# DATA SHEET

# LTE052T-060
## Active matrix 5" color TFT LCD Module

Product Specification March 30th 2000

**Philips Flat Display Systems**

## CONTENTS



**LIFE SUPPORT APPLICATIONS**

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## 1 GENERAL DESCRIPTION

This is an active matrix LCD module Which comprises

- A 5" color TFT panel
- Panel driver electronics
- Integrated backlight
- Integrated interface card

The 5" active area has full color capability using 320 (xRGB) x 234 pixels. The panel has a 4:3 aspect ratio and a wide viewing angle.

The module can withstand intense Environmental conditions

Outline dimensions compatible with double DIN size for automotive use.

## 2 FEATURES

- RGB stripe configuration
- Two analog RGB with Hsync and Vsync inputs
- Two analog RGB channels with possibility of picture in picture.
- ( C) VBS for synchronisation or Hs Vs with CLK signal
- Selectable NTSC/PAL (RGB)
- Up/down and left/right control signals
- Display aspect ratio 4 : 3
- Display resolution 234 lines
- High contrast TFT LCD drive system
- High speed response
- High brightness
- Wide viewing angle
- Integrated high efficiency backlight
- Extended temperature range.

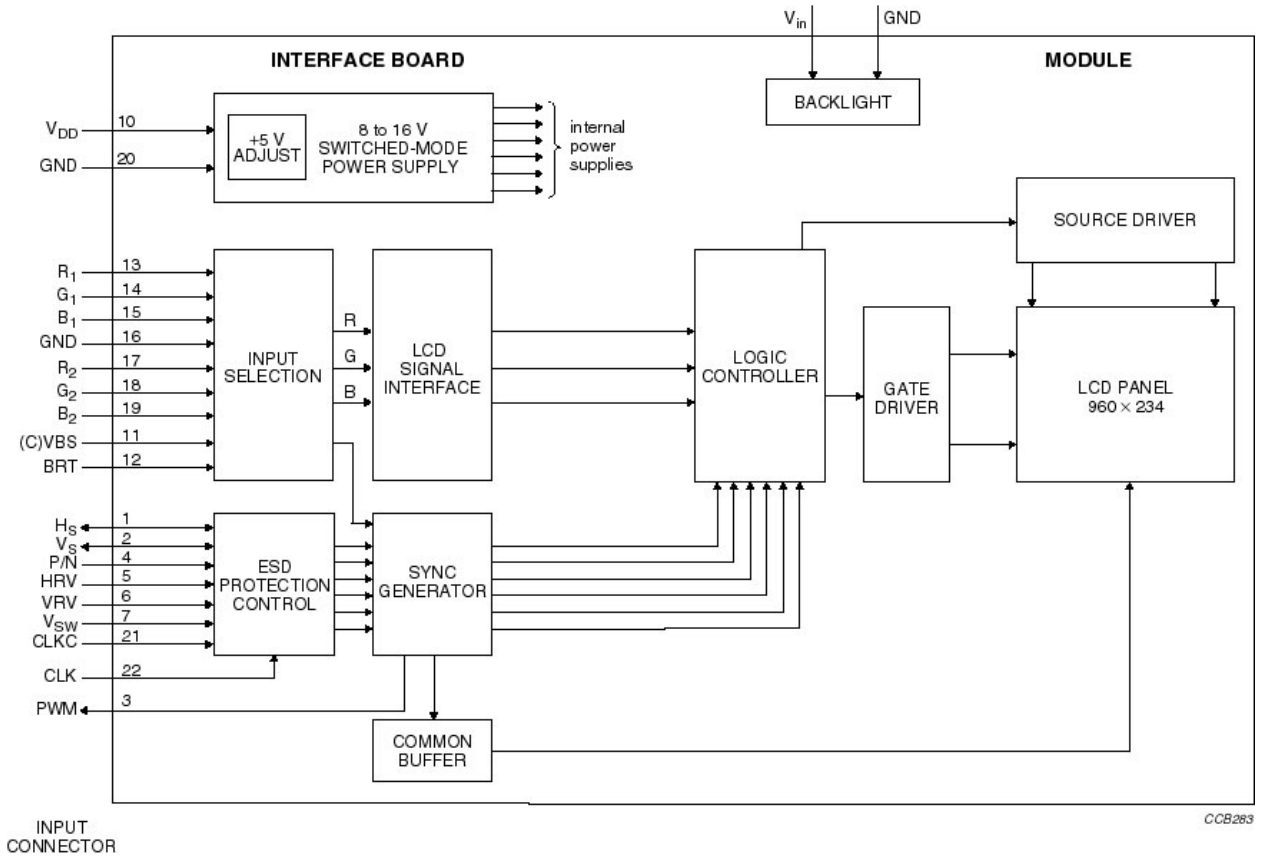
## 3 APPLICATIONS

- Car navigation
- TV and DVD monitors
- Video games
- Automation and process control monitors**.**

## 4 QUICK REFERENCE DATA

| PARAMETERS | VALUE | UNIT |
|---|---|---|
| Overall dimensions | | |
| Width | 126.9 | mm |
| Height | 89.6 | mm |
| Depth | 13.1 | mm |
| Active area dimensions | | |
| Width | 102.70 | mm |
| Height | 74.76 | mm |
| Display resolution | 320x234 | pixels |
| Pixel dimensions: | | |
| Horizontal | 3x0.107 | mm |
| Vertical | 0.319 | mm |
| Pixel configuration | RGB stripe | |
| Supply voltage (module) | 8 to 16 | Volt |
| Power consumption (without inverter) | 1.2 | W |
| Backlight life at 25C; $I_{lamp}$ = + 6.0 mA (RMS) Continuous operation | min. 10000 | hours |
| Typical viewing angle (contrast ratio >5) | | |
| Horizontal right | 70 | deg |
| Horizontal left | 70 | deg |
| Vertical up | 50 | deg |
| Vertical down | 70 | deg |
| Maximum operating ambient temperature | 70 | C |
| Operating panel surface temperature range | -30 to +85 | C |
| Storage temperature range | -40 to +90 | C |
| Typical response time: | | |
| Rise time | 30 | ms |
| Fall time | 15 | ms |
| Mass of the module | 183 +/- 10 | g |

4.1 BLOCK DIAGRAM (fig. 1)




## 4.1 diagram



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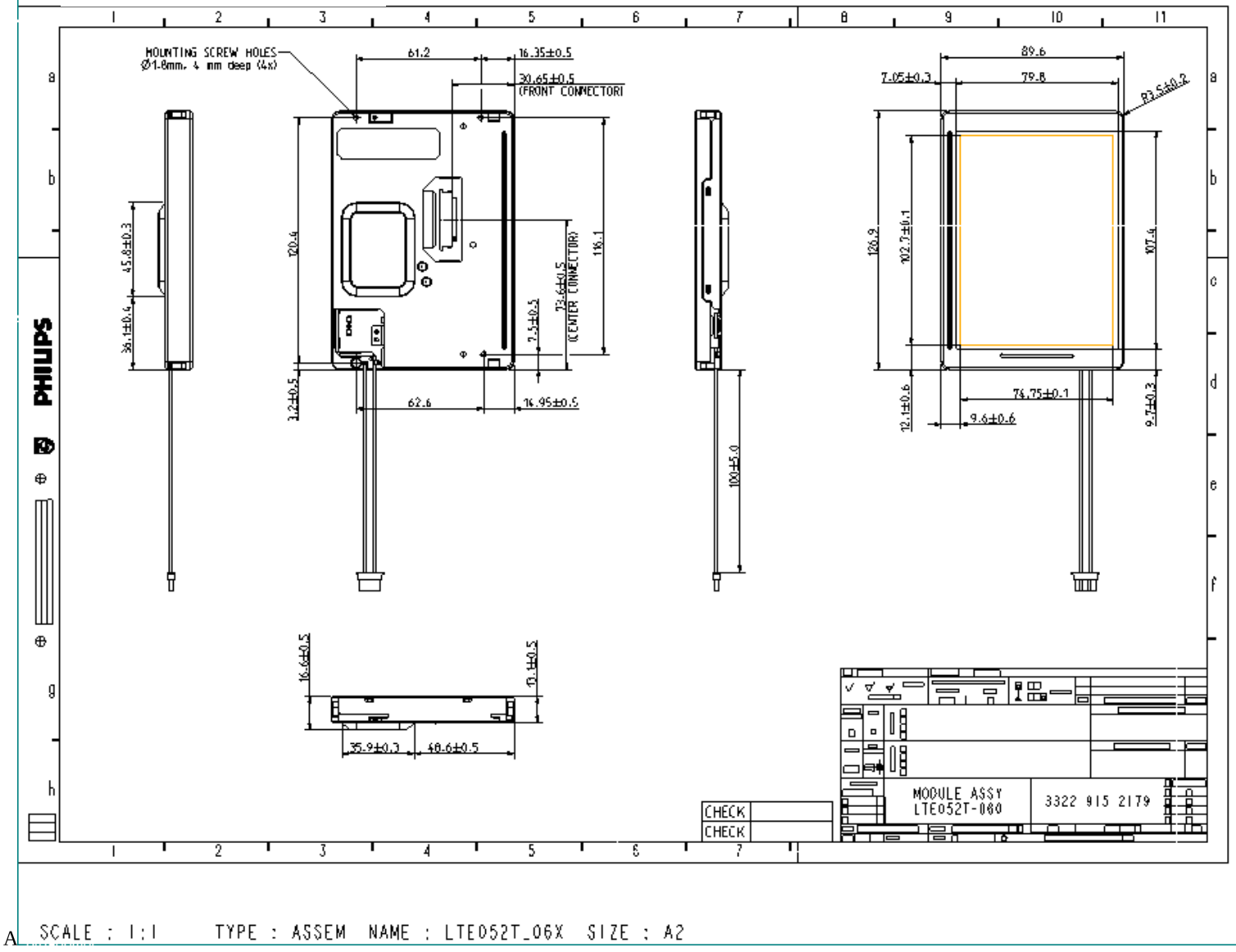
## 5 MECANICAL DATA (fig. 2)





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### 5.1 Dimensions

| PARAMETER | VALUE | UNIT |
|---|---|---|
| Display format | (320x3) x 234 | dots |
| Active area | 102.7 x 74.8 | mm |
| Screen size (diagonal) | 127<br>5.0 | mm<br>inch |
| Pixel pitch:<br>Horizontal<br>vertical | <br>3x 0.107<br>0.319 | <br>mm<br>mm |
| Dot configuration | RGB stripe | |
| Overall dimensions (excluding connectors)<br>Width<br>Height<br>Depth | <br>126.9 +/- 0.2<br>89.6 +/- 0.2<br>13.1 +/- 0.5 | <br>mm<br>mm<br>mm |
| Mass of the module | 183 +/- 10 | g |

### 5.2 Electrical connectors

| SERVICE | NUMBER OF PINS | MATING CONNECTOR |
|---|---|---|
| Interface | 22 | 22-pin flex foil ( 1mm pitch) |
| Backlight | 2 | SM02 (8.0)B-BHS 1- TB |

## 6 PINNING

| SYMBOL | PIN | I/O | DESCRIPTION |
|---|---|---|---|
| **Analog interface** | | | |
| $H_s$ | 1 | I/O | Horizontal sync; notes 1 and 2 |
| $V_s$ | 2 | I/O | Vertical sync; notes 1 and 3 |
| PWM | 3 | O | Synchronization signal for backlight |
| P/N | 4 | I | PAL/NTSC control signal, note 8 |
| HRV | 5 | I | Horizontal scanning direction; note 4 |
| VRV | 6 | I | Vertical scanning direction note 5 |
| $V_{sw}$ | 7 | I | $RGB_1/RGB_2$ video signal switching; note 6 |
| n.c. | 8 | - | Not connected |
| n.c. | 9 | - | Not connected |
| $V_{DD}$ | 10 | I | Supply voltage |
| VBS | 11 | I | VBS input for sync separator |
| BRT | 12 | I | Brightness control |
| $R_1$ | 13 | I | Red video signal 1 |
| $G_1$ | 14 | I | Green video signal 1 |
| $B_1$ | 15 | I | Blue video signal 1 |
| n.c. | 16 | - | Not connected |
| $R_2$ | 17 | I | Red video signal 2 |
| $G_2$ | 18 | I | Green video signal 2 |
| $B_2$ | 19 | I | Blue video signal 2 |
| GND | 20 | I | Ground |
| CLKC | 21 | I | Change I/O direction of CLK, $H_s$ and $V_s$; note 7 |
| CLK | 22 | I | Clock signal |
| **Backlight** | | | |
| $V_{in}$ | 1 | I | Backlight input voltage |
| GND | 2 | I | Backlight ground connection |

**NOTES**

1 CLKC= LOW: module is activated by CLK, $H_s$ and $H_s$.
2 CLKC = HIGH: $H_s$ is output, synchronised to VBS signal
CLKC = LOW: $H_s$ is horizontal sync input.
3 CLKC = HIGH: $V_s$ is output, synchronised to VBS signal
CLKC = LOW: $V_s$ is vertical sync input.
4 HRV = HIGH: image is normal
HRV = LOW: image is reversed into horizontal direction.
5 VRV = HIGH: image is normal
VRV = LOW: image is reversed into vertical direction.
6 $V_{sw}$ = HIGH: RGB1 is selected
$V_{sw}$ = LOW: RBG2 is selected
7 CLKC = HIGH : $H_s$ and $V_s$ become output mode
CLKC = LOW: CLK, $H_s$ and $V_s$ become input mode
8 P/N switching when not operating

## 7 ELECTRICAL CHARACTERISTICS

### 7.1 Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134)
$T_{amb}$ = 25 C.; GND = 0V; unless otherwise stated

| SYMBOL | DESCRIPTION | MIN> | MAX. | UNIT |
|---|---|---|---|---|
| $V_{dd}$ | Power supply voltage (pin 10) | -0.3 | 20 | V |
| $V_{i\ (analog)}$ | Analog input voltage (peak to peak value | -0.3 | 5 | V |
| $V_{i\ (dig)}$ | Digital input voltage | -0.3 | 5 | V |
| $V_{o\ (dig)}$ | Digital output voltage | -0.3 | 5.3 | V |

### 7.2 Recommended operating conditions module

| SYMBOL | DESCRIPTION | CONDITIONS | MIN. | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{DD}$ | Power supply ; note 1 | Within 200 ms | 7.8 | 12.0 | 16.0 | V |
| $V_{DD}$, ripple | Ripple on supply voltage | Freq. > 400 Hz | | | 0.1 | V |
| $V_{i(a)}$ | Analog input voltage:note 2<br>AC component (peak-to-peak value):<br>- AC component video content (peak-to peak value), note 3<br>- DC component | | 0.7<br><br>-<br><br>-1.0 | 1.0<br><br>0.7<br><br>0 | 2.0<br><br>-<br><br>+1.0 | <br>V<br>V<br><br>V |
| BRT | Brightness control | | 0 | | 5.0 | V |
| $f_{Hs}$ | VBS horizontal sync frequency<br>NTSC<br>PAL | CLKC=HIGH | <br><br>15.13<br>15.03 | <br><br>15.73<br>15.63 | <br><br>16.33<br>16.23 | <br><br>kHz<br>kHz |
| $t_{w\ (Hs)}$ | VBS horizontal sync pulse width<br>NTSC<br>PAL | CLKC=HIGH | <br><br>4.2<br>4.2 | <br><br>4.7<br>4.7 | <br><br>5.2<br>5.2 | <br><br>µs<br>µs |
| $t_{r(Hs)}$, $t_{f(Hs)}$ | VBS horizontal sync pulse rise and fall times | CLKC=HIGH | - | - | 0.5 | µs |
| $f_{Vs}$ | Vertical sync frequency<br>NTSC | CLKC=HIGH | <br>$f_H$/284 | <br>$f_H$/262 | <br>$f_H$/258 | <br>Hz |

| | | | | | | |
|---|---|---|---|---|---|---|
| | PAL | | $f_H$/344 | $f_H$/312 | $f_H$/304 | Hz |



| | | | | | | |
|---|---|---|---|---|---|---|
| $T_{w(Vs)}$ | Vertical sync. Pulse width<br>NTSC<br>PAL | CLKC = HIGH | <br>-<br>- | <br>3H<br>2.5H | <br>-<br>- | |
| $T_{r(Vs)}$, $t_{f(Vs)}$ | Vertical sync pulse rise and fall times | CLKC = HIGH | - | - | 0.5 | µs |
| $F_{clk}$ | Input clock frequency | CLKC = LOW | 6.0 | 6.8 | 7.6 | MHz |
| $T_{wh}$ | Input clock pulse width HIGH | CLKC = LOW | 20 | - | - | ns |
| $T_{wl}$ | Input clock pulse width LOW | CLKC = LOW | 20 | - | - | ns |
| $T_{r(clk)}$ | Input clock rise time | CLKC = LOW | - | - | 10 | ns |
| $T_{f(clk)}$ | Input clock fall time | CLKC = LOW | - | - | 10 | ns |
| $F_{Hs}$ | HSY input frequency | CLKC = LOW | $f_{clk}$/ 465 | $f_{clk}$ / 435 | $f_{clk}$/ 405 | kHz |
| $T_{w(Hs)}$ | HSY input pulse width | CLKC = LOW | 1 | 5 | 9 | µs |
| $T_{r(Hs)}t_{f(Hs)}$ | HSY input pulse rise and fall times | CLKC = LOW | - | - | 0.05 | µs |
| $F_{Vs}$ | VSY input frequency | CLKC = LOW | 50 | $F_{Hs}$/2 62 | $F_{Hs}$/ 258 | Hz |
| $T_{w (Vs)}$) | VSY input pulse width | CLKC = LOW | 1H | 3H | 5H | |
| $t_{su1}$ | VSY to HSY set-up time | CLKC = LOW | 1.0 | - | - | µs |
| $t_{HO1}$ | VSY to HSY hold time | CLKC = LOW | 1.0 | - | - | µs |
| $t_{SU2}$ | CLK to HSY set-up time | CLKC = LOW | 25 | - | - | ns |
| $t_{HO2}$ | CLK to HSY hold time | CLKC = LOW | 25 | - | - | ns |

NOTES
1 The module does not have load dump, under or over-voltage protection.
2 Applies to VBS input
3 Applies to $VR_1$, $VG_1$, $VB_1$, VR2, $VG_2$, and $VB_2$.

### 7.3 Recommended operating conditions backlight

$T_{amb}$ = -30 to +85 C; relative humidity < 90% at 60 C.

| SYMBOL | DESCRIPTION | CONDITIONS | MIN. | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{L (rms)}$) | CCFL tube voltage (RMS value) | Il(rms) = 6 mA | 530 | 580 | 630 | V |
| $I_{L (rms)}$ | CCFL tube current (RMS Value) | Normal operation | 5.5 | 6.0 | 6.5 | mA |
| $f_L$ | CCFL drive frequency | | 20 | - | 70 | kHz |
| $V_{IGS (rms)}$) | Ignition voltage (RMS value):<br>Tamb = 25 C<br>Tamb = -30 C | | <br>-<br>- | <br>1000<br>- | <br>-<br>1700 | <br>V<br>V |

### 7.4 Characteristics

GND = 0 V; $T_{amb}$ = -30 to + 70 C; unless otherwise stated.

| SYMBOL | DESCRIPTION | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| **$H_S$, $V_S$, CLK, $V_{SW}$** | | | | | | |
| $V_{IH}$ | HIGH-level input voltage | | 3.5 | | | V |
| $V_{IL}$ | LOW-level input voltage | | | | 1.5 | V |
| **P/N, VRV, CLKC, HRV** | | | | | | |
| $V_{IH}$ | HIGH-level input voltage | | 2.0 | | | V |
| $V_{IL}$ | LOW-level input voltage | | | | 0.8 | V |
| **$H_S$, $V_S$, PWM** | | | | | | |
| $V_{OH}$ | HIGH-level output voltage | $I_{OH}$ = -4 mA | 2.4 | | | V |
| $V_{OL}$ | LOW-level output voltage | $I_{OL}$ = +4 mA | | | 0.4 | V |
| **CLK** see note 1 | | | | | | |
| $V_{OL}$ | LOW-level output voltage | $I_{OL}$ = +4 mA | | | 0.4 | V |
| **CLK, HRV** | | | | | | |
| $I_{IH}$ | HIGH-level input current | $V_I$ = + 5 V | -0.1 | | +0.1 | µA |
| $I_{IL}$ | LOW-level input current | $V_I$ = 0 V | | | -4.5 | µA |
| **$H_S$, P/N, $V_S$, VRV, CLKC** | | | | | | |
| $I_{IH}$ | HIGH-level input current | $V_I$ = +5 V | | | +10 | µA |
| $I_{IL}$ | LOW-level input current | $V_I$ = 0 V | | | -200 | µA |
| **VSW** | | | | | | |
| $I_{IH}$ | HIGH-level input current | $V_I$ = +5 V | | | +10 | µA |
| | LOW-level input current | $V_I$ = 0 V | | | -600 | µA |
| **$R_1$, $G_1$, $B_1$, $R_2$, $G_2$, $B_2$, $V_{SW}$, VBS** | | | | | | |
| $C_I$ | input capacitance | f = 1 MHz | | 28 | | pF |
| **P/N, HRV, VRV, CLK, PWM, $H_S$, $V_S$** | | | | | | |
| $C_I$ | input capacitance | f = 1 MHz | | 37 | | pF |
| **CLKC** | | | | | | |
| $C_I$ | input capacitance | f = 1 MHz | | 10 | | nF |

**NOTE**

1 At CLKC = HIGH, CLK = zero (internal clock mode)

## 7.5 Input and output timing

| SYMBOL | DESCRIPTION | CONDITIONS | TYP. | UNIT |
|---|---|---|---|---|
| $t_{field}$ | field period: | | | |
| | NTSC | $f_{field}$=60Hz | 16.67 | ms |
| | PAL | $f_{field}$=50Hz | 20.0 | ms |
| $t_{line}$ | line period: | | | |
| | NTSC | | 63.5 | µs |
| | PAL | | 64.0 | µs |
| $f_{line}$ | line frequency: | | | |
| | NTSC | | 15.73 | kHz |
| | PAL | | 15.625 | kHz |
| $t_{DV1}$ | $V_S$ delay field 1 | | 1H | |
| $t_{DV2}$ | $V_S$ delay field 2 | | H/2 | |
| $t_{VO}$ | vertical pulse width | | 4H | |
| $t_{VID}$ | video signal on-display time | | 50.1 | µs |
| $t_{d(disp)}$ | sync edge to start display delay time: | | | |
| | NTSC | | 10.6 | µs |
| | PAL | | 11.1 | µs |
| $t_{pd(HS)}$ | sync edge to $H_S$ delay time | 50% level | 1.4 | µs |
| $t_{HO}$ | horizontal pulse width | 50% level | 1.2 | µs |

7.5.1 **DISPLAYED LINES ( PAL MODE)**

Field 1 displayed line numbers:
27 to 298

Field 2 displayed lines numbers:
339 to 611

In PAL, on average, every seventh line is skipped.
Actual lines skipped in field 1:
34 + 14N where N = 0,1 to 18 and
40 + 14M where M = 0,1 to 18.

Actual lines skipped in field 2
344 + 14N where N = 0,1 to 18 and
350 + 14M where M = 0,1 to 18.

7.5.2 **DISPLAYED LINES (NTSC MODE)**

Field 1 displayed line numbers:
23 to 256

Field 2 displayed lines numbers:
286 to 519

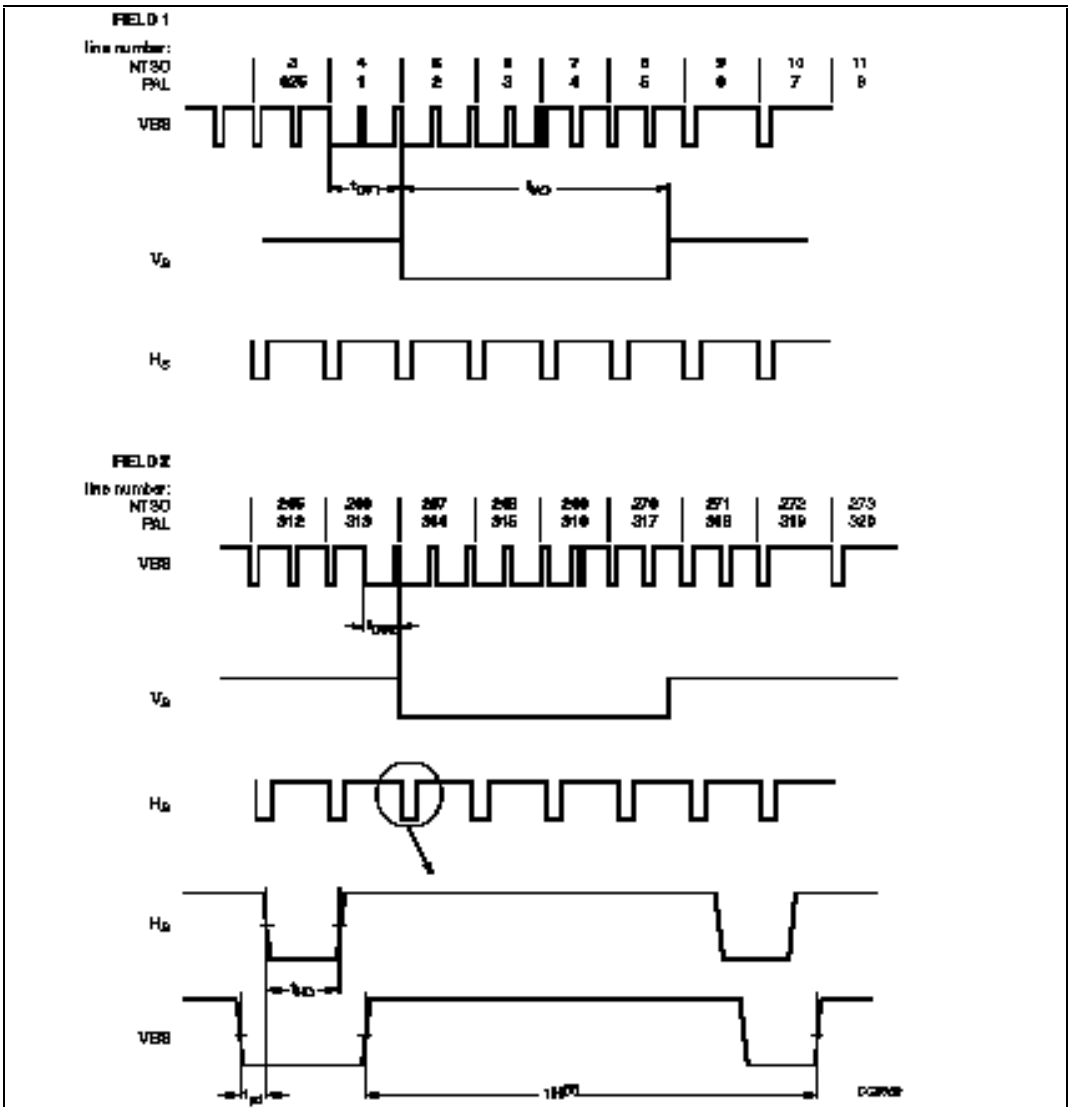



Fig. 3 Input and output signals

## 7.6 External clock

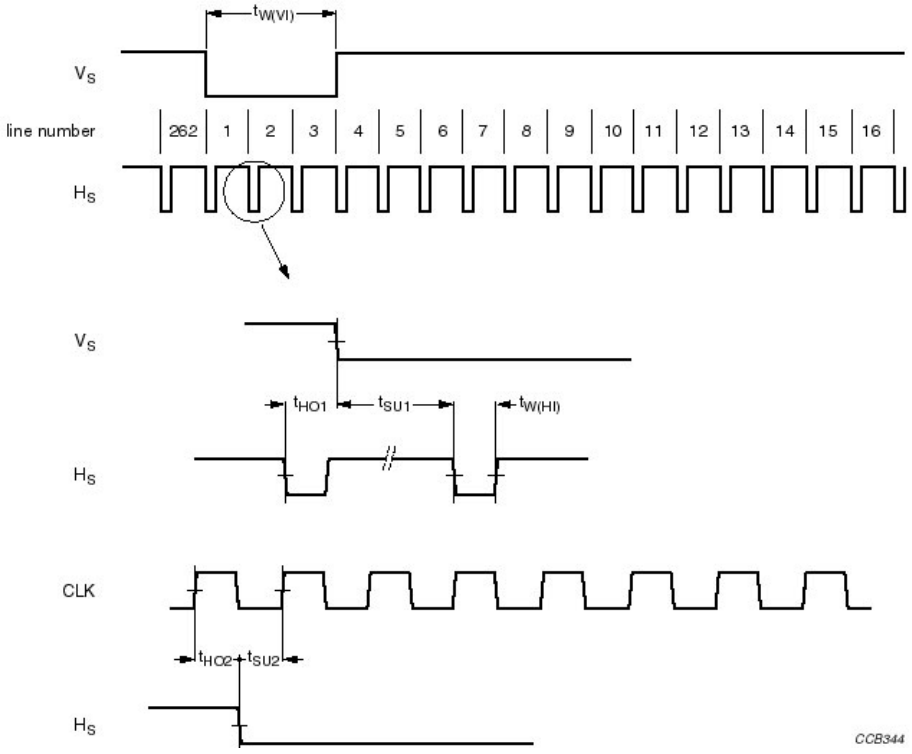



**Fig. 4. Definition of line and pixel numbers**

### 7.7 Backlight dimming

PWM timing is only valid for standard PAL or NTSC synchronisation signal

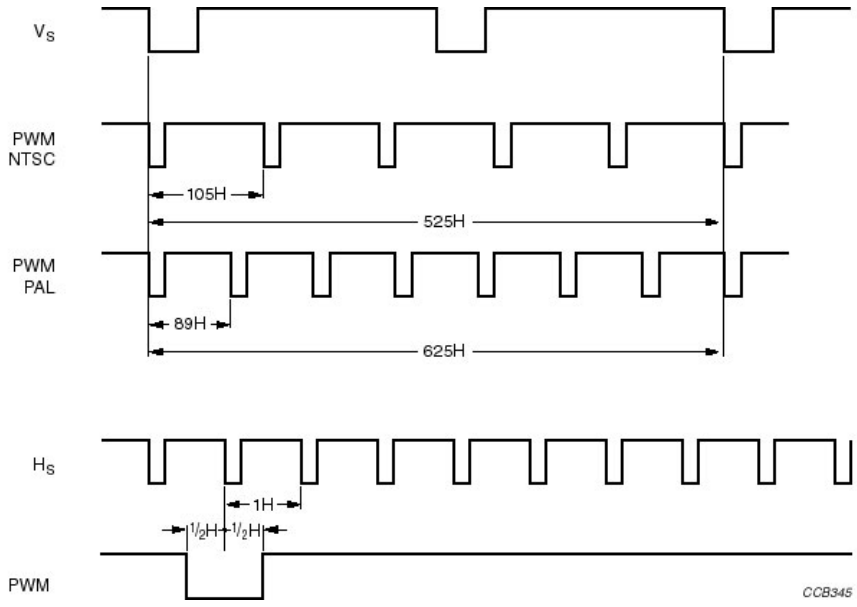



**Figure 5 Generated PWM signal for NTSC and PAL**

### 7.8 Power on/off sequences

Recommended sequence for power on:

1 Switch on the power supply
2 Switch on the control signals

Recommended sequence for power off:

1 Switch off the control signals power supply
2 Switch off the power supply

Power supply reset:
If the power supply voltage $V_{DD}$ drops ± 7.2V, the module switches off. The module will automatically switch on when the $V_{DD}$ increases above ± 7.4V. Maximum transition time from 6.5 to 8 Volt is 500 msec.

## 8 OPTICAL DATA

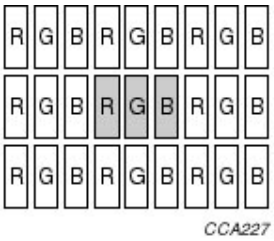
### 8.1 Optical characteristics

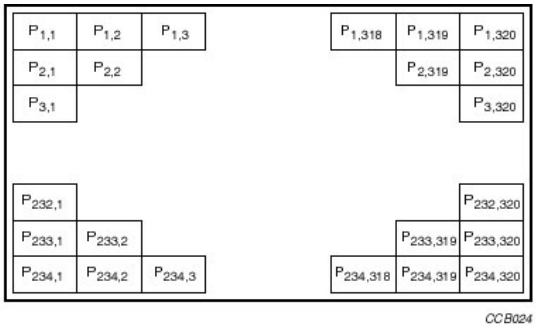
$T_{amb}$ = +22 ± 3 C; elapsed time from switch-on is greater than 45 minutes; driving conditions are typical values unless otherwise specified. Measurements are made perpendicular to the panel unless otherwise specified

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| L | luminance | $I_{(RMS)}$ = 6.0 mA; note 1. | 300 | 350 | | $Cd/m^2$ |
| $CR_{max}$ | maximum contrast ratio | At optimum viewing angle; note 1 | 100 : 1 | 200 | | |
| α | viewing angle: | CR>5; note 1 | | | | |
| | Θ =horizontal right | | 60 | 70 | | deg |
| | Θ =horizontal left | | 60 | 70 | | deg |
| | Θ =vertical up | | 45 | 50 | | deg |
| | Θ =vertical down | | 45 | 70 | | deg |
| $t_{res}$ | average response time | rise time | | 30 | | ms |
| | | fall time | | 15 | | ms |
| | color coordinates: | peak white; note 2 | | | | |
| $x_W$ | white | | 0.265 | 0.315 | 0.365 | |
| $y_W$ | white | | 0.280 | 0.330 | 0.380 | |
| $x_R$ | red | | 0.557 | 0.607 | 0.657 | |
| $y_R$ | red | | 0.274 | 0.324 | 0.374 | |
| $x_G$ | green | | 0.263 | 0.313 | 0.363 | |
| $y_G$ | green | | 0.523 | 0.573 | 0.623 | |
| $x_B$ | blue | | 0.122 | 0.147 | 0.172 | |
| $y_B$ | blue | | 0.071 | 0.121 | 0.171 | |
| $α_{opt}$ | Optimum viewing angle (for contrast) | Θ =270 (6 o'clock); notes.1 and 3 | | 3 | | deg |

**NOTES**
1. Brightness control input (BRT) open circuit
2. No dimming
3. Customer is advised to use the display in the 12 o'clock direction

## 8.2 Pixel organization




### 8.3 Contrast ratio

The contrast ratio (CR) is the ratio between the transmission ($\tau$) in a full white area (R = G = B = 1) and the transmission ($\tau_d$) in a dark area (R = G = B = 0):

$CR = \tau / \tau_d$

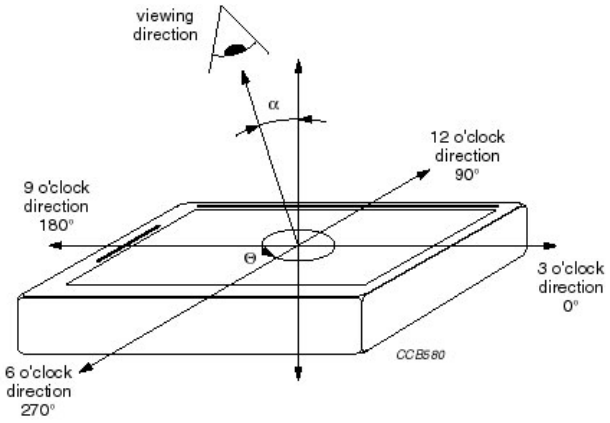
### 8.4 Response time

Response time ($t_{res}$) is the mean of rise time ($t_r$) and fall time ($t_f$):

$t_{res} = ( t_r + t_f ) / 2$

Rise time is the time for luminance to change from 10% to 90% as a result of a change of electrical condition, fall time is the time for luminance to change from 90% to 10% as a result of a change of electrical condition.

## 8.5 Viewing angle



## 9 ENVIRONMENTAL DATA

### 9.1 Environmental tests

Measurements are performed after two hours in room temperature environment; unless otherwise specified.

| TEST | CONDITIONS | METHOD | REMARK |
|---|---|---|---|
| High temperature, operating | $T_{panel}$ = +85 C for 240 hours | IEC 60068-2-2Bb | panel surface temperature |
| Low temperature, operating | $T_{amb}$ = −30 C for 240 hours | IEC 60068-2-1Ab | |
| High temperature storage | $T_{amb}$ = +90 C for 240 hours | IEC 60068-2-2Bb | module not operated |
| Low temperature storage | $T_{amb}$ = −40 C for 240 hours | IEC 60068-2-1Ab | module not operated |
| High temperature, high humidity, operating | $T_{amb}$ = +60 C, RH = 90% for 240 hours | IEC 60068-2-3Ca | module operating |
| Thermal shock | $T_{amb}$ = −40 to 85 C; 168 cycles | IEC 60068-2-14Nb | module not operated |
| UV 765 W/m$^2$ | 168 hr | IEC 60068-2-5Sa | module not operated |

### 9.2 Mechanical tests

| TEST | CONDITIONS | METHOD | REMARK |
|---|---|---|---|
| Shock | 3 directions: X, Y, Z axes;<br>6 repeats;<br>peak acceleration = 100 G;<br>pulse duration = 6 ms | IEC 60068-2-27Ea | not operated;<br>not packed |
| Vibration | 3 directions: X, Y, Z axes;<br>6 repeats;<br>sweep time = 11 minutes;<br>peak acceleration = 10 G;<br>frequency = 10 to 150 Hz;<br>amplitude = 1.5 mm peak-to-peak | IEC 60068-2-6Fc | not operated;<br>not packed |

### 9.3 Electrostatic discharge (ESD)
Under directive "89/336/EEG" conforms with "EN50082-1".

### 9.4 Electromagnetic (EMC)
Under directive "89/336/EEG" conforms with "EN55022/B" and "EN61000-4-6".

### 9.5 Safety
Complies with "IEC60950"

## 10 Handling and safety requirements

| **WARNING** |
|---|
| The display glass may break when it is dropped or bumped on a hard surface. Handle with care. Should the display break, do not touch the liquid crystalline material. In case of contamination with liquid crystal material, wash immediately with water and soap. |

| **CAUTION** |
|---|
| At temperatures lower than the rated storage temperature, the liquid crystal solidifies causing permanent damage to the display. |
| At temperatures higher than the rated storage temperature, the liquid crystal turns into an isotropic liquid and may not recover. |
| The display module should not be exposed to harmful gases, such as acid and alkali gases, which corrode electronics components. |
| Disassembling the display module can cause permanent damage and invalidates the warranty agreements. |
| Observe general precautions that are common to handling delicate electronic components. The glass can break and polarizers can easily be damaged. Moreover the display is sensitive to static electricity and other rough environmental conditions. |

## 11 MOUNTING

| **CAUTION** |
|---|
| Allow enough space at the back of the module for sufficient airflow to disperse heat generated by the backlighting system. |

## 12 DEFINITIONS

| **Data sheet status** | |
|---|---|
| Objective specification | This data sheet contains target or goal specifications for product development |
| Preliminary specifications | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specification |
| **Limiting values** | |
| Limiting values given are in accordance with the absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability | |
| **Application information** | |
| Where applications information is given, it is advisory and does not form part of the specification. | |

# ***Philips Flat Display Systems Company Sales Offices***

## Philips Flat Display systems

Jan Campertstraat 5
6416 SG Heerlen
The Netherlands
Tel +31 45 5437 750
Fax +31 45 5437 780

## Philips Flat Display Systems

3200 North First Street
San Jose, CA, 95134
USA
Tel. +1 408 570 5600
Fax +1 408 570 5700

## 1. SCOPE

This Quality Description Sheet applies to all versions of the Active Matrix Liquid Crystal Display Module type number LTE052T-060 (hereinafter called the Module), supplied by Philips Flat Panel Display Co. (PFPD) B.V. to the Customer or an agent of the Customer.



## 2. Conformance to specification

Conformance to specification regarding visual defects is guaranteed by a 100% final inspection and by a lotrelease based on a sampling inspection with zero defects. With regard to parametric specifications the PFPD Quality Assurance monitoring system will apply.

## 3. Inspection conditions and test patterns

| Item | Conditons | |
|---|---|---|
| Lighting | Fluorescent light (Day-Light Type) Display Surface illumination to be 500 - 1000 Lux. | |
| Temperature | 25 ˚C +/- 5˚C | |
| Driving Conditon | Equipment | Customer controller or PFPD original controller |
| | Test pattern | Black, White, R, G, B |
| | Supply voltage | typical supply voltages given in commercial specification |
| | inspection time | ≤ 1 minute |

Remarks: Inspect at 20 inches from display.
Defects that are not noticed within 1 minute shall be ignored.
Standard Viewing angle of the inspection shall be perpendicular to the display surface.
Inspection at other viewing angles shall not exceed the range of specified viewing angle.

## 4. VISUAL DEFECT CRITERIA

The defect categories covered in this QDS are comprised of defects in the active display area such as dot defects, blemishes and partly or completely malfunctioning displays as well as the visual appeareance of the complete product and the packing of the product. The different defect categories are described below.

## 4.1 Dot and Line defects inspection specifications.

4.1- 1 Count with the following display pattern

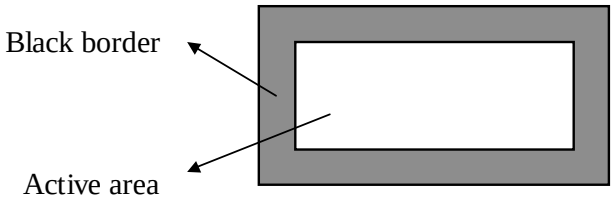


a) Black pattern
b) White pattern
c) R pattern
d) G pattern
e) B pattern

4.1- 2 Acceptable number of defects

| Item | | R | G | B | Total Number | inspection pattern |
|---|---|---|---|---|---|---|
| Dot defect | Bright defect | 2 | 1 | 3 | 6 | (a) (e) |
| | Dark defect | 4 | | | | Total of (c) (d) (e) |
| Line defect | | 0 | | | | (a) (b) (c) (d) (e) |

## 4.2 Blemishes, cosmetic anomalies inspection specifications.

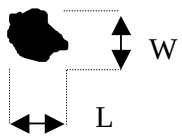



Active area dimensions: see product specification
Black border: rim between active area and metal front cover

4.2.1 Circular defects

| Size (mm) | Acceptable number | |
|---|---|---|
| | Active area | Black border |
| $D \leq 0.15$ | No count | No count |
| $0.15 < D \leq 0.20$ | 3 | |
| $0.20 < D \leq 0.31$ | 1 | |
| $0.31 < D$ | 0 | |

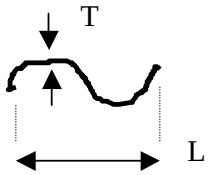
D = (Length + Width ) / 2



4.2.2 Long defects

| Size (mm) | | Acceptable number | |
|---|---|---|---|
| | | Active area | Black border |
| T ≤ 0.03 | - | No count | No count |
| 0.03 < T ≤ 0.08 | L ≤ 2.0 | No count | |
| 0.03 < T ≤ 0.08 | 2.0 < L ≤ 3.0 | 1 | |
| 0.03 < T ≤ 0.08 | 3.0 < L | 0 | |
| 0.08 < T | - | 0 | |

T = defect thickness
L = defect contour length




4.2.3 Pinholes

Black border only.

| Size (mm) | Acceptable number |
|---|---|
| | Black border |
| D ≤ 0.15 | No count |
| 0.15 < D | 0 |

D = diameter

4.2.4 Color blemishes

If applicable shall not exceed the accepted limit sample.

## 4.3 Malfunctioning

Not allowed are:
- Malfunctioning display: no picture, distinct block or line failure.
- Malfunctioning backlight.
- Excessive start up time (> 3 sec.)

## 4.4 Appearance

Not allowed are:



- Type/serial number wrong, missing or not legible.
- Offensive surface damage.
- Connectors damaged.
- Stains within active area, such as finger prints or adhesive residues.
- Dirty appearance (can not be removed with a dry cloth).

## 4.5 Packing

Not allowed are:

- Box damaged, wet, badly taped or stapled causing the product not to arrive in good condition at the Customer.
- Type or model number wrong, missing or not legible.

The specification of the LTE502T-9197-1 is based on the specification of the LTE052T-060.
The General Quality Description Sheet of the LTE052T-06* family is valid for the LTE502T-9197-1.



The LTE502T-9197-1 product is almost equal to the LTE052T-060 product, exceptions are:

- Pin 22 of the interface connector became possible pixel clock output
- Mechanical drawing updated.

## Details of the deviations are list as follows:

1. **Section 6 Pinning for electrical interface:** Pin 22 was changed to pixel clock I/O pin.

| SYMBOL | PIN | I/O | DESCRIPTION |
|---|---|---|---|
| **Analog interface** | | | |
| $H_s$ | 1 | I/O | Horizontal sync; notes 1 and 2 |
| $V_s$ | 2 | I/O | Vertical sync; notes 1 and 3 |
| PWM | 3 | O | Synchronization signal for backlight |
| P/N | 4 | I | PAL/NTSC control signal, note 8 |
| HRV | 5 | I | Horizontal scanning direction; note 4 |
| VRV | 6 | I | Vertical scanning direction note 5 |
| $V_{sw}$ | 7 | I | $RGB_1$/ $RGB_2$ video signal switching; note 6 |
| n.c. | 8 | - | Not connected |
| n.c. | 9 | - | Not connected |
| $V_{DD}$ | 10 | I | Supply voltage |
| VBS | 11 | I | VBS input for sync separator |
| BRT | 12 | I | Brightness control |
| $R_1$ | 13 | I | Red video signal 1 |
| $G_1$ | 14 | I | Green video signal 1 |
| $B_1$ | 15 | I | Blue video signal 1 |
| n.c. | 16 | - | Not connected |
| $R_2$ | 17 | I | Red video signal 2 |
| $G_2$ | 18 | I | Green video signal 2 |
| $B_2$ | 19 | I | Blue video signal 2 |
| GND | 20 | I | Ground |
| CLKC | 21 | I | Change I/O direction of CLK, $H_s$ and $V_s$; note 7 |
| CLK | 22 | I/O | Clock signal |
| **Backlight** | | | |
| $V_{in}$ | 1 | I | Backlight input voltage |
| GND | 2 | I | Backlight ground connection |

**NOTES**

1 CLKC= LOW: module is activated by CLK, $H_s$ and $H_s$.
2 CLKC = HIGH: $H_s$ is output, synchronised to VBS signal
CLKC = LOW: $H_s$ is horizontal sync input.
3 CLKC = HIGH: $V_s$ is output, synchronised to VBS signal
CLKC = LOW: $V_s$ is vertical sync input.
4 HRV = HIGH: image is normal
HRV = LOW: image is reversed into horizontal direction.
5 VRV = HIGH: image is normal
VRV = LOW: image is reversed into vertical direction.
6 $V_{sw}$ = HIGH: $RGB_1$ is selected
$V_{sw}$ = LOW: $RGB_2$ is selected

7 CLKC = HIGH : CLK, $H_s$ and $V_s$ become output mode
CLKC = LOW: CLK, $H_s$ and $V_s$ become input mode
8 P/N switching when not operating

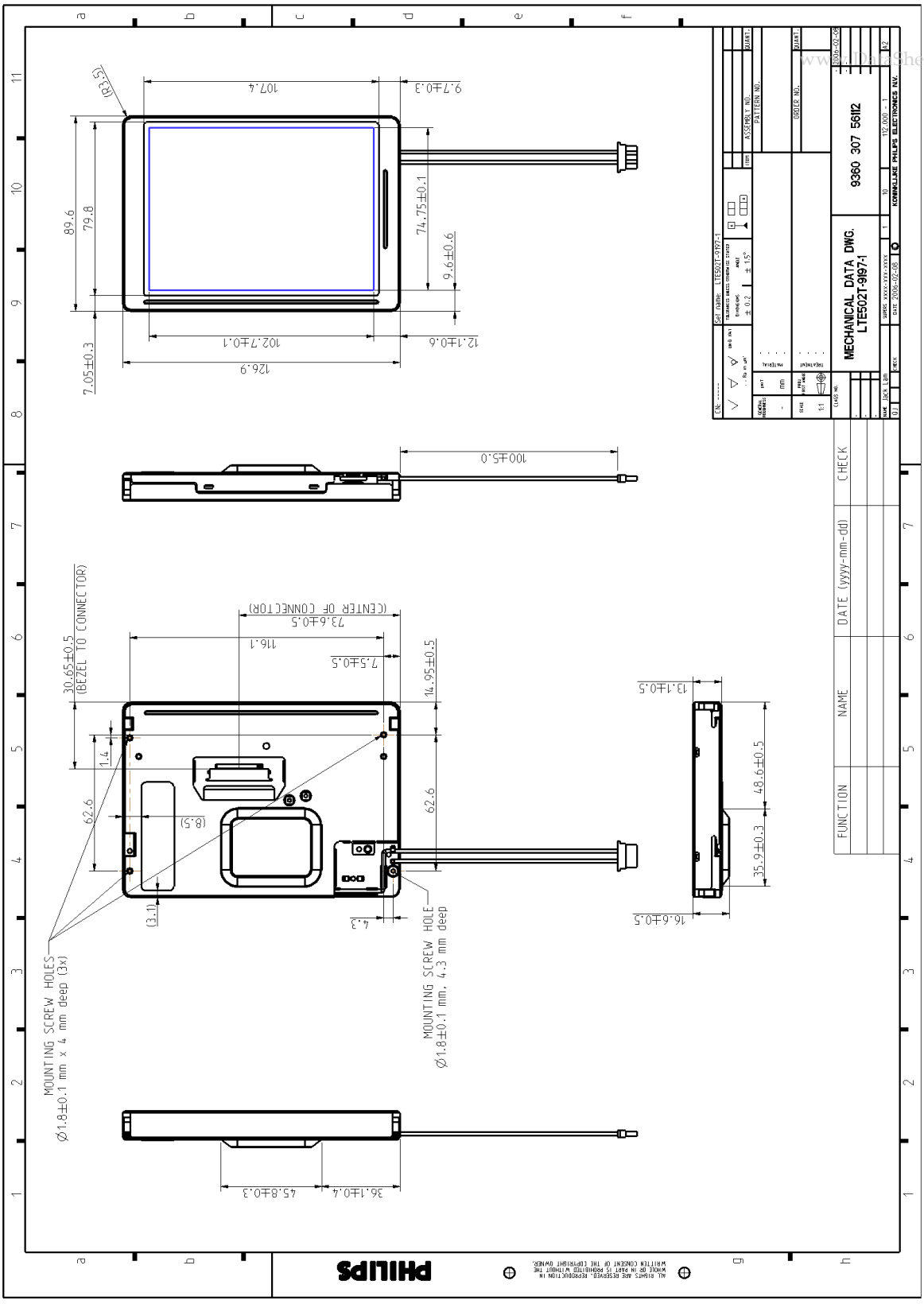


**2. Section 7.4 Characteristics:** Merge "Hs, Vs, PWM" and "CLK" into one related item.

GND = 0 V; $T_{amb}$ = -30 to + 70 C; unless otherwise stated.

| SYMBOL | DESCRIPTION | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| **$H_S$, $V_S$, CLK, $V_{SW}$** | | | | | | |
| $V_{IH}$ | HIGH-level input voltage | | 3.5 | | | V |
| $V_{IL}$ | LOW-level input voltage | | | | 1.5 | V |
| **P/N, VRV, CLKC, HRV** | | | | | | |
| $V_{IH}$ | HIGH-level input voltage | | 2.0 | | | V |
| $V_{IL}$ | LOW-level input voltage | | | | 0.8 | V |
| **$H_S$, $V_S$, PWM, CLK** | | | | | | |
| $V_{OH}$ | HIGH-level output voltage | $I_{OH}$ = -4 mA | 2.4 | | | V |
| $V_{OL}$ | LOW-level output voltage | $I_{OL}$ = +4 mA | | | 0.4 | V |
| **CLK, HRV** | | | | | | |
| $I_{IH}$ | HIGH-level input current | $V_I$ = + 5 V | -0.1 | | +0.1 | µA |
| $I_{IL}$ | LOW-level input current | $V_I$ = 0 V | | | -4.5 | µA |
| **$H_S$, P/N, $V_S$, VRV, CLKC** | | | | | | |
| $I_{IH}$ | HIGH-level input current | $V_I$ = +5 V | | | +10 | µA |
| $I_{IL}$ | LOW-level input current | $V_I$ = 0 V | | | -200 | µA |
| **VSW** | | | | | | |
| $I_{IH}$ | HIGH-level input current | $V_I$ = +5 V | | | +10 | µA |
| | LOW-level input current | $V_I$ = 0 V | | | -600 | µA |
| **R, G, B, $V_{SW}$, VBS** | | | | | | |
| $C_I$ | input capacitance | f = 1 MHz | | 28 | | pF |
| **P/N, HRV, VRV, CLK, PWM, $H_S$, $V_S$** | | | | | | |
| $C_I$ | input capacitance | f = 1 MHz | | 37 | | pF |
| **CLKC** | | | | | | |
| $C_I$ | input capacitance | f = 1 MHz | | 10 | | nF |

## 3. Section 5 Mechanical Data:






| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | COMPANY RESTRICTED | | |
| | | Commercial Specification | | | | A | ~~05-10-27~~ |
| | | Active Matrix 5" colour TFT LCD Module | | | 9360 307 56112 | A | ~~05-12-13~~ |
| | | LTE502T-9197-1 | | | | | 06-02-16 |
| Leo Chow | | | 05-10-24 | 1 | 190 -3 | EN | --- A4 |
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