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FEATURES:(1)10.4" VGA color display with High Luminance (400cd/m²)
(2)Wide Viewing Angle (Vertical:120, Horizontal:140)
(3)Built in Long Life Lamps (50,000 h)

TENTATIVE**MECHANICAL SPECIFICATIONS**

| Item | Specifications |
|----------------------------|-----------------------------------|
| Dimensional Outline (typ.) | 238.5(W) x 177.5(H) x 12max(D) mm |
| Number of Pixels | 640(W) x 480(H) pixels |
| Active Area | 211.2(W) x 158.4(H) mm |
| Pixel Pitch | 0.33(W) x 0.33(H) |
| Weight (approximately) | 500g |
| Backlight | Twin CCFLs, Sidelight type |

ABSOLUTE MAXIMUM RATINGS

| Item | Min. | Max. | Unit | |
|--|--------------------|----------------------|-------|---------|
| Supply Voltage | (V _{DD}) | -0.3 | 6.5 | V |
| | (V _{FL}) | 0 | 2.0 | kV(rms) |
| FL Driving Frequency (f _{FL}) | --- | 100 | kHz | |
| Input Signal Voltage (V _{IN}) | -0.3 | V _{DD} +0.3 | V | |
| Operating Temperature (Note) | -10 | 65 | °C | |
| Storage Temperature | -20 | 80 | °C | |
| Storage Humidity (Max. wet bulb temperature = 39°C) | 10 | 90 | %(RH) | |

Note) Only operation is guaranteed at Operating Temperature. Display quality is evaluated at +25°C.

ELECTRICAL SPECIFICATION (T_a=25°C) (RECOMMENDED OPERATION CONDITION)

| Item | Min. | Typ. | Max. | Unit | Remarks | |
|---|-----------------------|------|---------------------|--------|---|-----------------------|
| Supply Voltage | (V _{DD}) | 4.75 | 5.0 | 5.25 | V | V _{DD} :5V |
| | | 3.0 | 3.3 | 3.6 | V | V _{DD} :3.3V |
| | (V _{FL}) | --- | 460 | --- | V(rms) | |
| FL Start Voltage | 1200 | --- | 1900 | V(rms) | T _a =-10°C | |
| High Level Input Voltage (V _{IH}) | 0.7 V _{DD} | --- | V _{DD} | | | |
| Low Level Input Voltage (V _{IL}) | 0 | --- | 0.3 V _{DD} | V | | |
| Current Consumption | *1 (I _{DD}) | --- | 225 | --- | mA | |
| | *2 (I _{FL}) | 3.0 | 6.0 | 6.5 | mA(rms) | |
| *1 *2 Power Consumption | --- | 6.3 | --- | W | I _{FL} =6.0mA(rms) V _{DD} :3.3V | |

*1 : 8 color bars pattern

*2 : Except the efficiency of FL inverter

OPTICAL SPECIFICATION (T_a=25°C)

| Item | Min. | Typ. | Max. | Unit | Remarks |
|----------------------------|-------------------|------|------|-------------------|-----------------------------|
| Contrast Ratio (CR) | 250 | 500 | --- | --- | |
| Viewing Angle (CR ≥ 10) | (Upper+Lower) | --- | 120 | --- | ° |
| | (Left+Right) | --- | 140 | --- | ° |
| Response Time | (τ _r) | --- | 50 | ms | |
| | (τ _f) | --- | 50 | ms | |
| Luminance | --- | 400 | --- | cd/m ² | I _{FL} =6.0mA(rms) |
| Lamp Life Time (MTBF)*3 *4 | 50,000 | | | h | |

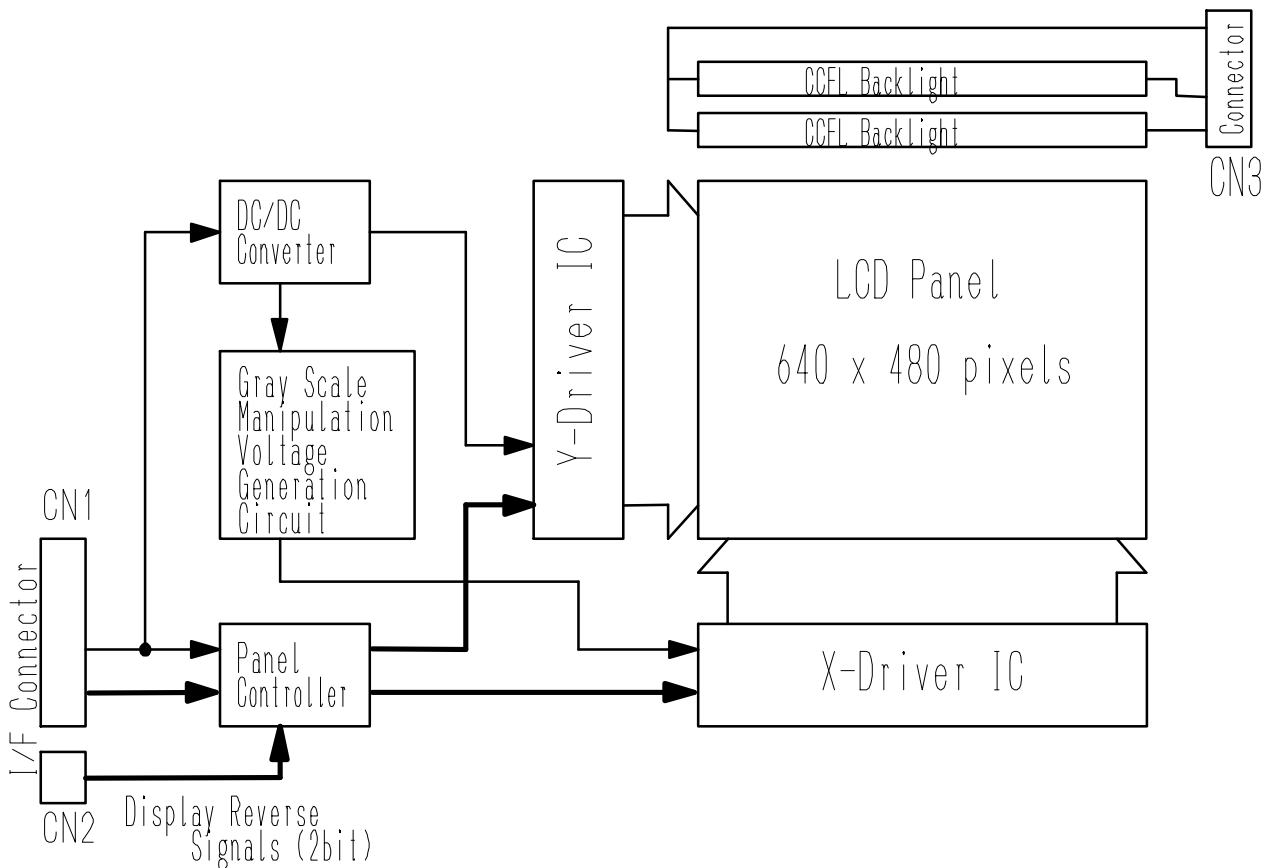
*3 : Conditions ; T_a=25°C, I_{FL}=6.0mA(rms), continuous lighting

*4 : Definitions of failure ; 1) Lcd luminance becomes half of the minimum value. 2) Lamp doesn't light normally.

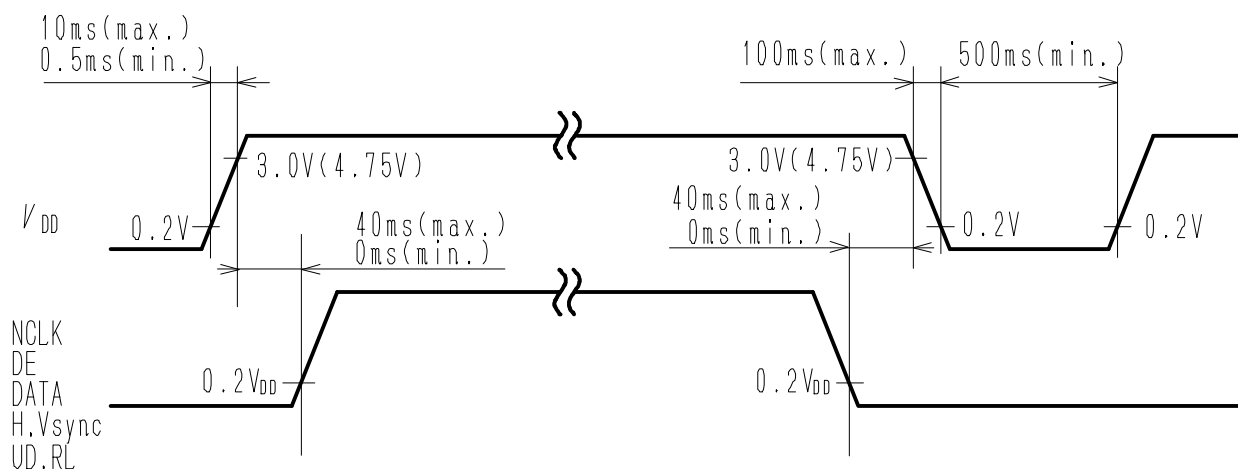
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*The information contained herein may be changed without prior notice. It is therefore advisable to contact Toshiba Matsushita Display Technology before proceeding with the design of equipment incorporating this product.

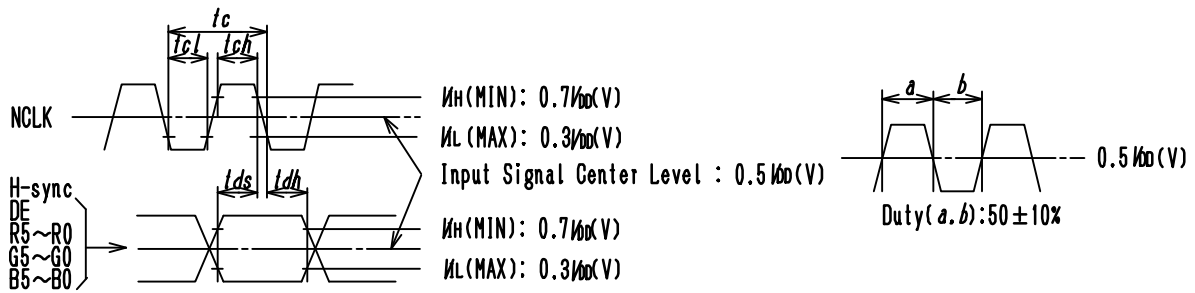
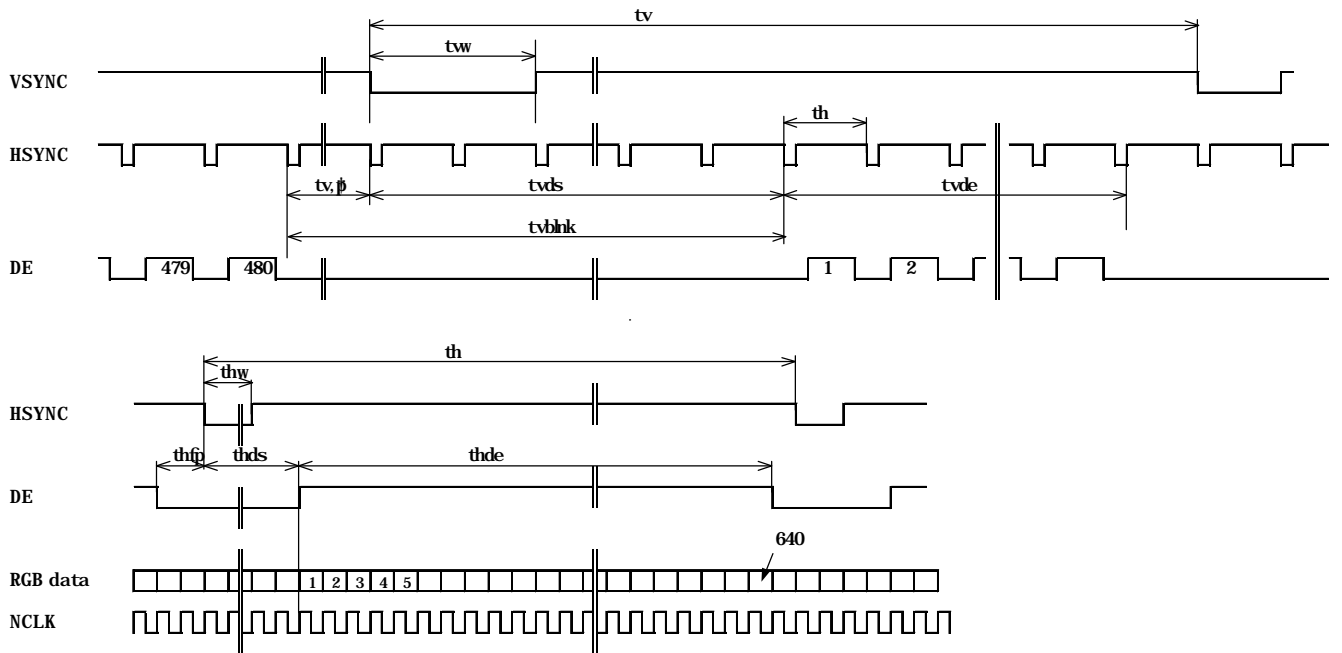
BLOCK DIAGRAM



SEQUENCE OF POWER SUPPLIES AND SIGNALS



TIMING CHART



TIMING SPECIFICATION ^{1) 2) 3) 4) 5) 6)}

| Item | Symbol | min. | typ. | Max. | unit |
|-----------------------------|---------------|------|------|------|-----------|
| Frame Period | <i>tv</i> | 500 | 525 | 550 | <i>th</i> |
| Vertical blanking Term | <i>tvblnk</i> | 20 | 45 | 70 | <i>th</i> |
| V-sync Pulse Width | <i>tvw</i> | 2 | - | - | <i>th</i> |
| Vertical Front Porch | <i>tvfp</i> | 2 | - | - | <i>th</i> |
| Vertical Data Sync Period | <i>tvds</i> | 6 | - | - | <i>th</i> |
| Vertical Display Term | <i>tvde</i> | 480 | 480 | 480 | <i>th</i> |
| Horizontal Period | <i>th</i> | 740 | 800 | 860 | <i>tc</i> |
| H-sync Pulse Width | <i>thw</i> | 8 | 160 | - | <i>tc</i> |
| Horizontal Front Porch | <i>thfp</i> | 8 | - | - | <i>tc</i> |
| Horizontal Data Sync Period | <i>thds</i> | 8 | - | - | <i>tc</i> |
| Horizontal Display Term | <i>thde</i> | 640 | 640 | 640 | <i>tc</i> |
| Clock Period | <i>tc</i> | 35.0 | 39.7 | - | ns |
| Clock "H" Time | <i>tch</i> | 10.0 | - | - | ns |
| Clock "L" Time | <i>tcl</i> | 10.0 | - | - | ns |
| Data Setup Time | <i>tds</i> | 5.0 | - | - | ns |
| Data Hold Time | <i>tdh</i> | 10.0 | - | - | ns |

Note 1) If NCLK is fixed to "H" or "L" level for certain period while DE is supplied, the panel may be damaged.

Note 2) Please adjust LCD operating signal timing and FL driving frequency, to optimize the display quality.

There is a possibility that flicker is observed by the interference of LCD operating signal timing and FL driving condition (especially driving frequency), even if the condition satisfies above timing specifications and recommended operating conditions shown in 3.

Note3) Do not make *tv*, *th* and *tvds* fluctuate.

Note4) In case of using the long frame period, the deterioration of display quality, noise etc. may be occurred.

Note5) NCLK count of each Horizontal Scanning Time should be always the same.

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

Frame period should be always the same.

CONNECTOR PIN ASSIGNMENT FOR INTERFACE

CN1 INPUT SIGNAL

Connector : DF14H-30P-1.25H / HIROSE ELECTRIC CO., LTD.

Mating Connector : DF14-30S-1.25C, Contact Pin : DF14-2628SCF

| Terminal No. | Symbol | Function |
|--------------|------------------|---------------------------|
| 1 | GND | |
| 2 | NCLK | SAMPLING CLOCK |
| 3 | H-Sync | HORIZONTAL SYNC. |
| 4 | V-Sync | VERTICAL SYNC. |
| 5 | GND | |
| 6 | R0 ²⁾ | RED DISPLAY DATA (LSB) |
| 7 | R1 ²⁾ | RED DISPLAY DATA |
| 8 | R2 ²⁾ | RED DISPLAY DATA |
| 9 | R3 ²⁾ | RED DISPLAY DATA |
| 10 | R4 ²⁾ | RED DISPLAY DATA |
| 11 | R5 ²⁾ | RED DISPLAY DATA (MSB) |
| 12 | GND | |
| 13 | G0 ²⁾ | GREEN DISPLAY DATA (LSB) |
| 14 | G1 ²⁾ | GREEN DISPLAY DATA |
| 15 | G2 ²⁾ | GREEN DISPLAY DATA |
| 16 | G3 ²⁾ | GREEN DISPLAY DATA |
| 17 | G4 ²⁾ | GREEN DISPLAY DATA |
| 18 | G5 ²⁾ | GREEN DISPLAY DATA (MSB) |
| 19 | GND | |
| 20 | B0 ²⁾ | BLUE DISPLAY DATA (LSB) |
| 21 | B1 ²⁾ | BLUE DISPLAY DATA |
| 22 | B2 ²⁾ | BLUE DISPLAY DATA |
| 23 | B3 ²⁾ | BLUE DISPLAY DATA |
| 24 | B4 ²⁾ | BLUE DISPLAY DATA |
| 25 | B5 ²⁾ | BLUE DISPLAY DATA (MSB) |
| 26 | DE | DATA ENABLE |
| 27 | GND | |
| 28 | VDD | +3.3V (+5.0V)POWER SUPPLY |
| 29 | VDD | +3.3V (+5.0V)POWER SUPPLY |
| 30 | GND | |

CN2 INPUT SIGNAL

Connector : DF14H-2P-1.25H / HIROSE ELECTRIC CO., LTD.

Mating Connector : DF14-2S-1.25C, Contact Pin : DF14-2628SCF

| Terminal No. | Symbol | Function |
|--------------|--------|---|
| 1 | U D | VERTICAL REVERSE("L" level or Open ; normal, "H" level ; reverse) |
| 2 | R L | HORIZONTAL REVERSE ("L" level or Open ; normal , "H" level ; reverse) |

CN3 / 4 CCFL POWER SOURCE

Connector : BHR-04VS-1 / JAPAN SOLDERLESS TERMINAL MFG CO., LTD.

Mating Connector³⁾ : SM04(4.0)B-BHS-1 / JAPAN SOLDERLESS TERMINAL MFG CO., LTD.

| Terminal No. | Symbol | Function |
|--------------|------------------|-----------------------------------|
| 1 | VFLH1 | CCFL Power Supply (high voltage) |
| 2 | VFLH2 | CCFL Power Supply (high voltage) |
| 3 | NC ¹⁾ | Non Connection (open) |
| 4 | VFLL | CCFL Power Supply (low voltage) |

Note 1) NC terminal should be open.

Note 2) See next page.

Note 3) Take away terminal No.3 of the mating connector. If does not take away, it may cause smoke burn of electrical parts by high voltage.

256k (k=1024) COLORS COMBINATION TABLE

| | Display | R5 R4 R3 R2 R1 R0 | G5 G4 G3 G2 G1 G0 | B5 B4 B3 B2 B1 B0 | Gray Scale Level |
|-----------------------------|-------------------------|-------------------|-------------------|-------------------|------------------|
| Basic Color | Black | L L L L L L | L L L L L L | L L L L L L | - |
| | Blue | L L L L L L | L L L L L L | H H H H H H | - |
| | Green | L L L L L L | H H H H H H | L L L L L L | - |
| | Light Blue | L L L L L L | H H H H H H | H H H H H H | - |
| | Red | H H H H H H | L L L L L L | L L L L L L | - |
| | Purple | H H H H H H | L L L L L L | H H H H H H | - |
| | Yellow | H H H H H H | H H H H H H | L L L L L L | - |
| | White | H H H H H H | H H H H H H | H H H H H H | - |
| Gray Scale of Red | Black | L L L L L L | L L L L L L | L L L L L L | L 0 |
| | Dark ↑ ↓ Light | L L L L L H | L L L L L L | L L L L L L | L 1 |
| | | L L L L H L | L L L L L L | L L L L L L | L 2 |
| | | : : : | : : : | : : : | L3... L60 |
| | | H H H H L H | L L L L L L | L L L L L L | L61 |
| | | H H H H H L | L L L L L L | L L L L L L | L62 |
| | Red | H H H H H H | L L L L L L | L L L L L L | Red L63 |
| Gray Scale of Green | Black | L L L L L L | L L L L L L | L L L L L L | L 0 |
| | Dark ↑ ↓ Light | L L L L L L | L L L L L H | L L L L L L | L 1 |
| | | L L L L L L | L L L L H L | L L L L L L | L 2 |
| | | : : : | : : : | : : : | L3... L60 |
| | | L L L L L L | H H H H L H | L L L L L L | L61 |
| | | L L L L L L | H H H H H L | L L L L L L | L62 |
| | Green | L L L L L L | H H H H H H | L L L L L L | Green L63 |
| Gray Scale of Blue | Black | L L L L L L | L L L L L L | L L L L L L | L 0 |
| | Dark ↑ ↓ Light | L L L L L L | L L L L L L | L L L L L H | L 1 |
| | | L L L L L L | L L L L L L | L L L L H L | L 2 |
| | | : : : | : : : | : : : | L3... L60 |
| | | L L L L L L | L L L L L L | H H H H L H | L61 |
| | | L L L L L L | L L L L L L | H H H H H L | L62 |
| | Blue | L L L L L L | L L L L L L | H H H H H H | Blue L63 |
| Gray Scale of White & Black | Black | L L L L L L | L L L L L L | L L L L L L | L 0 |
| | Dark ↑ ↓ Light | L L L L L H | L L L L L H | L L L L L H | L 1 |
| | | L L L L H L | L L L L H L | L L L L H L | L 2 |
| | | : : : | : : : | : : : | L3... L60 |
| | | H H H H L H | H H H H L H | H H H H L H | L61 |
| | | H H H H H L | H H H H H L | H H H H H L | L62 |
| | White | H H H H H H | H H H H H H | H H H H H H | White L63 |

RELIABILITY TEST

TEST CONDITIONS

- 1) The module should be driven and inspected under normal test conditions.
- 2) The module should not have condensation of water (moisture) on the module.
- 3) The module should be inspected after two or more hours storage in normal conditions (15 - 35°C, 45 - 65%(RH)).
- 4) A module shall be used only for one test.

SPECIFICATIONS

The module shall have no failure in the following reliability test items.

| Test Item | Test Conditions | Result |
|---|---|--------|
| High Temperature Operation ¹⁾ | 65°C 192 h | OK |
| High Temperature Storage ²⁾ | 80°C 192 h | OK |
| High Temperature High Humidity operation ¹⁾ | 50°C 80% 192 h | OK |
| Low Temperature Operation ¹⁾ | -10°C 192 h | OK |
| Low Temperature Storage ²⁾ | -20°C 192 h | OK |
| Temperature Shock ²⁾ | -20°C ⇔ 80°C 0.5h 0.5h 50 cycles | OK |
| Mechanical Vibration ²⁾ | 10 - 200 - 10Hz sweep/cycle, 1.5×9.8m/s ² constant, X.Y.Z each directions, 0.5h each | OK |
| Mechanical Shock ²⁾ | 50×9.8m/s ² , 20ms, ±X, ±Y, ±Z direction, one time each | OK |

Note 1) Operating

Note 2) Non-Operating

Definitions of failure for judgment shall be as follows:

- 1) Function of the module should be maintained.
- 2) Current consumption should be smaller than the specified value.
- 3) Appearance and display quality should not have distinguished degradation.
- 4) Luminance should be larger than 50% of the minimum value specified in OPTICAL SPECIFICATION.

**FOR SAFETY**

LCD module is generally designed with precise parts to achieve light weighted thin mechanical dimensions.

In using our Modules, make certain that you fully understand and put into practice the warnings and safety precautions detailed in Engineering Information No.EE-N001,"CAUTIONS AND INSTRUCTIONS FOR TOSHIBA LCD MODULES".

Refer to individual specifications and TECHNICAL DATA sheets (hereinafter called "TD") for more detailed technical information.

1) SPECIAL PURPOSES

A) Toshiba Matsushita Display Technology's Standard LCD Modules have not been customized for operation in extreme environments or for use in applications where performance failures could be life-threatening or otherwise catastrophic.

B) Since Toshiba Matsushita Display Technology's Standard LCD Modules have not been designed for operation in extreme environments, they must never be used in devices that will be exposed to abnormally high levels of vibration or shock which exceed Toshiba Matsushita Display Technology's published specification limits.

C) In addition, since Toshiba Matsushita Display Technology Standard LCD Modules have not been designed for use in applications where performance failures could be life-threatening or catastrophic, they must never be installed in aircraft navigation control systems (such as, but not limited to Traffic Collision Avoidance System and Air Traffic Indicator), in military defense or weapons systems, in critical industrial process-control systems (e.g., those involved in the production of nuclear energy), or in critical medical device or patient life-support systems.

2) DISASSEMBLING OR MODIFICATION

DO NOT DISASSEMBLE OR MODIFY the module. It may damage sensitive parts inside LCD module, and may cause scratches or dust on the display.

Toshiba Matsushita Display Technology does not warrant the module, if customer disassembled or modified it.

3) BREAKAGE OF LCD PANEL

DO NOT INGEST liquid crystal material, DO NOT INHALE this material, and DO NOT CONTACT the material with skin, if LCD panel is broken and liquid crystal material spills out.

If liquid crystal material comes into mouth or eyes, rinse mouth or eyes out with water immediately.

If this material contact with skin or cloths, wash it off immediately with alcohol and rinse thoroughly with water.

4) GLASS OF LCD PANEL

BE CAREFUL WITH CHIPS OF GLASS that may cause injuring fingers or skin, when the glass is broken.

5) ELECTRIC SHOCK

DISCONNECT POWER SUPPLY before handling LCD module.

DO NOT TOUCH the parts inside LCD module and the fluorescent lamp's connector or cables in order to prevent electric shock, because high voltage is supplied to these parts from the inverter unit while power supply is turned on.

6) ABSOLUTE MAXIMUM RATINGS AND POWER PROTECTION CIRCUIT

DO NOT EXCEED the absolute maximum rating values under the worst probable conditions caused by the supply voltage variation, input voltage variation, variation in parts' constants, environmental temperature, etc., otherwise LCD module may be damaged.

Employ protection circuit for power supply, whenever the specification or TD specifies it.

Suitable protection circuit should be applied for each system design.

7) RECOMMENDED OPERATION CONDITIONS

The performance and quality of the LCD panel are warranted only when the LCD panel is used within "the recommended operation conditions". Toshiba Matsushita Display Technology Co., Ltd. never warrants the performance and quality of the LCD panel when you use the LCD panel over "the recommended operation conditions", although within "the absolute maximum rating".

To use the LCD panel over "the recommended operation conditions" may have bad influence on the characteristics and reliability of the LCD panel and may shorten the life of the LCD panel.

Therefore, when designing the whole set, not to be over "the recommended operation conditions", you should fully take care of supply voltage change, characteristic of connection parts, surge of input-and-output line, and surrounding temperature.

8) DISPOSAL

When dispose LCD module, obey to the applicable environmental regulations.