DATA SHEET

LTE072T-050
LTE072T-051
Active matrix 7" colour
TFT LCD module

Preliminary specification

9 July, 1999

PHILIPS

CONTENTS

1. GENERAL DESCRIPTION

The LTE072T-050 (PAL CVBS) and the LTE072T-051 are TFT (thin film transistor) active matrix LCD module. Each module comprises:

- A silicon TFT panel
- Driver electronics with control array
- An analog RGB/CVBS interface board
- An inverter
- A built-in backlight

The 7" diagonal display active area contains 480 (RGB) x 234 pixels and has a full colour capability. It has wide viewing angle and an aspect ratio of 16:9. The module can withstand intense environments.

2. FEATURES

- RGB stripe configuration
- analog RGB with horizontal and vertical sync inputs
- Video composite signal for synchronisation
- PAL/NTSC selectable inputs
- Left/right, up/down control signal
- 16:9 aspect ratio
- 234 line display
- High contrast TFT LCD drive
- High speed response
- High brightness luminance
- Wide viewing angle display
- Integrated high-efficiency backlight
- Extended temperature range
- Power supply voltage 8 to 16 V
- Fast start up backlight at low temperatures

3. APPLICATIONS

- Car navigation &and information
- Car entertainment
- TV and VCR monitor
- Video games
- Automation and process-control monitor

4. QUICK REFERENCE DATA

PARAMETER	VALUE	UNIT
Overall dimensions (without backlight and inverter) width height depth	 167.0 102.0 11.0	 mm mm mm
Screen size (diagonal)	7 176	Inch mm
Active area dimensions width height	 153.4 86.3	 mm mm
Display resolution	480 x 3 x 234	pixels
Pixel dimensions horizontal vertical	 0.107 x 3 0. 369	 mm mm
Pixel configuration	RGB stripe	
Supply voltage module	8 - 16	V
Supply voltage backlight inverter	8 - 16	V
Power consumption module (nominal value)	1.3	W
Power consumption backlight inverter (nominal value)	7.2	W
Advised viewing direction	12 o'clock	
Maximum contrast ratio (peak viewing angle)	> 100	
Adjustable luminance	3.5 - 350	Cd/m^2
Backlight lifetime	15.000	hours
Operating temperature range (panel surface temperature)	-30 to +85	^oC
Storage temperature	-40 to +90	^oC
Response speed (typical)	50	ms
Mass module module with backlight inverter	 230 245	 g g

4.1 Backlight inverter

The backlight inverter is an integral part of the module

PARAMETER	VALUE	UNIT
Supply input voltage	8 - 16	V
Maximum input current (Vinv = 12 V)	1	A
Backlight dimming ratio	1 : 100	
Minimum Backlight lifetime (Tamb = 25^oC)	15.000	hours
Mass inverter	15	g

4.2 Block diagram

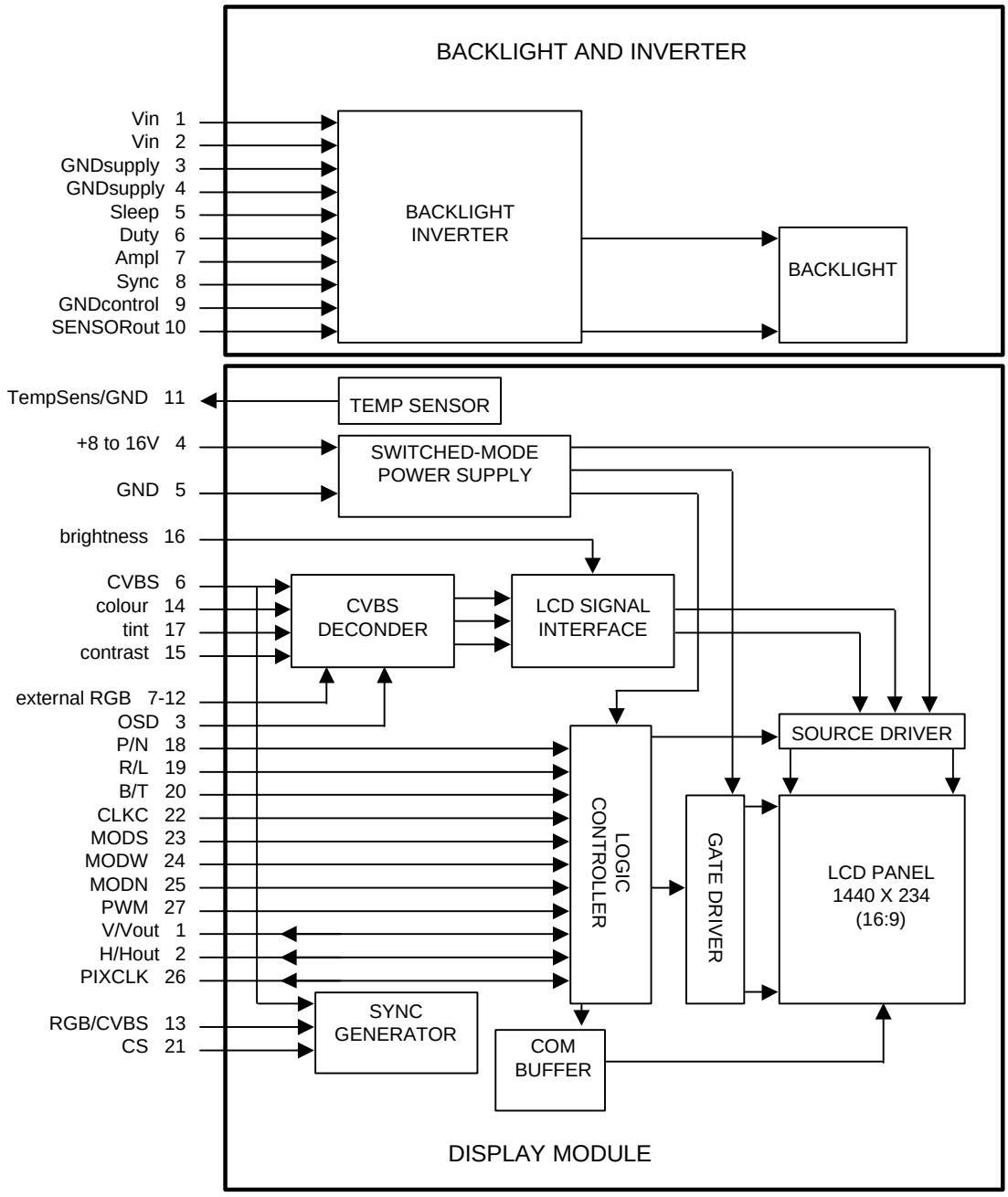


Fig.1 Block diagram.

5. MECHANICAL DATA

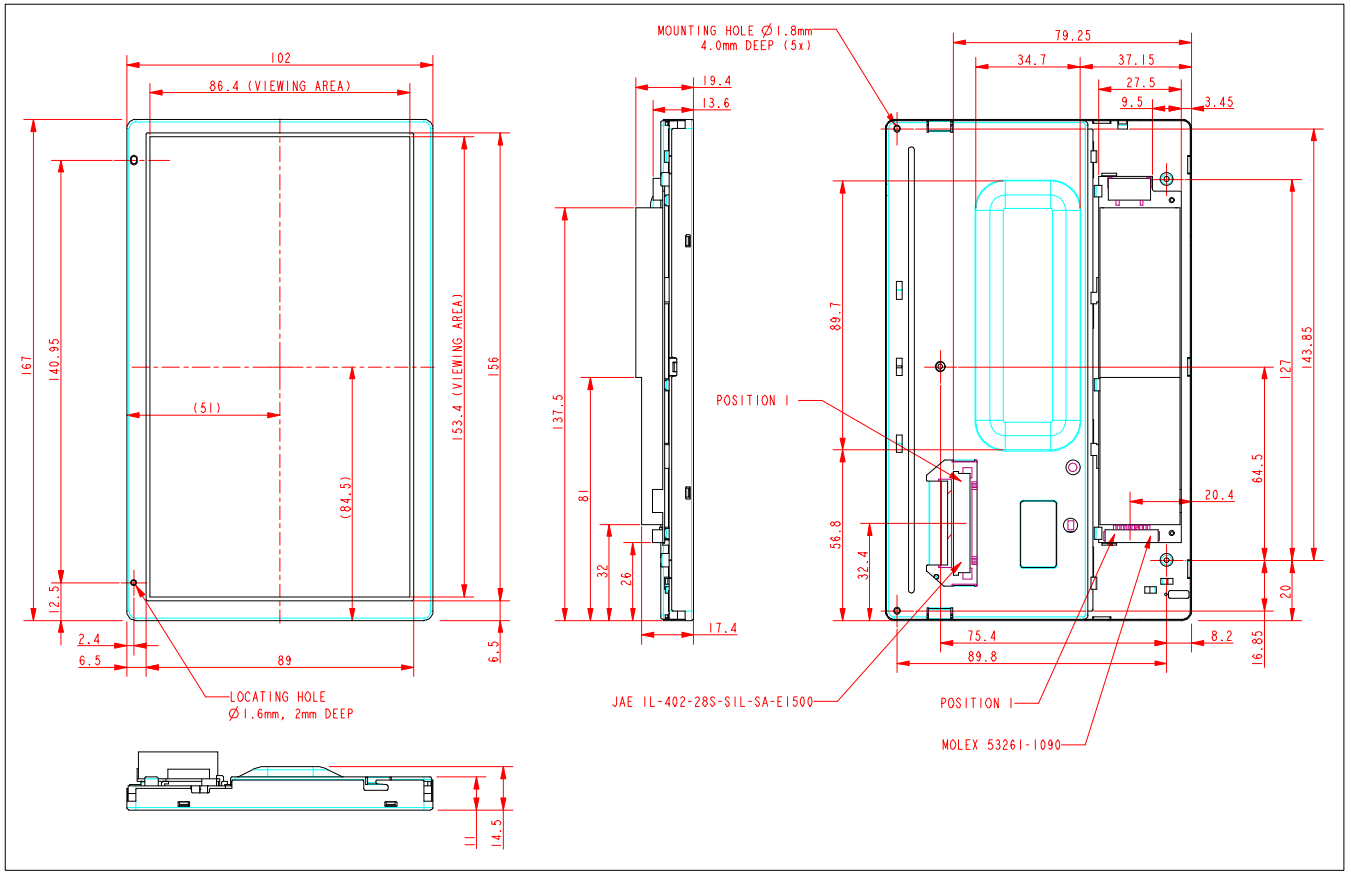


Fig.2 Mechanical Outline

5.1 Dimensions

PARAMETER	VALUE	UNIT
Display format	(480 x 3) x 234	dots
Active area	153.4 x 86.3	mm
Screen size (diagonal)	176 7	mm inches
Pixel pitch horizontal vertical	 3 x 0.107 0.369	 mm mm
Dot configuration	RGB stripe	
Overall dimensions (without interface board and inverter) width height depth	 167.0 102.0 11	 mm mm mm
Mass module module with backlight inverter	 230 245	 g g

5.2 Electrical connectors

SERVICE	CONNECTOR	TYPE NUMBER	NUMBER OF PINS	MATING CONNECTOR
Analog interface	JAE; see note 1	JAE-IL-402-28S-SIL-SA-E1500	28	Flex Foil, pitch = 1.0 mm
Inverter	Molex	53261-1090	10	Molex 51021-1000

Notes
1. Bottom contact entry

6. PINNING

6.1 Analog interface

SYMBOL	PIN	I/O	DESCRIPTION
V/V_{out}	1	I/O	vertical sync pulse I/O; negative going pulses for both input and output
H/H_{out}	2	I/O	horizontal sync pulse I/O; negative going pulses for both input and output
OSD	3	I	On screen data select input; default LOW for OSD OFF
V_{sup}	4	I	Supply voltage (+8 to 16 V)
GND	5	-	Ground
CVBS	6	I	Composite video input; module can synchronize on CVBS or CS input
GND	7	-	Ground
R	8	I	Red video input
GND	9	-	Ground
G	10	I	Green video input
T_{sensor}/GND	11	-	Temperature sensor / AC ground
B	12	I	Blue video input
RGB/CVBS	13	I	RGB/CVBS select input; default LOW (10 kohm pull-down resistor) selects CVBS; RGB/CVBS=HIGH (+5V) selects RGB (CS is then sync input)
Colour	14	I	0 to 3.5 V colour control input (CVBS only)
Contrast	15	I	0 to 3.5 V contrast control input (CVBS only)
Brightness	16	I	0 to 3.5 V brightness control input
Tint	17	I	0 to 3.5 V Tint control input (NTSC only)
P/N	18	I	PAL/NTSC mode select; default HIGH (10 kohm pull-up resistor) selects NTSC 60 Hz mode. For PAL mode 50 Hz versions, P/N is default LOW
R/L	19	I	scan direction right/ left; default HIGH (10 kohm pull-up resistor) for left-to-right scanning; R/L= LOW (0 V) gives right-to-left scanning
B/T	20	I	scan direction bottom-to-top/ top-to-bottom; default HIGH (10 kohm) for top-to-bottom scanning; B/T= LOW (0 V) gives bottom-to-top scanning
CS	21	I	composite sync input; positive or negative-going TTL signal
CLKC	22	I	clock select (internal sync/ external clock); see note 1
MODS	23	I	Aspect ratio control input
MODW	24	I	Aspect ratio control input
MODN	25	I	Aspect ratio control input
PIXCLK	26	I/O	pixel clock
PWM	27	O	backlight dimming output; see note 2
n.c.	28	-	Not used. Do not connect.

Notes

1. CLCK input is default HIGH (10 Kohm) for internal clock mode. With CLCK=LOW, PIXCLK is inputas the clock signal, V and H become sync inputs and P/N,MODS,MODW and MODN must be set HIGH
2. PWM signal can be used to control the PWM dimming frequency directly. It can also be used to control dimming in combination with HSY. The PWM signal should be used only with standard NTSC or PAL signal inputs.

6.2 Backlight inverter interface

Pin No.	Symbol	Description	Remarks
CN1-1	V_{in}	Supply voltage	8.0 ~ 16.0 V
CN1-2	V_{in}	Supply voltage	8.0 ~ 16.0 V
CN1-3	GND_{supply}	Supply ground	
CN1-4	GND_{supply}	Supply ground	
CN1-5	Sleep	Sleep control by digital voltage	0.0 ~ 5.0 V
CN1-6	Duty	Duty cycle dimming control by analog or PWM voltage	0.0 ~ 5.0 V
CN1-7	Ampl	Amplitude control by analog or PWM voltage	0.0 ~ 5.0 V
CN1-8	Sync	Synchronization of internal PWM	0.0 ~ 5.0 V
CN1-9	$GND_{control}$	Control ground	
CN1-10	$Sensor_{out}$	Sensor readout	10 kΩ NTC

7. ELECTRICAL CHARACTERISTICS

7.1 Limiting values

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

SYMBOL	DESCRIPTION	MIN.	MAX.	UNIT
$V_{DD,}$ V_{inv}	power supply input voltage	8	16	V
RH	relative humidity; see note 1	-	90	%
T_{stg}	storage temperature; see note 1	-40	+90	^{0}C
T_{oper}	operation temperature; see note 2	-30	+85	^{0}C

Notes

1. No condensation is allowed under any condition.
2. Panel surface temperature should not exceed 85 ^{o}C.

7.2 Characteristics

SYMBOL	DESCRIPTION	CONDITION	MIN.	TYP.	MAX.	UNIT
Power supply						
Vsup	Supply voltage (pin 4)	Within 300 ms	8.0	12.0	16.0	V
Isup	Supply current	8 - 16 V	90	110	500	mA
Logic levels (V/Vout, H/Hout, OSD, RGB/CVBS, P/N, R/L, B/T, CS, CLKC, MODS, MODW, MODN, PIXCLK, PWM						
V_{IH}	High-level input voltage		3.5	5.0	5.2	V
I_{IL}	Low-level input voltage		0	-	0.8	V
Analog inputs						
V_{RGB}(p-p)	Analog video input voltage (peak-to-peak value)	R_l = 75 Ohm	0	0.7	1.1	V
External control inputs						
Brightness	Brightness control		0	2.0	3.5	V
Contrast	Contrast control		0	2.8	3.5	V
Tint	Tint control		0	3.0	3.5	V
Colour	Colour control		0	2.8	3.5	V
Backlight inverter						
Vinv	Supply voltage		8.0	12.0	16.0	V
Iinv	Supply current	Vinv = 12.0 V		600		mA
Sleep	Sleep control voltage		-0.3		V_{in}+0.3	V
Duty	Dimming control voltage		-0.3		V_{in}+0.3	V
Ampl	Amplitude control voltage		-0.3		V_{in}+0.3	V
Sync	Synchronisation voltage		-0.3		V_{in}+0.3	V

7.3 Timing

7.3.1 EXTERNAL CLOCK MODE (CHANGE CLOCK CLKC = LOW)

- Module is synchronised to horizontal sync output pulses HSY and VSY
- Input clock CLK, HSY and VSY are switched to input mode
- Module is activated by CLK (CLK timing is with respect to horizontal pixel sampling clock PIXCLK)

Timing: external clock mode

SYMBOL	DESCRIPTION	MIN.	TYP.	MAX.	UNIT
$t_{W(VI)}$	Vertical sync pulse width	1H	3H	5H	
t_{H01}	Vertical sync hold time	1.0	-	-	µs
t_{SU1}	Vertical sync set-up time	1.0	-	-	µs
$t_{W(HI)}$	Horizontal sync pulse width	1.0	5.0	9.0	µs
t_{H02}	Horizontal sync hold time	25	-	-	ns
t_{SU2}	Horizontal sync set-up time	25	-	-	ns
f_{clk}	CLK frequency	9.0	10.0	11.0	MHz
f_{VSY}, f_{Vin}	VSY, V_{in} frequency	50	f_{HSY} /312	f_{HSY} /300	Hz
f_{HSY}, f_{Hin}	HSY, H_{in} frequency	f_{clk} /650	F_{clk} /610	f_{clk} /570	Hz

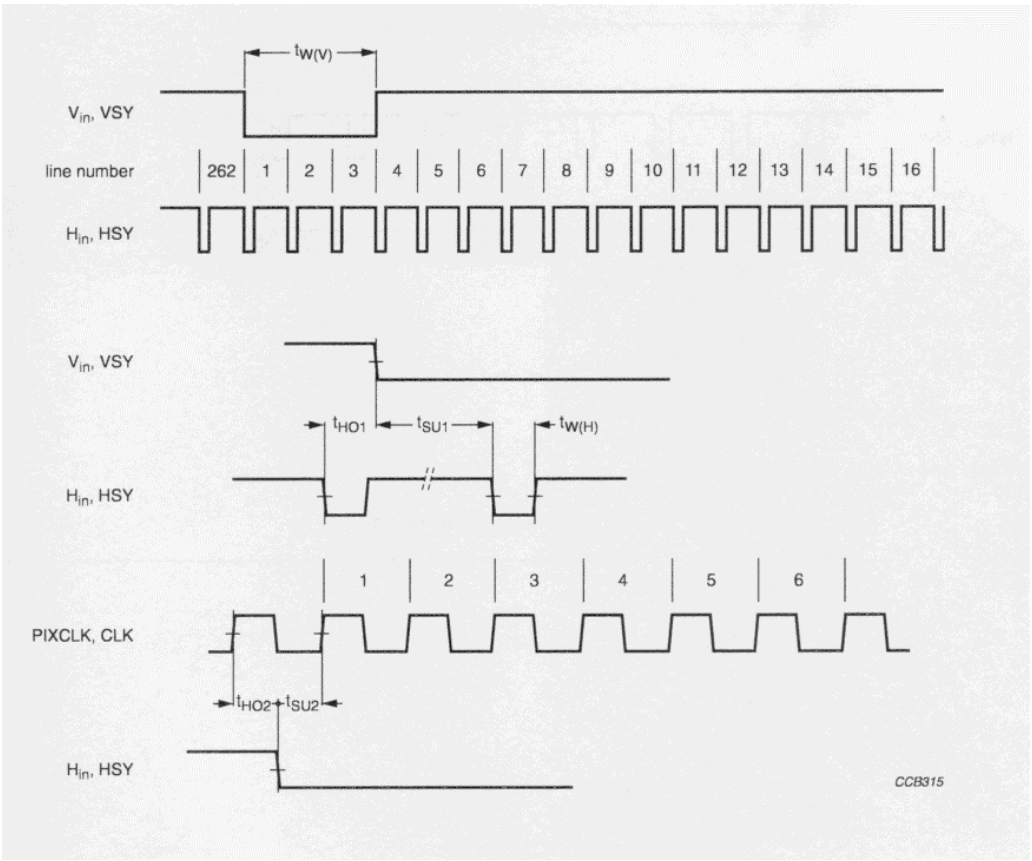
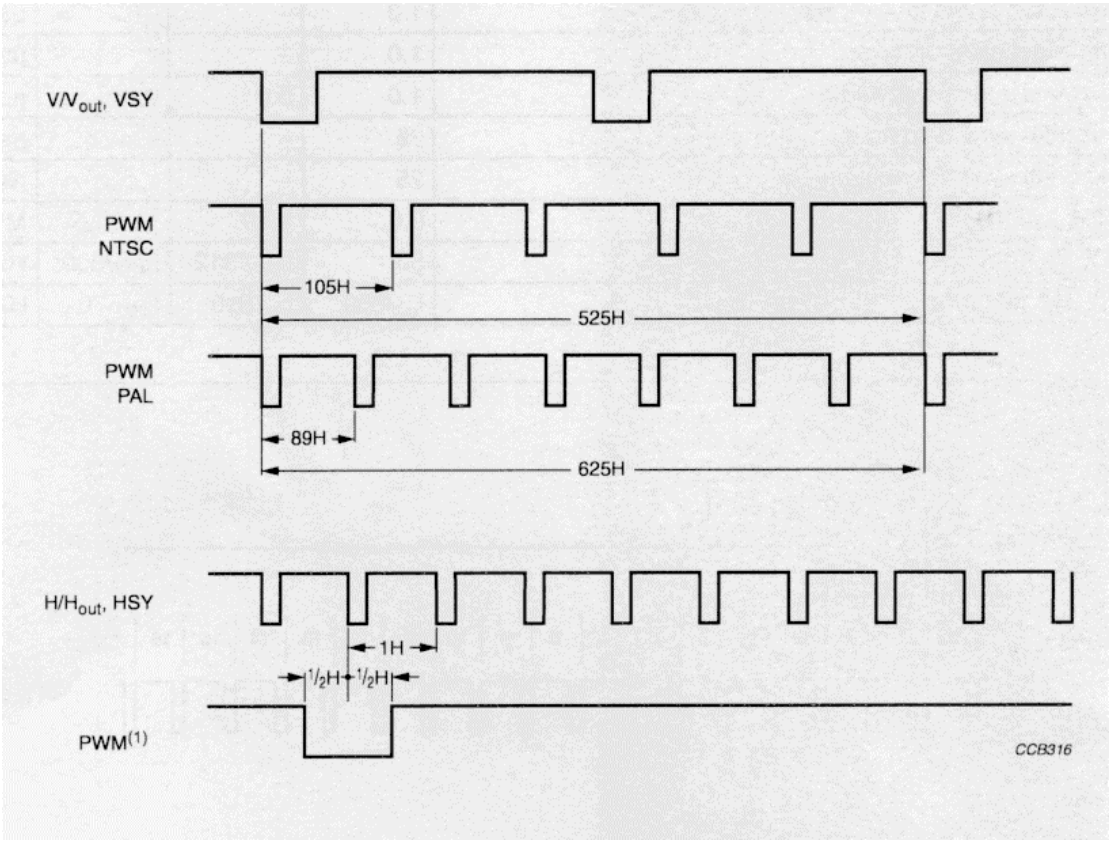


Fig. 3 Horizontal and vertical timing in external clock mode

7.3.2 PWM SIGNAL



(1) Typical PWM frequency, PAL: 175 Hz; NTSC: 150 Hz

Fig. 4 Output timing, PWM signal

7.4 Inverter characteristics

7.4.1 DIMMING FUNCTION

Dimming can be controlled in two ways (but not simultaneously):

- By applying an analog control voltage on CN1-6.
- By applying a digital pulse width modulated control signal on CN1-6.

7.4.1.1 Applying a dc control voltage

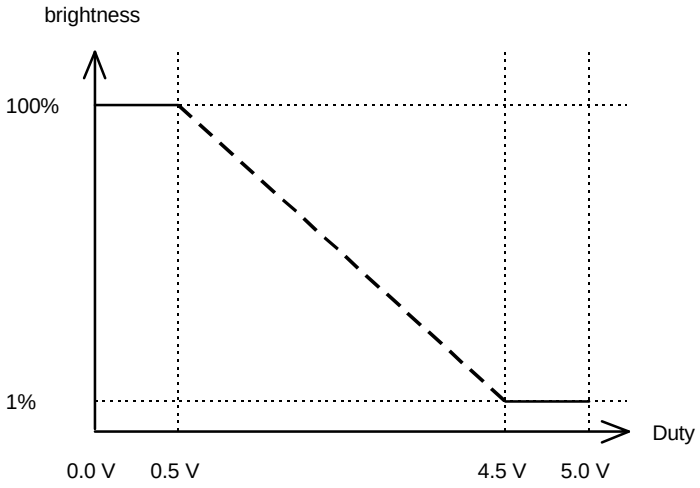


Figure 1 - brightness as a function of a dc voltage on CN1-6

7.4.1.2 Applying a pulse width modulated control signal

Brightness is determined by the dc-level of a pulse width modulated control signal Duty. The upper and lower voltage limits, as well as the duty cycle determine the brightness. Internally a low pass filter is applied. The control frequency should be 500 Hz or higher.

7.4.1.3 Interfacing characteristics CN1-6

Item	Unit	Min	Typ	Max
input impedance	kΩ	100		
Termination voltage	V		tbd	
cut-off frequency of low-pass filter	Hz		500	
Attenuation per octave	dB		tbd	

7.4.2 AMPLITUDE CONTROL

Amplitude can be controlled in two ways (but not simultaneously):

- By applying an analog control voltage on CN1-7.
- By applying a digital pulse width modulated control signal on CN1-7.

An external temperature sensor (NTC 10kΩ), connected to CN3, is used to monitor the working point of the CCFT. Control logic is not on the inverter but external. The sensor wires are lead to CN1

directly without any interfacing. Boost mode should only be used for a short period of time at low ambient temperature.

7.4.2.1 Applying a dc control voltage

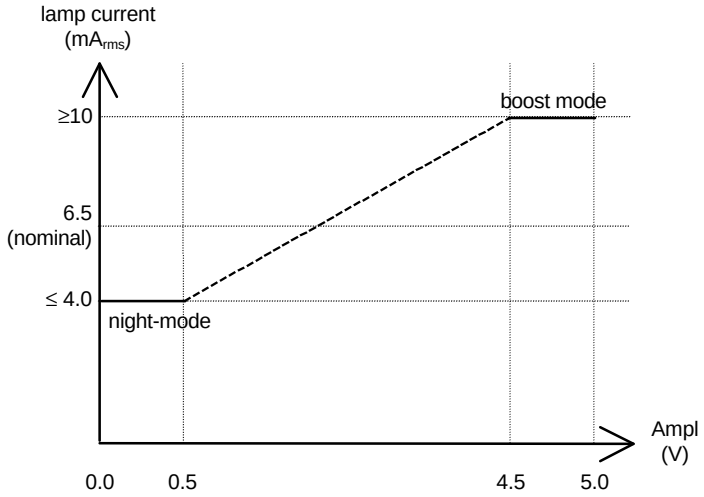


Figure 2 - amplitude as function of a dc voltage on CN1-7

With the lamp current at boost mode the following run-up times can be achieved:

Ambient temperature (still air) [°C]	**time to reach 50% of max brightness at the specified temperature [s]**
-30	40
-20	20
-10	10

Note: The inverter is not dimmed.

7.4.3 APPLYING A PULSE WIDTH MODULATED CONTROL SIGNAL

Amplitude is determined by the dc-level of a pulse width modulated control signal Ampl. The upper and lower voltage limits, as well as the duty cycle determine the amplitude. Internally a low pass filter is applied. The control frequency should be 500 Hz or higher.

7.4.4 INTERFACING CHARACTERISTICS CN1-7

Item	**Unit**	**Min**	**Typ**	**Max**
input impedance	kΩ	100		
Termination voltage	V		tbd	
cut-off frequency of low-pass filter	Hz		500	
Attenuation per octave	dB		tbd	

8. OPERATING MODES

MODE	DESCRIPTION		SOURCE ASPECT	ADDRESS		
				MODS	MODW	MODN
NTSC						
1	Full display mode		4:3	H	H	H
2	Wide-1 mode		4:3	H	H	L
3	normal mode		4:3	H	L	H
6	14:9 or overscan mode		4:3	L	H	L
7	Normal right mode		4:3	L	L	H
8	Normal left mode		4:3	L	L	L

MODE	DESCRIPTION		SOURCE ASPECT	ADDRESS		
				MODS	MODW	MODN
PAL						
1	Full display mode		4:3	H	H	H
2	Wide-1 mode		4:3	H	H	L
3	normal mode		4:3	H	L	H
4	Cinema mode		16:9	H	L	L
5	Wide-2 mode		4:3	L	H	H
6	14:9 or overscan mode		4:3	L	H	L
7	Normal right mode		4:3	L	L	H
8	Normal left mode		4:3	L	L	L

9. OPTICAL DATA

9.1 Optical characteristics

T_{amb} = +22 ± 3°C; elapsed time from switch-on is greater than 30 minutes; dimming is not applied; measurements are made perpendicular to the panel; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
L	Luminance	Peak white	350	400		Cd/m^2
CR	Contrast Ratio		100:1	250:1	-	
α	Viewing angle:	CR $\geq$ 5				
	θ = 180° (9 o'clock)		60	70	-	Deg
	θ = 0° (3 o'clock)		60	70	-	Deg
	θ = 90° (12 o'clock)		35	45	-	Deg
	θ = 270° (6 o'clock)		60	70	-	Deg
		CR $\geq$ 10				
	θ = 180° (9 o'clock)		50	55	-	Deg
	θ = 0° (3 o'clock)		50	55	-	Deg
	θ = 90° (12 o'clock)		30	35	-	Deg
	θ = 270° (6 o'clock)		45	55	-	Deg
t_{res}	Average response time		-	30	50	ms
	Colour coordinates:					
X_R	Red		0.526	0.576	0.626	
Y_R	Red		0.289	0.339	0.389	
X_G	Green		0.163	0.313	0.363	
Y_G	Green		0.445	0.495	0.545	
X_B	Blue		0.126	0.151	0.176	
Y_B	Blue		0.067	0.117	0.167	
X_W	White	Peak white	0.260	0.310	0.360	
Y_W	White	Peak white	0.257	0.307	0.357	
α_{opt}	Optimum contrast angle	6 o'clock	-	9	-	Deg
DR	Dimming ratio		-	1:100	-	

9.2 Response time

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

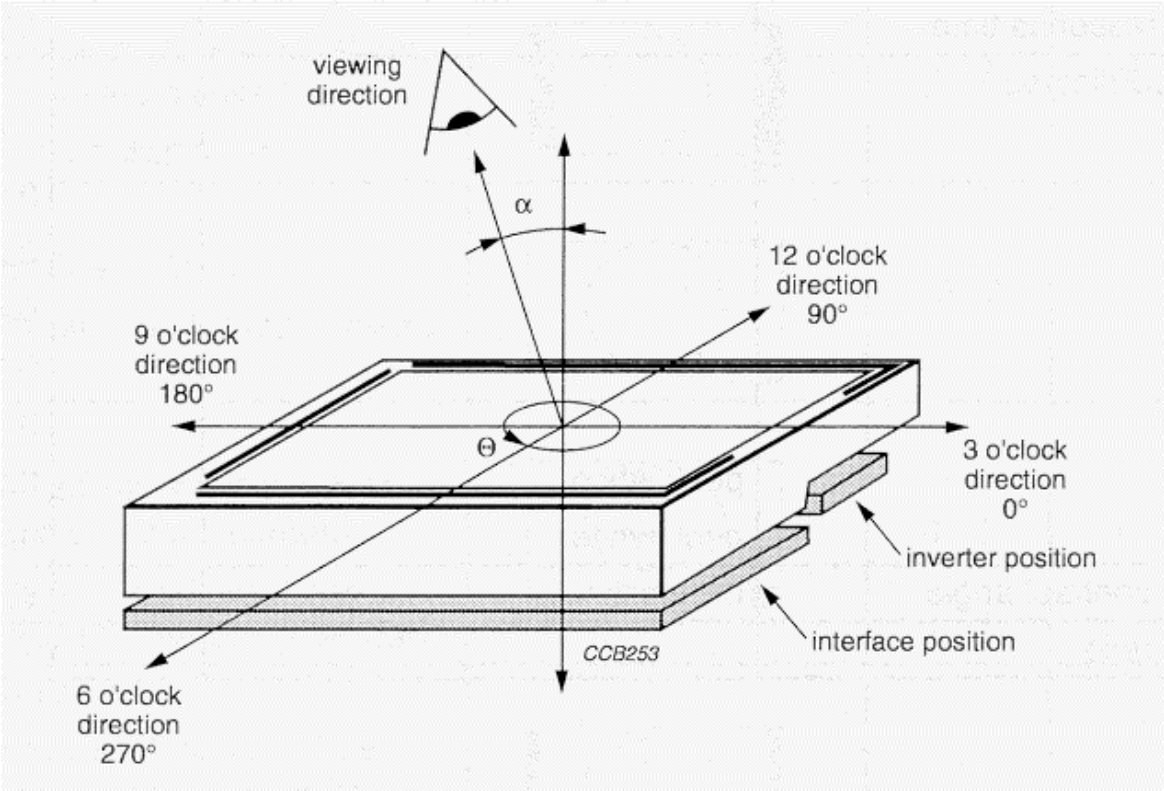
$t_{res} = (t_r + t_f) / 2$

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.

9.3 Contrast ratio

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

$CR = \tau / \tau_d$



α = declination
θ = azimuth

Fig. 5 Viewing angle

10. ENVIRONMENTAL DATA

10.1 Environmental tests

TEST	CONDITIONS	METHOD	REMARK
High temperature operating test	T_{panel} = +85^{0}C for 240 hrs	IEC 60 068-2-2Bp	panel surface temperature
Low temperature operating test	T_{amb} = -30^{0}C for 240 hrs	IEC 60 068-2-2Ab	
High temperature storage test	T_{amb} = +90^{0}Cfor 240 hrs	IEC 60 068-2-2Bp	module not operation
Low temperature storage test	T_{amb} = -40^{0}C for 240 hrs	IEC 60 068-2-1Ab	module not operation
High temperature, high humidity operating test	T_{amb} = =60^{0}C, RH = 90% for 240 hrs; no condensation	IEC 60 068-2-3CA	module not operation
Thermal shock	10 cycles of T_{amb} = -30^{0}C to T_{amb} = +85^{0}C	IEC 60 068-2-14Na	module not operation
UV exposure resistance	765 W/m^2 for 168 hrs	IEC 60 068-2-5Sa	module not operation

10.2 Mechanical tests

TEST	CONDITIONS	METHOD	REMARK
Shock test	3 directions: X, Y, Z axes; 6 repeats; peak acceleration = 100 G; pulse duration = 6 ms ½ sine wave	IEC 60 068-2-27Ea	Not operated; not packed

Vibration test	3 directions: X, Y and Z axes;
	6 repeats;
	sweep time = 11 minutes;
	peak acce3leration = 10 G;
	frequency = 10 to 150 Hz;
	amplitude = 1.5 mm
	peak-to-peak
	sine wave
		IEC 60 068-2-6Fc	Not operated; not packed

10.3 Electrostatic discharge (ESD)

Under directive *“89/336/EEG”* conforms with *“EN50082-1”*.

10.4 Electromagnetic compatability (EMC)

Complies with *“FCC part 15”*.
Under directive *“89/336/EEG”* conforms with *“EN55022/B”* and *“EN61000-4-6”*.

10.5 Safety

Complies with *“IEC 60950”* and *“UL1950”*.

11. 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.
The display module contains parts that operate at high voltage. Under no circumstances should the front or back cover be removed during operation.

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 (see also Section 11) and other rough environmental conditions.

12. MOUNTING

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

13. DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). 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 application information is given, it is advisory and does not form part of the specification.	

14. LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips Flat Display Systems customers using or selling these products for use in such applications do so at their own risk and agree to fully Philips Flat Display Systems for any damages resulting from such improper use or sale.