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# LMT057DNAFWU-AAN

LCD Module User Manual

| Prepared by: | Checked by: | Approved by: |
|---|---|---|
| Date: | Date: | Date: |

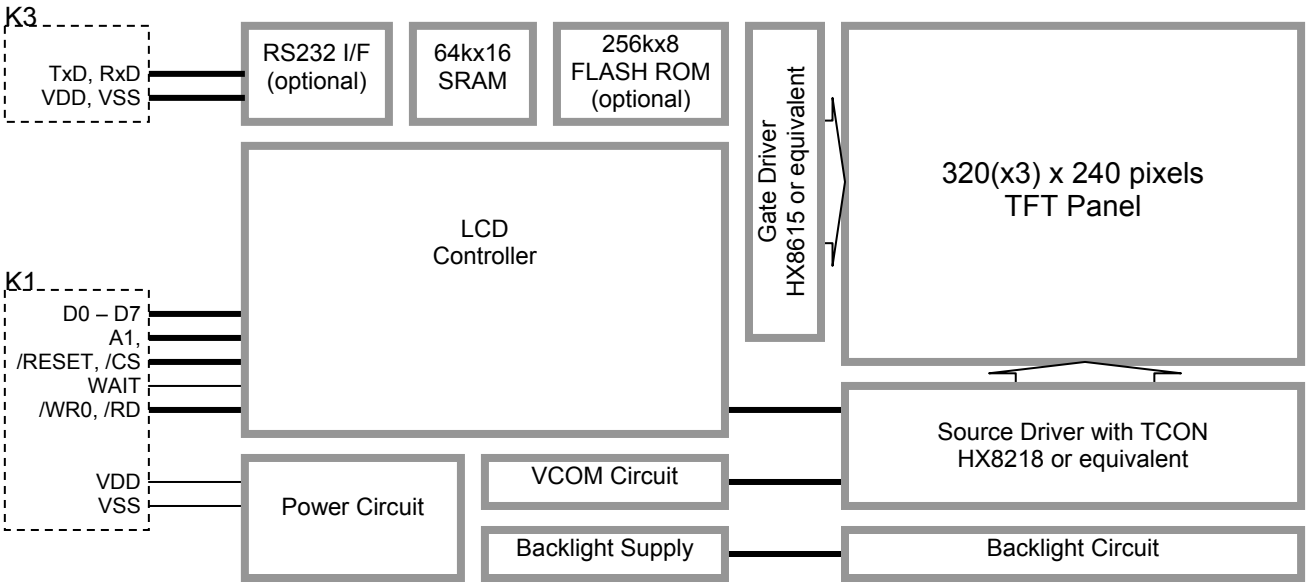
| Rev. | Descriptions | Release Date |
|---|---|---|
| 0.1 | Preliminary New release | 2007-04-13 |
| 0.2 | Typing Correction in Dot Pitch | 2007-04-20 |
| 0.3 | Typing Correction in 6.3.3 Opcode [82] discription | 2007-05-17 |
| 0.4 | Jumper Setting Correction | 2007-06-08 |
| 0.5 | Typing Correction in 6.1 & 6.3,Add 6.4 | 2008-09-28 |
| 0.6 | Update General Specification | 2009-06-22 |

# Table of Content

# 1. General Specification

| | |
|---|---|
| Display Technology : | a-Si TFT active matrix |
| Display Mode : | TN Type Full Color / Transmissive / Normal White |
| Screen Size(Diagonal) : | 5.7” |
| Outline Dimension : | 155.2 x 109.0 x 12.7 MAX. (mm)<br>(see attached drawing for details) |
| Active Area : | 115.2 x 86.4 (mm) |
| Number of dots : | 320 x 3 (RGB) x 240 |
| Dot Pitch : | 0.12 x 0.36 (mm) |
| Pixel Configuration : | RGB Stripe |
| Backlight : | LED |
| Surface Treatment : | Anti-Glare Treatment |
| Viewing Direction : | 12 o’clock |
| Operating Temperature : | -20 ~ +70°C |
| Storage Temperature : | -30 ~ +80°C |

# 2. Block Diagram



## 2.1 Terminal Functions

### 2.1.1 MCU Terminal (K1, 8bit-Data, 1bit-Add)

| Pin No. | Pin Name | I/O | Descriptions |
|---|---|---|---|
| 1 | VSS | Power Input | Power Supply GND (0V) |
| 2 | | | |
| 3 | VDD | Power Input | Positive Power Supply |
| 4 | | | |
| 5 | A1 | Input | Register Select<br>A1=LOW: Accessing Address F004 (command package port)<br>A1=High: Accessing Address F006 (data and status port) |
| 6 | /CS | Input | Chip Select Inputs<br>/CS=LOW: Data IO is enabled |
| 7 | /RESET | Input | Reset Signal Input<br>/RESET=LOW: Reset<br>/RESET=HIGH: Normal |
| 8 | D0 | Bi-directional I/O | 8-bit bi-directional data bus |
| : | : | | |
| 15 | D7 | | |
| 16 | WAIT | Output | Wait Signal |
| 17 | /RD | Input | Read enable input, active LOW |
| 18 | /WR0 | Input | Write enable input, active LOW |
| 19 | NC | - | No connection, leave open |
| 20 | NC | - | No connection, leave open |

### 2.1.2 RS232 Terminal (K3)

| Pin No. | Pin Name | I/O | Descriptions |
|---|---|---|---|
| 1,2 | Tx | Output | Data Output<br>(to pin2 of PC RS232C<9pin D-connector>) |
| 3,4 | Rx | Input | Data Input<br>(to pin3 of PC RS232C<9pin D-connector>) |
| 5,6 | VSS | Power | Power (0V) and Signal ground<br>(to pin5 of PC RS232C<9pin D-connector>) |
| 7,8 | NC | - | No connection, leave open |
| 9,10 | VDD | Power | Positive Power Supply |

# 3. Absolute Maximum Ratings

| Items | Symbol | Min. | Max. | Unit | Condition |
|---|---|---|---|---|---|
| Supply Voltage | $V_{DD}$ | -0.3 | 5.5 | V | $V_{SS}$ = 0V |
| Input Voltage | $V_{IN}$ | -0.3 | 5.5 | V | $V_{SS}$ = 0V |
| Operating Temperature | $T_{OP}$ | -20 | 70 | °C | No Condensation |
| Storage Temperature | $T_{ST}$ | -30 | 80 | °C | No Condensation |

Cautions:
Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

# 4. Electrical Characteristics

## 4.1 DC Characteristics (MCU terminal)

$V_{SS}$=0V, $V_{DD}$ =5.0V, $T_{OP}$ =25°C

| Items | Symbol | MIN. | TYP. | MAX. | Unit | Applicable Pin |
|---|---|---|---|---|---|---|
| Operating Voltage | $V_{DD}$ | 4.8 | 5.0 | 5.2 | V | VDD |
| Input High Voltage | $V_{IH}$ | 3.0 | - | VDD | V | Input pins, Bi-direction pins |
| Input Low Voltage | $V_{IL}$ | VSS | - | 0.6 | V | Input pins, Bi-direction pins |
| Output High Voltage | $V_{OH}$ | 2.6 | - | - | V | Bi-direction pins (*1) |
| Output Low Voltage | $V_{OL}$ | - | - | 0.6 | V | Bi-direction pins (*2) |
| Operating Current | $I_{DD}$ | - | 260 | 600 | mA | VDD |

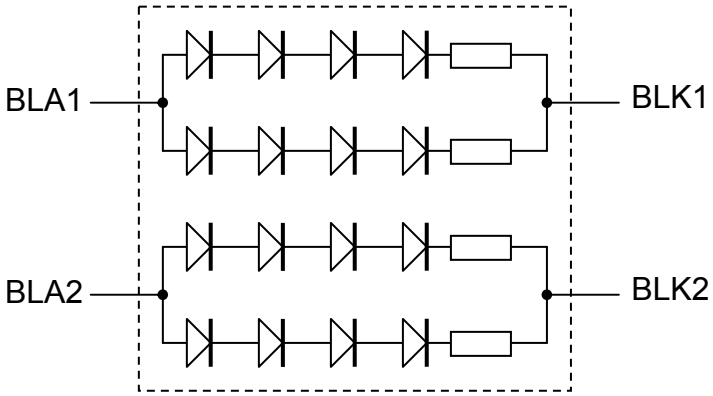
Note:
*1. $I_{OH}$=-3.0mA
*2. $I_{OL}$= 3.0mA

## 4.2 LED Backlight Circuit Characteristics

$V_{BLK1}$=$V_{BLK2}$= 0V, $If_{BLA1}$+$If_{BLA2}$=60mA, $T_{OP}$=25°C

| Items | Symbol | MIN. | TYP. | MAX. | Unit | Note |
|---|---|---|---|---|---|---|
| Forward Voltage | $Vf_{BLA}$ | - | 12.4 | - | V | BLA1, BLA2 |
| Forward Current | $If_{BLA}$ | - | - | 100 | mA | BLA1+BLA2 |
| Life Time | - | - | 20000 | - | hr | |
| Uniformity | - | 75 | 80 | - | % | |

Cautions:
Exceeding the recommended driving current could cause substantial damage to the backlight and shorten its lifetime.




No. of LED = 4x4=16 pcs

## 4.3 AC Characteristics

Please refer to LCD controller datasheet for details.

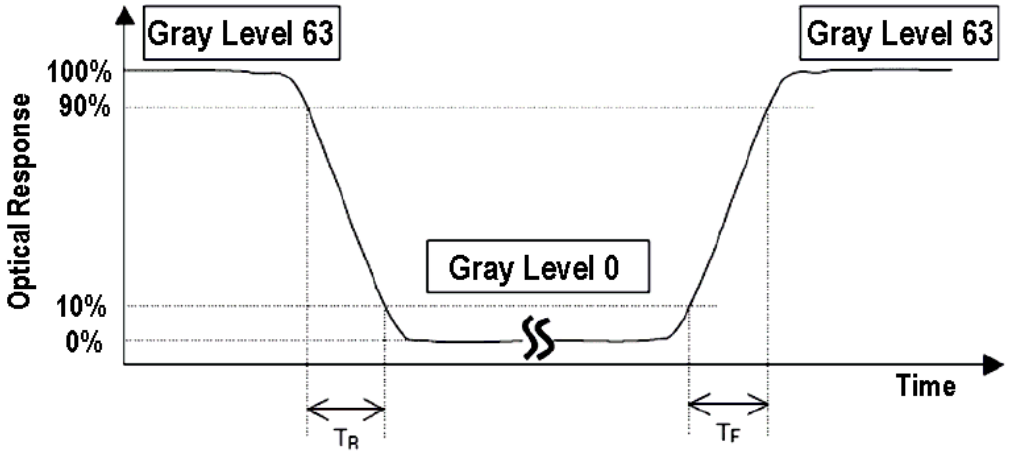
# 5. Optical Characteristics

Light source: C light, using CMO TN LC + Polarizer
reference only

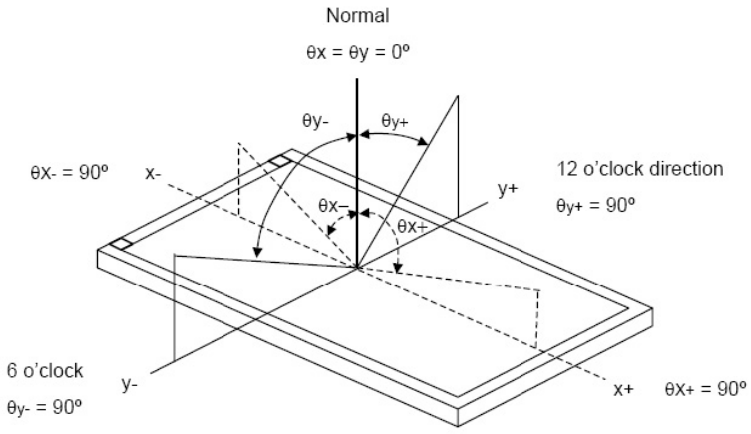
| Item | Symbol | MIN. | TYP. | MAX. | UNIT | Note. |
|---|---|---|---|---|---|---|
| Brightness | - | 200 | 250 | - | nit | |
| Transmittance | Tr | | 8.6 | - | % | |
| Contrast Ratio | CR | 150 | 250 | - | - | (*1) |
| White Color Chromaticity(X) | $W_X$ | 0.282 | 0.313 | 0.342 | - | |
| White Color Chromaticity(Y) | $W_Y$ | 0.299 | 0.338 | 0.359 | - | |
| Response Time Rise | $T_R$ | - | 15 | 30 | ms | |
| Response Time Fall | $T_F$ | - | 35 | 50 | ms | |
| Viewing Angle(Φ=180°) | θl | - | 15 | - | deg | CR≥10 (*2) |
| Viewing Angle(Φ=0°) | Θr | - | 45 | - | deg | CR≥10 (*2) |
| Viewing Angle(Φ=90°) | Θu | - | 15 | - | deg | CR≥10 (*2) |
| Viewing Angle(Φ=270°) | θd | - | 35 | - | deg | CR≥10 (*2) |
| NTSC Ratio | S | - | 50% | - | - | |

Note:

*1. Definition of Contrast Ratio
The contrast ratio could be calculate by the following expression:
Contrast Ratio (CR) = L63 / L0
Where : L63=Luminance of gray level 63
L0=Luminance of gray level 0
CR=CR at middle point of the LCD panel.




*2 Definition of Viewing Angle



# 6. Function Specifications

## 6.1 Hard-wired Setting

The following is the list of Jumpers on the LCD module:
Note: Never try to change the reserved jumper. It may damage the system

| Interface Mode | interface terminal | JP1 | JP3 | JP4, JP5 | JP25 | JP26 | JP27 | Note |
|---|---|---|---|---|---|---|---|---|
| **8bit-data 1bit-address** | K1 | OPEN | CLOSE | OPEN | OPEN | CLOSE | OPEN | Default setting |
| **RS232C interface** | K3 | OPEN | CLOSE | OPEN | CLOSE | CLOSE | OPEN | |

## 6.2 VR setting

P6, P4 adjust the VCOM signal on K5 (LCD terminal).
Check point: C12-positive terminal to GND
VCOM should be swing between +3.5V and –1.5V (typ.)
Note,
as VCOM signal generated by POL signal form LCD module,
it must connect the LCD module for the adjustment.

P5 adjust the VGL, output on K5 (LCD terminal).
Check-point: C15-negative terminal to GND
VGL should be –10V(typ.)
Note,
the power supply is controlled by display power on command.
it must init the controller for the adjustment

### 6.3 Command Packet Format

All commands are organized in packet with a 1 byte “Opcode” followed by optional parameters / data up to 64 bytes.

#### 6.3.1 Command Packet Format

| Opcode (1 byte) | Parameters / Data (up to 64 bytes) |
|---|---|

For multi-byte parameter/data, send LSB (low byte)first, MSB (highest byte) last.

#### 6.3.2 Opcode Group

00 - 0F Reserved for Serial Communication
10 - 1F 2D Hardware-acceleration: Fonts Drawing Operations
20 - 2F 2D Hardware-acceleration: Geometric Drawing Operations
30 - 3F Audio Operations
40 - 4F Reserved
50 - 5F Reserved
60 - 6F Communication
70 - 7F Reserved
80 - 8F System Control
F0 – FF Reserved for serial mode synchronization

#### 6.3.3 Opcode Description

| Opcode (HEX) | Operations | Parameters / Data |
|---|---|---|
| 00 | Set “Control & Status Port” of the Command Interpreter | The value of this data (one byte) will be directly written to the Control & Status register. |
| 10 | charset_config | Character Set (1 byte):<br>00: Built in 8x8 ASCII<br>01: 8x8 CGRAM (Embedded RAM)<br>02: 8x16 CGRAM (Embedded RAM)<br>03: 16x16 CGRAM (Embedded RAM)<br>04: 16x16 GB2312-80 (External ROM)<br>05: 16x16 BIG5 (External ROM)<br>06: 8x8 Custom 8-bit encoding (External ROM)<br>07: 8x8 Custom 16-bit encoding (External ROM) |
| 12 | set_print_coord | Character Print Coordinates (4 bytes)<br>- x (2 bytes)<br>- y (2 bytes)<br>For Mono LCD, x = (multiple of 8) – 1<br>For Color LCD, no restriction on the value of x coordinate |
| 14 | set_font_fgcolor | Character Foreground Color (2 bytes)<br>(same as td_fgcolor, with opcode = (20 HEX))<br>Mono LCD: 1bpp, 2bpp, 4bpp<br>Color LCD: 16-bit TFT (5R:6G:5B)<br>12-bit STN (4R:4G:4B) |
| 15 | set_font_bgcolor | Character Background Color (2 bytes)<br>Mono LCD: 1bpp, 2bpp, 4bpp<br>Color LCD: 16-bit TFT (5R:6G:5B)<br>12-bit STN (4R:4G:4B) |
| 16 | show_char | Display Character (1 or 2 bytes) |
| 17 | show_string | Display String<br>- Character count (1 byte)<br>(0 ≤ character count ≤ 63)<br>- String (≤ 63 bytes) |

<table>
<tr><th>Opcode (HEX)</th><th>Operations</th><th>Parameters / Data</th></tr>
<tr><td>20</td><td>td_fgcolor</td><td>Set Foreground Color (2 bytes)<br>Mono LCD: 1bpp, 2bpp, 4bpp<br>Color LCD: 16-bit TFT (5R:6G:5B)<br>12-bit STN (4R:4G:4B)</td></tr>
<tr><td>23</td><td>draw_pixel</td><td>Draw Pixel<br>- x (2 bytes)<br>- y (2 bytes)</td></tr>
<tr><td>24</td><td>draw_line</td><td>Draw Line<br>- x_start (2 bytes)<br>- y_start (2 bytes)<br>- x_end (2 bytes)<br>- y_end (2 bytes)</td></tr>
<tr><td>26</td><td>draw_rect</td><td>Draw Hollow Rectangle (Box)<br>- x_start (2 bytes)<br>- y_start (2 bytes)<br>- x_end (2 bytes)<br>- y_end (2 bytes)</td></tr>
<tr><td>27</td><td>fill_rect</td><td>Fill Rectangle (Box)<br>- x_start (2 bytes)<br>- y_start (2 bytes)<br>- x_end (2 bytes)<br>- y_end (2 bytes)</td></tr>
<tr><td>28</td><td>draw_circle</td><td>Draw Circle<br>- x_center (2 bytes)<br>- y_center (2 bytes)<br>- radius (1 byte)</td></tr>
<tr><td>29</td><td>fill_circle</td><td>Fill Circle<br>- x_center (2 bytes)<br>- y_center (2 bytes)<br>- radius (1 byte)</td></tr>
<tr><td>60</td><td>set_baud</td><td>Set baud rate<br>- divisor (lower byte) (1 byte)<br>- divisor (upper byte) (1 byte)
<table>
<tr><th>Divisor</th><th>RS232 baud rate</th></tr>
<tr><td>1047</td><td>110</td></tr>
<tr><td>24</td><td>4800</td></tr>
<tr><td>12</td><td>9600 <default></td></tr>
<tr><td>6</td><td>19200</td></tr>
<tr><td>3</td><td>38400</td></tr>
<tr><td>2</td><td>57600</td></tr>
<tr><td>1</td><td>115200</td></tr>
</table></td></tr>
<tr><td>80</td><td>refresh_setting</td><td>N/A</td></tr>
<tr><td>81</td><td>set_mem_ptr</td><td>Set memory pointer<br>- address (3 bytes)</td></tr>
<tr><td>82</td><td>read_reg</td><td>Read register<br>- address (2 bytes)</td></tr>
<tr><td>83</td><td>write_reg</td><td>Write register<br>- address (2 bytes)<br>- data (1 byte)</td></tr>
<tr><td>84</td><td>write_mem</td><td>Write memory<br>- count (1 byte)<br>- data (up to 63 bytes)</td></tr>
<tr><td>8F</td><td>mem_clk_en</td><td>Enable memory clock<br>“69 45 61 67 6C 65” (6 bytes in HEX)</td></tr>
</table>

### 6.3.4 Registers Table

| Register (HEX) | R/W | Reset Value | Descriptions |
|---|---|---|---|
| F000 | Read<br><br>Write | 1000 0000 | Chip ID Port Always read back 80 (HEX)<br>Write "DE FC 0B" (HEX) to enable memory clock, same as command with OPCODE "8F". |
| F001 | Read only | 0000 0000 | Chip Revision Port<br>Always read back 00 (HEX) for iEM8000 |
| F004 | Write only | - | Command Packet Port -<br>Writing of Command Packets. |
| F006 | Write | xxxx 1xx0 | Port for writing control or reading status<br>Bit[7:4] : Reserved<br>Bit[3] : DISPLAY ON / OFF<br>0=DISPLAY ON<br>1=DISPLAY OFF<br>Bit[2:1] : Reserved<br>Bit[0] : End of Command, Write "1" after each command packet |
| | Read | xxxx xxx0 | Bit[7:1] : Reserved<br>Bit[0] : FIFO full<br>Read "1" if Command FIFO is full.<br>Hosts must read this bit = "0" before writing to Command Packet Port. |
| F080 | Read / Write | 0000 0000 | Bit[7:6] : External SRAM Select<br>Bit[7:6] = 11: Required setting<br>- 64Kx16 external SRAM connected<br>Bit[5] : Horizontal TFT Pulse Polarity<br>0: Active low<br>1: Active high<br>Bit[4] : Vertical TFT Pulse Polarity<br>0: Active low<br>1: Active high<br>Bit[3] : STN Panel I/F Data Width<br>0: 4-bit single<br>1: 8-bit single<br>Bit[2] : Color Mode Select<br>0: Monochrome<br>1: Color<br>Bit[1:0] : Color Depth Select<br>If Monochrome (Bit[2] = 0)<br>00: 1 bit-per-pixel<br>01: 2 bit-per-pixel<br>10: 4 bit-per-pixel<br>11: Reserved<br>If Color (Bit[2] = 1)<br>00: 16 bit-per-pixel (TFT panel)<br>01: 12 bit-per-pixel (CSTN panel)<br>10: Reserved<br>11: Reserved |
| F081 | Read / Write | x000 0000 | Bit[7] : Reserved<br>Bit[6:0] : Panel Horizontal Character Count – 1,<br>Panel Horizontal Character Count[8:0] supports horizontal panel size up to 128 characters or 1024 pixels. |
| F082 | Read / Write | 0000 0000 | Bit[7:0] : Panel Line Count - 1 bit[7:0] |
| F083 | Read / Write | xxxx xxx0 | Bit[7:1] : Reserved<br>Bit[0] : Panel Line Count – 1 bit[8],<br>Panel Line Count[8:0] supports vertical panel size up to 512 lines. |
| F084 | Read / Write | 0000 0000 | Bit[7:0] :<br>Display Start Position X Coordinate – 1 bit[7:0] |
| F085 | Read / Write | xxxx xx00 | Bit[7:2] : Reserved<br>Bit[1:0] :<br>Display Start Position X Coordinate – 1 bit[9:8] |

| Register (HEX) | R/W | Reset Value | Descriptions |
|---|---|---|---|
| F086 | Read / Write | 0000 0000 | Bit[7:0]<br>Display Start Position Y Coordinate – 1 bit[7:0] |
| F087 | Read / Write | xxxx xx00 | Bit[7:2] : Reserved<br>Bit[1:0] :<br>Display Start Position Y Coordinate – 1 bit[9:8]<br>Display Start Position (X,Y) is for panning of the view port on a virtual display. |
| F088 | Read / Write | 0000 0000 | LCD_LUT1<br>Bit[7:4] : for Gray level 3<br>Bit[3:0] : for Gray level 2 |
| F089 | Read / Write | 0000 0000 | LCD_LUT0<br>Bit[7:4] : for Gray level 1<br>Bit[3:0] : for Gray level 0 |
| F08A | Read / Write | x000 0000 | Bit[7] : Reserved<br>Bit[6:0] : Virtual Display Character count – 1<br>It supports horizontal virtual size up to 128 characters or 1024 pixels. |
| F08B | Read / Write | xx00 0000 | Bit[7:6] : Reserved<br>Bit[5:0] : WF count for STN panels<br>000000: WF pin toggles every frame<br>000001: WF pin toggles every 2 LP pulses<br>000010: WF pin toggles every 3 LP pulses ……<br>……<br>111111: WF pin toggles every 64 LP pulses |
| F08C | Read / Write | xxxx 0000 | Bit[7:4] : Reserved<br>Bit[3:0] : Horizontal non-display period<br>0000: 2 characters (16 pixels)<br>0001: 3 characters (24 pixels) …….<br>……..<br>1111: 17 characters (136 pixels) |
| F08D | Read / Write | xxxx 0000 | Bit[7:4] : Reserved<br>Bit[3:0] : Vertical non-display period<br>0000: 1 line<br>0001: 2 lines ……...<br>……<br>1111: 16 lines |
| F08E | Read / Write | 0000 000x | Bit[7:4] : Pixel Clock Divider<br>0000: 24 MHz (divided by 1)<br>0001: 12 MHz (divided by 2)<br>0010: 8 MHz (divided by 3)<br>0011: 6MHz (divided by 4) ……<br>…….<br>1111: 1.5MHz (divided by 16)<br>Bit[3] : Display Blank<br>0: Normal<br>1: Blank<br>Bit[2] : Display Invert<br>0: Normal<br>1: Invert<br>Bit[1] : LCD_ON Polarity<br>0: LCD_ON pin active low<br>1: LCD_ON pin active high<br>Bit[0] : Reserved |

| Register (HEX) | R/W | Reset Value | Descriptions |
|---|---|---|---|
| F08F | Read / Write | x000 0000 | Bit[7] : Reserved<br>Bit[6:0] : Number of frames to start – 1<br>Maximum 128 frames<br>(see section 2.15.1 for detail) |
| F090 | Read / Write | xx00 0000 | Bit[7:6] : Reserved<br>Bit[5:0] : Horizontal Front Porch for TFT panels<br>000000: 1 pixel<br>000001: 2 pixels ……...<br>……..<br>111111: 64 pixels |
| F091 | Read / Write | xx00 0000 | Bit[7:6] : Reserved<br>Bit[5:0] : Horizontal Back Porch for TFT panels<br>000000: 1 pixel<br>000001: 2 pixels ……...<br>……..<br>111111: 64 pixels |
| F092 | Read / Write | xxx0 0000 | Bit[7:5] : Reserved<br>Bit[4:0] : Horizontal Pulse Width for TFT panels<br>00000: 1 pixel<br>00001: 2 pixels ……...<br>……..<br>11111: 32 pixels |
| F093 | Read / Write | 0000 0000 | Bit[7:0] : Scratch Pad register |
| F094 | Read / Write | xx00 0000 | Bit[7:6] : Reserved<br>Bit[5:0] : Vertical Front Porch for TFT panels<br>000000: 1 line<br>000001: 2 lines ……...<br>……..<br>111111: 64 lines |
| F095 | Read / Write | xx00 0000 | Bit[7:6] : Reserved<br>Bit[5:0] : Vertical Back Porch for TFT panels<br>000000: 1 line<br>000001: 2 lines ……...<br>……..<br>111111: 64 lines |
| F096 | Read / Write | xxx0 0000 | Bit[7:5] : Reserved<br>Bit[4:0] : Vertical Pulse Width for TFT panels<br>00000: 1 line<br>00001: 2 lines ……...<br>……..<br>11111: 32 lines |

| Register (HEX) | R/W | Reset Value | Descriptions |
|---|---|---|---|
| F100 | Read / Write | 00xx xx00 | Bit[7] – Enable / Disable<br>0: Disable Sprite<br>1: Enable Sprite<br>Bit[6] – Transparency<br>0: Transparency disable<br>1: Transparency enable<br>When enabled: Sprite data = 00 becomes transparent and LCD background will be displayed instead.<br>Bit[5:2] – Reserved<br>Bit[1:0] – Sprite Modes Select<br>01: Sprite with 2 bit-per-pixel<br>00, 10, 11: Reserved |
| F102 | Read / Write | 0000 0000 | Bit[7:0] - SP_LUT0L[7:0] |
| F103 | Read / Write | 0000 0000 | Bit[7:0] - SP_LUT0H[7:0] |
| F104 | Read / Write | 0000 0000 | Bit[7:0] - SP_LUT1L[7:0] |
| F105 | Read / Write | 0000 0000 | Bit[7:0] - SP_LUT1H[7:0] |
| F106 | Read / Write | 0000 0000 | Bit[7:0] - SP_LUT2L[7:0] |
| F107 | Read / Write | 0000 0000 | Bit[7:0] - SP_LUT2H[7:0] |
| F108 | Read / Write | 0000 0000 | Bit[7:0] - SP_LUT3L[7:0] |
| F109 | Read / Write | 0000 0000 | Bit[7:0] - SP_LUT3H[7:0] |
| F10A | Read / Write | 0000 0000 | Bit[7:0] – Sprite Horizontal Pixel Count – 1<br>Maximum 256 pixels |
| F10B | Read / Write | 0000 0000 | Bit[7:0] – Sprite Vertical Line Count – 1<br>Maximum 256 lines |
| F10C | Read / Write | 0000 0000 | Bit[7:0] –<br>Sprite Horizontal Start Position bit[7:0] |
| F10D | Read / Write | xxxx xx00 | Bit[7:2] – Reserved<br>Bit[1:0] - Sprite Horizontal Start Position bit[9:8]<br>Sprite Horizontal Start Position bit[9:0] is measured in pixels and counted from left to right of the edge of the panel display (i.e. not virtual display). |
| F10E | Read / Write | 0000 0000 | Bit[7:0] –<br>Sprite Vertical Start Position bit[7:0] |
| F10F | Read / Write | xxxx xxx0 | Bit[7:1] – Reserved<br>Bit[0] - Sprite Vertical Start Position bit[8]<br>Sprite Vertical Start Position bit[8:0] is measured in lines and counted from top to bottom of the edge of the panel display (i.e. not virtual display). |
| F142 | Write Only | 0000 0000 | Bit[7:0] –<br>Sprite / overlay storage starting address bit[7:0] |
| F143 | Write Only | 0000 0000 | Bit[7:0] –<br>Sprite / overlay storage starting address bit[15:8] |
| F144 | Write Only | 0000 0000 | Bit[7:2] – Reserved<br>Bit[1:0] –<br>Sprite / overlay storage starting address bit[17:16]<br>This is the starting address to put the sprite/overlay image |
| F180 | Read Only | 0000 0000 | Bit[7:0] – Background Color bit[7:0] |
| F181 | Read Only | 0000 0000 | Bit[7:0] –Background Color bit[15:8] |
| F182 | Read Only | 0000 0000 | Bit[7:0] – Foreground Color bit[7:0] |
| F183 | Read Only | 0000 0000 | Bit[7:0] –Foreground Color bit[15:8] |

| Register (HEX) | R/W | Reset Value | Descriptions |
|---|---|---|---|
| F500 | Read / Write | 1110 1110 | CS0 Configuration Port – Pulse Width<br>Bit[7:4] : Write Cycle Pulse Width<br>0000: 1 memory clock (24 MHz -> 41.6ns)<br>0001: 2 memory clocks<br>…….<br>1110:15 memory clocks<br>1111: Reserved<br>Bit[3:0] : Read Cycle Pulse Width<br>0000: 1 memory clock (24 MHz -> 41.6ns)<br>0001: 2 memory clocks<br>…….<br>1110:15 memory clocks<br>1111: Reserved |
| F501 | Read / Write | 0000 0000 | CS0 Configuration Port – Control<br>Bit[7] : Enable bit<br>0:Disable CS0<br>1:Enable CS0<br>Bit[6] : Memory data bus width<br>0: 8-bit memory data bus width<br>1: 16-bit memory data bus width<br>Bit[5] : 16-bit SRAM option<br>0:two 8-bit SRAMs<br>1:one 16-bit SRAM<br>Bit[4] : Reserved<br>Bit[3] : CS0 assertion time relative to address assertion.<br>0:CS0 and address assert at the same time<br>1:CS0 lags address by 1 memory clock.<br>Bit[2] : CS0 Negation Timing<br>0:CS0 and Address negate at the same time<br>1:CS0 leads Address by 1 memory clock in write access.<br>Bit[1] : Write Enable Assertion Time<br>0: Write Enable and Address Assert at the same time.<br>1: Write Enable lags Address by 1 memory clock.<br>Bit[0] : Write Enable Negation Time<br>0: Write Enable and Address negate at the same time.<br>1: Write Enable leads Address by 1 memory clock. |
| F504 | Read / Write | xxxx 1110 | CS1 Configuration Port – Pulse Width<br>Bit[7:4] : Reserved<br>Bit[3:0] : Read Cycle Pulse Width<br>0000: 1 memory clock (24 MHz -> 41.6ns)<br>0001: 2 memory clocks<br>0001: 3 memory clocks<br>…….<br>1101:14 memory clocks<br>1110:15 memory clocks<br>1111: Reserved |
| F505 | Read / Write | 0000 0000 | CS1 Configuration Port – Control<br>Bit[7] : Enable bit<br>0:Disable CS1<br>1:Enable CS1<br>Bit[6] : Memory data bus width<br>0: 8-bit memory data bus width<br>1: 16-bit memory data bus width<br>Bit[5] : Reserved<br>Bit[4] : Reserved<br>Bit[3] : CS1 assertion time relative to address assertion.<br>0:CS1 and Address assert at the same time<br>1:CS1 lags Address by 1 memory clock.<br>Bit[2] : CS1 Negation Timing<br>0:CS1 and Address negate at the same time<br>1:CS1 leads Address by 1 memory clock in write access.<br>Bit[1:0] : Reserved |
| F6C4 | Read / Write | xx11 0011 | Set Memory Clock Divide<br>Bit[7:6] = Reserved<br>Bit[5:0] = 010000 to set 24MHz memory clock for proper operations |

### 6.4 UART Serial Host Communication Packet Format

In UART serial host mode, each communication packet starts with a byte of “FF” and ended with “FE”. Length of parameters (one byte) is also required into the packet. An Acknowledge Packet will be sent back to the UART serial host by the T8000 once the command is finished execution.

**UART Serial host Communication Packet Format**

| Sequence | No of byte | Content |
|---|---|---|
| 1 | 1 | 0xFF (hex) <START BYTE> |
| 2 | 1 | Opcode |
| 3 | 1 | Length of Parameters |
| 4 | 1 to 64 | Parameters / Data (up to 64bytes) |
| 5 | 1 | 0xFE (hex) <END BYTE> |

Note: A “FF” bytes sequence of length equal to or more than 65 will cause re-synchronization.

**UART Serial host re-synchronization Packet Format**

| Sequence | No of byte | Content |
|---|---|---|
| 1 | Equal or more than 65 | 0xFF (hex) |
| 2 | | 0xFF (hex) |
| : | | : |
| : | | : |

Note: A “FF” bytes sequence of length equal to or more than 65 will cause re-synchronization.

For commands required read data (Opcode 82) from the T8000, it will send read data embedded in the Acknowledge Packet automatically when data is ready.

**UART Serial host Acknowledge Packet Format, without “register read data”**

| Sequence | No of byte | Content |
|---|---|---|
| 1 | 1 | 0x00 (hex) |

**UART Serial host Acknowledge Packet Format, with “register read data”**

| Sequence | No of byte | Content |
|---|---|---|
| 1 | 1 | Register read data |
| 2 | 1 | 0x00 (hex) |

# 7. Precautions of using LCD Modules

**Mounting**

- Mounting must use holes arranged in four corners or four sides.
- The mounting structure so provide even force on to LCD module. Uneven force (ex. Twisted stress) should not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- It is suggested to attach a transparent protective plate to the surface in order to protect the polarizer. It should have sufficient strength in order to the resist external force.
- The housing should adopt radiation structure to satisfy the temperature specification.
- Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. Never rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics deteriorate the polarizer.)
- When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer

**Operating**

- The spike noise causes the mis-operation of circuits. It should be within the ±200mV level (Over and under shoot voltage)
- Response time depends on the temperature.(In lower temperature, it becomes longer.)
- Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
- Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- When fixed patterns are displayed for a long time, remnant image is likely to occur.
- Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference

**Electrostatic Discharge Control**

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

**Strong Light Exposure**

Strong light exposure causes degradation of polarizer and color filter.

**Storage**

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

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

**Protection Film**

- When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt tore main on the polarizer. Please carefully peel off the protection film without rubbing it against the polarizer.
- When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
- You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

**Transportation**

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

# 8. Appendix A <Inspection items and criteria for appearance defect>

| Items | Criteria | | | |
|---|---|---|---|---|
| Open Segment or Common | Not permitted | | | |
| Short | Not permitted | | | |
| Wrong Viewing Angle | Not permitted | | | |
| Decliners | Not permitted | | | |
| Contrast Ration Uneven | According to the limit specimen | | | |
| Crosstalk | According to the limit specimen | | | |
| White spots | X>1 pixel | A-area | Not permitted | Max 6 spots allowed |
| | | B-area | Max. 1 allowed | |
| | 1/2 pixel<X≤1 pixel | A-area | Not permitted | |
| | | B-area | Max. 2 allowed | |
| | X≤1/2 pixel | A-area | Max. 1 allowed | |
| | | B-area | Max. 4 allowed | |
| Black Sport | X>1 pixel | A-area | Not permitted | |
| | | B-area | Max. 2 allowed | |
| | X≤1/2 pixel | A-area | Max. 1 allowed | |
| | | B-area | Max. 4 allowed | |
| Line Defect | Apparent vertical horizontal line defects are not permitted | | | |

Note:

1. On Pixel include 3 dots (RedDot + GreenDot + BlueDot)
2. Definition of Panel “A-area” and “B-area”