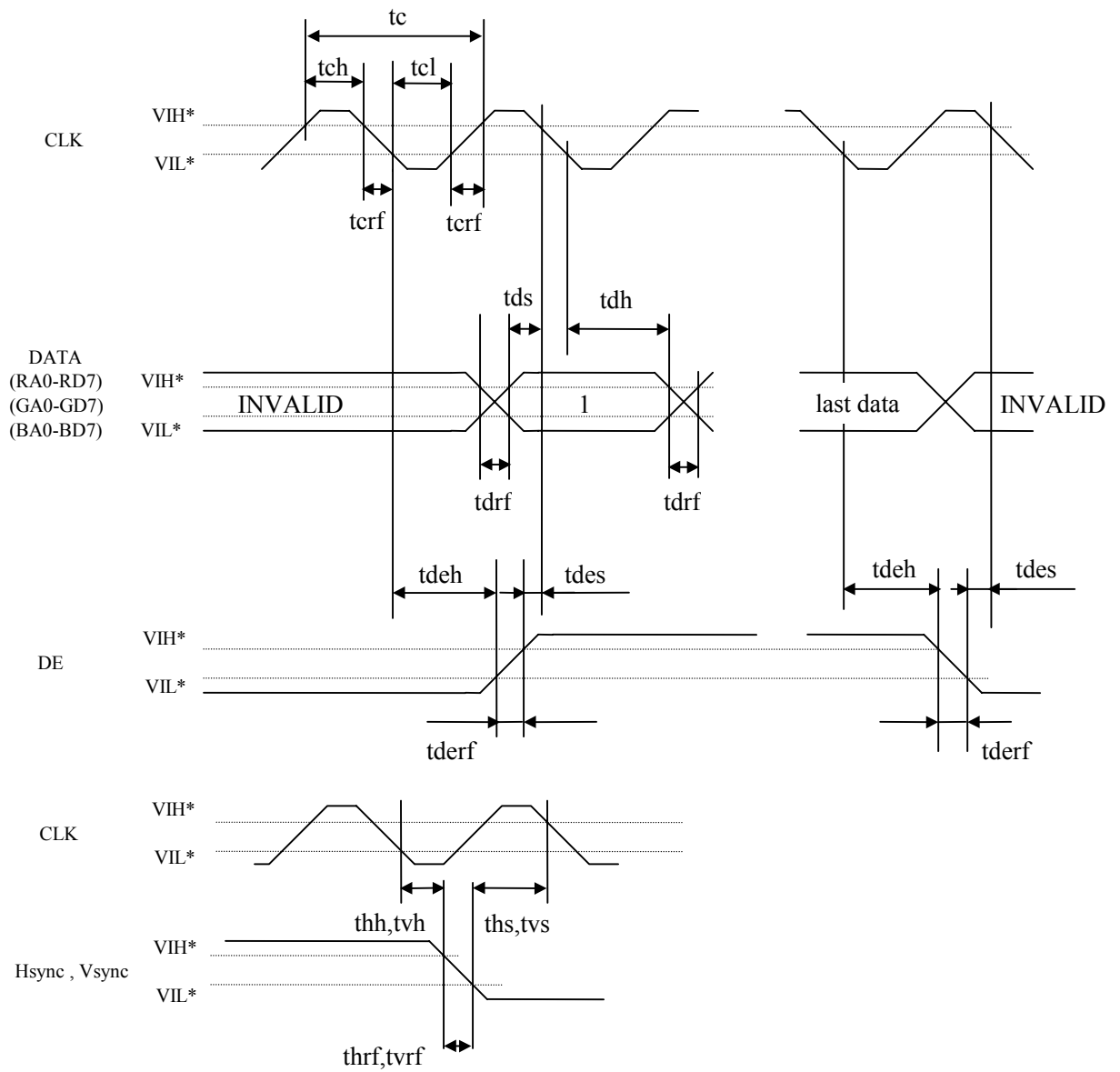
e.g.: "th" (CLK number)

660, 662, 664, ... 672, 674, ... 688, 690

(2) Input signals timing chart



[Detail of input signals timing chart]



* See the specifications of LVDS manufactures for detailed design.

(3) Display positions of input data

| | | | |
|-----------|-----------|-----|--------------|
| D(0,0) | D(1,0) | ... | D(2559,0) |
| D(0,1) | D(1,1) | ... | D(2559,1) |
| • | • | • | • |
| • | • | • | • |
| • | • | • | • |
| • | • | • | • |
| • | • | • | • |
| • | • | • | • |
| D(0,2047) | D(1,2047) | ... | D(2559,2047) |

(4) Pixel Arrangement

| | | | |
|-----|-------|-------|---------------|
| | 0 | 1 | 2559 |
| 0 | L C R | L C R | • • • • • • • |
| | • • • | • • • | • • • • • • • |
| 204 | L C R | L C R | • • • • • • • |
| 7 | L C R | L C R | L C R |

17. OPTICAL CHARACTERISTICS

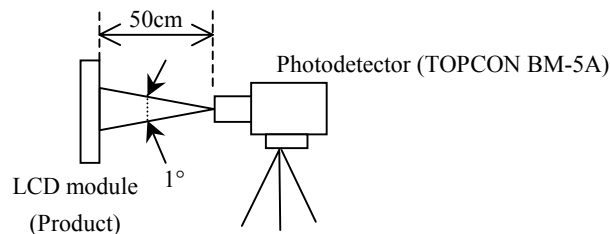
(Note1)

| Parameter | Symbol | Condition | | Min. | Typ. | Max. | Unit | Remarks |
|--|---------------|---|-----------|------|----------------|------|-------------------|---------|
| Contrast ratio | CR | Note2 | | - | 600 | - | - | Note3 |
| Luminance | L | White, Note2 | | - | 850 | - | cd/m ² | - |
| Luminance uniformity | LU | Max. / Min. | | - | 1.1 | 1.3 | - | Note6 |
| Chromaticity Coordinates | - | White (x, y) | | - | (0.255, 0.310) | - | - | Note2 |
| Viewing angle range | θ_{x+} | CR > 10, White/Black $\theta_{y\pm}=0^\circ$ | | - | 85 | - | deg. | Note4 |
| | θ_{x-} | | | - | 85 | - | deg. | |
| | θ_{y+} | CR > 10, White/Black $\theta_{x\pm}=0^\circ$ | | - | 85 | - | deg. | |
| | θ_{y-} | | | - | 85 | - | deg. | |
| Response time (Module surface temperature :TBD) | Ton | Black to White | 10% → 90% | - | 15 | - | ms | Note5 |
| | Toff | White to Black | 90% → 10% | - | 15 | - | ms | Note5 |
| Luminance control range | - | Maximum luminance: 100% | | - | 30 to 100 | - | % | - |

Note1: Measurement conditions are as follows.

Ta = 25°C, VDD = 12V, VDDB=12V, Display mode: QSXGA, Horizontal cycle = 123.9kHz,
Vertical cycle = 60.0Hz

Optical characteristics are measured at luminance saturation after 20minutes from working the product, in the dark room. Also measurement method for luminance is as follows.

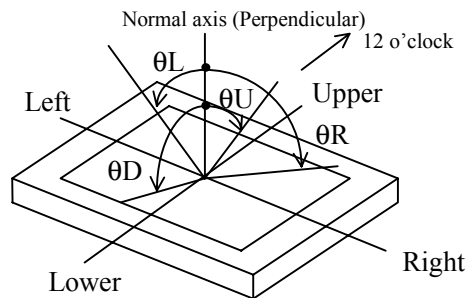


Note2: Viewing angle is $\theta_x = \pm 0^\circ$, $\theta_y = \pm 0^\circ$. at center.

Note3: The contrast ratio is calculated by using the following formula.

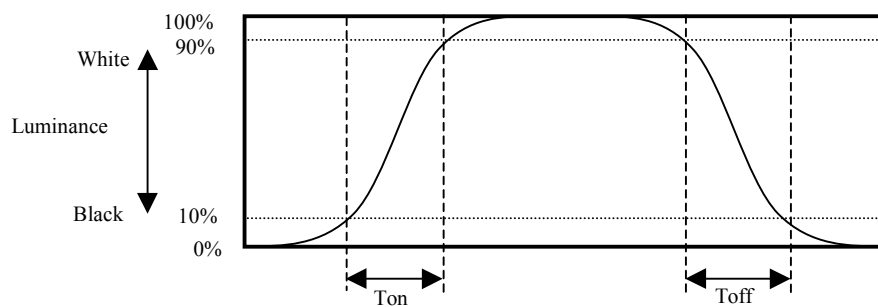
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance with all pixels in "white"}}{\text{Luminance with all pixels in "black"}}$$

Note4: Definition of viewing angles



Note5: Definition of response times

Response time is measured, the luminance changes from "black" to "white", or "white" to "black" on the same screen point, by photo-detector. Ton is the time it takes the luminance change from 10% up to 90%. Also Toff is the time it takes the luminance change from 90% down to 10% (See the following diagram.).



Note6: Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

$$\text{Luminance uniformity} = \frac{\text{Maximum Luminance}}{\text{Minimum Luminance}}$$

The luminance is measured at near the 5 points shown below.

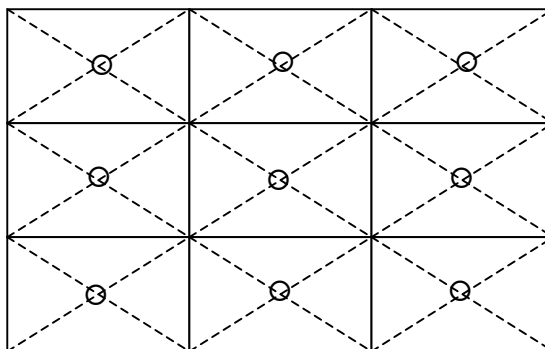
| | | | |
|------|-----|------|------|
| | 427 | 1279 | 2133 |
| 341 | ① | | ② |
| 1023 | | ③ | |
| 1707 | ④ | | ⑤ |

18. RELIABILITY TESTS

| Test item | | Condition | Judgment |
|--|---------------|---|--|
| High temperature and humidity (Operation) | | ① $60 \pm 2^{\circ}\text{C}$, RH = 60%, 240hours ② Display data is white. | No display malfunctions Note1 |
| Heat cycle (Operation) | | ① $0 \pm 3^{\circ}\text{C}$...1hour $55 \pm 3^{\circ}\text{C}$...1hour ② 50cycles, 4hours/cycle ③ Display data is white. | No display malfunctions Note1 |
| Thermal shock (Non operation) | | ① $-20 \pm 3^{\circ}\text{C}$...30minutes $60 \pm 3^{\circ}\text{C}$...30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes. | No display malfunctions Note1 |
| Vibration (Non operation) | | ① 5 to 100Hz, 11.76m/s^2 ② 1 minute/cycle ③ X, Y, Z direction ④ 10 times each directions | No display malfunctions Note1 No physical damages |
| Mechanical shock (Non operation) | | ① 294m/s^2 , 11ms ② X, Y, Z direction ③ 3 times each directions | No display malfunctions Note1 No physical damages |
| ESD (Operation) | | ① 150pF, 150Ω , $\pm 10\text{kV}$ ② 9 places on a panel surface Note2 ③ 10 times each places at 1 sec interval | No display malfunctions Note1 |
| Dust (Operation) | | ① Sample dust: No.15 (by JIS-Z8901) ② 15 seconds stir ③ 8 times repeat at 1 hour interval | No display malfunctions Note1 |
| Low pressure | operation | ① 53.3 kPa ② $0^{\circ}\text{C} \pm 3^{\circ}\text{C}$...24 hours ③ $55^{\circ}\text{C} \pm 3^{\circ}\text{C}$...24 hours | No display malfunctions Note1 |
| | non-operation | ① 15 kPa ② $-20^{\circ}\text{C} \pm 3^{\circ}\text{C}$...24 hours ③ $-60^{\circ}\text{C} \pm 3^{\circ}\text{C}$...24 hours | |

Note1: Display functions are checked under the same conditions as product inspection.

Note2: See the following figure for discharge points



19. PRECAUTIONS

19.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read "19.2 CAUTIONS", after understanding this contents!**



CAUTION

This sign has a meaning that customer will be injured himself and/or the product will sustain a damage, if customer makes a mistake in operations.



This sign has the meaning that customer will get an electrical shock, if customer has wrong operations.



This sign has the meaning that customer will be injured by himself, if customer has wrong operations.

19.2 CAUTIONS



Do not touch HIGH VOLTAGE PART of the inverter while turn on. Customer will be in danger of an electric shock.



- * Pay attention to burn injury for the working IC! It may be over 35°C from ambient temperature.
- * Do not shock and press the LCD panel and the backlight lamp! There is a danger of breaking, because they are made of glass. (Shock: To be not greater 294m/s² and to be not greater 11ms, Pressure: To be not greater 19.6N)

19.3 ATTENTIONS

(1) Handling of the product

- ① Take hold of both ends without touch the circuit board when customer pulls out products (LCD modules) from inner packing box. If customer touches it, products may be broken down or out of adjustment, because of stress to mounting parts.
- ② If customer puts down the product temporarily, the product puts on flat subsoil as a display side turns down.
- ③ Take the measures of electrostatic discharge such as earth band, ionic shower and so on, when customer deals with the product, because products may be damaged by electrostatic.
- ④ The torque for mounting screws must never exceed 0.34N·m. Higher torque values might result in distortion of the bezel.
- ⑤ Do not press or rub on the sensitive display surface. If customer clean on the panel surface, NEC Corporation recommends using the cloth with ethanolic liquid such as screen cleaner for LCD.

- ⑥ Do not push-pull the interface connectors while the product is working, because wrong power sequence may break down the product.
- ⑦ Do not hook cables nor pull connection cables such as flexible cable and so on, for fear of damage.

(2) Environment

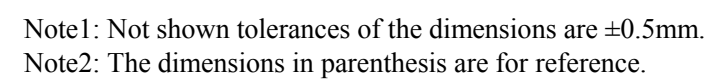
- ① Do not operate or store in high temperature, high humidity, dewdrop atmosphere or corrosive gases. Keep the product in antistatic pouch in room temperature, because of avoidance for dusts and sunlight, if customer stores the product.
- ② Do not operate in high magnetic field. Circuit boards may be broken down by it.
- ③ Use an original protection sheet on the product surface (polarizer). Adhesive type protection sheet should be avoided, because it may change color or properties of the polarizer.

(3) Characteristics

- ① Response time, luminance and color may be changed by ambient temperature.
- ② The LCD may be seemed luminance non-uniformity, flicker, vertical seam or small spot by display patterns.
- ③ Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on operating time, and especially low temperature, because the LCD has cold cathode fluorescent lamps.
- ④ Do not display the fixed pattern for a long time because it may cause image sticking. Use a screen saver, if the fixed pattern is displayed on the screen.
- ⑤ The display color may be changed by viewing angle because of the use of condenser sheet in the backlight unit.
- ⑥ Optical characteristics may be changed by input signal timings.
- ⑦ The interference noise of input signal frequency for this product's signal processing board and luminance control frequency of customer's backlight inverter may appear on a display. Set up luminance control frequency of backlight inverter so that the interference noise does not appear.
- ⑧ The product may be changed of luminance by voltage variation, even if power source applies recommended voltage to backlight inverter.
- ⑨ Optical characteristics may be changed by input signal timings.

(4) Other

- ① All GND, GNDB, VDD and VDDB terminals should be connected without a non-connected signal line.
- ② Do not disassemble a product or adjust volume without permission of NEC Corporation.
- ③ See "REPLACEMENT MANUAL FOR LAMPHOLDER SET", if customer would like to replace backlight lamps.
- ④ Pay attention not to insert waste materials inside of products, if customer uses screwdrivers.
- ⑤ When customer returns product for repair and so on, pack it with original shipping package because of avoidance of some damages during transportation.
- ⑥ Not only the module but also the equipment that used the module should be packed and transported as the module becomes vertical. Otherwise, there is the fear that a display dignity decreases by an impact or vibrations."



NEC Corporation

REVISION HISTORY

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