Preliminary Technical Product Specification

2.0" Transflective Normally Black QVGA LTPS

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Table of contents

1   Introduction

Product consists of a 2.0" diagonal 240RGBx320 LTPS TFT normally black display with a single chip-on-glass driver IC. A backlight incorporating 4pcs white LED's is included to illuminate the display. The LCD module can interface to the application via flex foil with a board-to-board connector.

2   General specifications

2.1 Main display

Parameter	Value	Unit
LCD type	Transflective, LTPS TFT	
Image mode	Normally Black	
Driver IC	JBT6K71	
Interface method	8 bit parallel CPU I/F (i80)	
Number of colors	262K Colors	
Display resolution active area	240RGB x 320	Pixels (rows x columns)
LCD panel dimensions:		
Width	35.04	mm
Height	49.42	mm
Active area dimensions:		
Width	30.24	mm
Height	40.32	mm
Pixel pitch (HxW)	0.126x(3x0.042)	mm
Pixel configuration	RGB vertical stripe	
Glass thickness	0.3	mm
Surface treatment	HC	
Viewing direction	6 o'clock	

2.1   Backlight

Parameter	Value	Unit
LED type	Nichia NSSW020BT U2/V1, B5	4 LED's
LED current supplied by external current source		
-LED current	15	mA
Luminance uniformity	75% (min)	

2.2   Module

Parameter	Value	Unit
Module dimensions		
Width	36.7	mm
Height	52.5	mm
Thickness	2.55	mm
Weight	TBD	gram
No. of I/O pins	20	

4 Electrical characteristics

4.1 Block Diagram
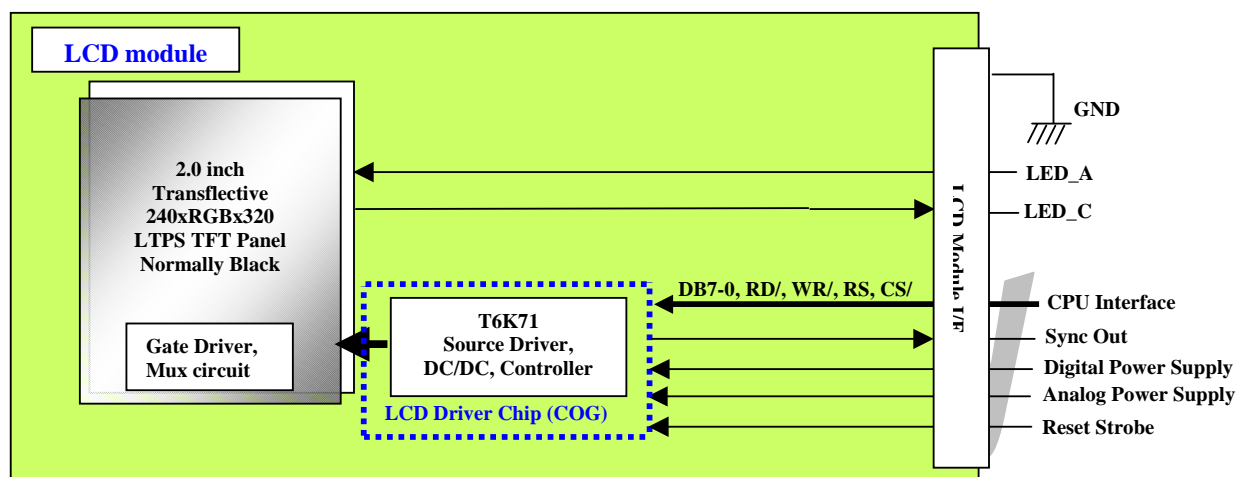
4.2 Pin assignment

Pin no.	Symbol	I/O	Description	Remark
1	DB7	I/O	Data Bus Bit 7	MSB
2	DB6	I/O	Data Bus Bit 6	
3	DB5	I/O	Data Bus Bit 5	
4	DB4	I/O	Data Bus Bit 4	
5	DB3	I/O	Data Bus Bit 3	
6	DB2	I/O	Data Bus Bit 2	
7	/RD	I	Read Strobe	Active low
8	/WR	I	Write Strobe	Active low
9	VSS	-	GND	
10	WSYNC	O	Output frame sync signal	Picture sync against tearing effect
11	LED_A	-	Backlight LED Anode	Positive terminal for serial string of 4 LED's
12	LED_C	-	Backlight LED Cathode	Negative terminal for serial string of 4 LED's
13	/CS	I	Chip Select	Active low
14	VCC1	-	Digital Power Supply	
15	VCC2	-	Analog Power Supply	
16	RS	I	Register Select	Data = high; Command = low
17	VSS	-	GND	
18	DB0	I/O	Data Bus Bit 0	LSB
19	DB1	I/O	Data Bus Bit 1	
20	/RST	I	Reset Strobe	Active low

4.3 Absolute Maximum Ratings

PARAMETER	SYMBOL	Rating	UNIT	NOTE
Digital power supply voltage	V_{CC1}	-0.3 to 4.6	V	
Analog power supply voltage	V_{CC2}	-0.3 to 4.6	V	
Input voltage	Vin	-0.3 to V_{CC1} +0.3	V	
Operating temperature	Topr	-20 to 60	°C	
Storage temperature	Tstg	-30 to 70	°C	

4.4 DC Characteristics

SYMBOL	DESCRIPTION	CONDITION	MIN.	TYP	MAX	UNIT	NOTE
V_{CC1}	Digital power supply		1.7	1.8	3.1	V	
V_{CC2}	Analog power supply		2.6	2.8	3.1	V	
	Ripple on V_{CC2}				±50	mV	1
V_{IHD}	Input high voltage		V_{CC1}-0.35		V_{CC1}	V	
V_{ILD}	Input low voltage		0		0.35	V	
V_{OHD}	Output high voltage		V_{CC1}-0.4		V_{CC1}	V	
V_{OLD}	Output low voltage		0		0.2 V_{CC1}	V	
I_{CC2} I_{CC1}	Normal mode	Full screen, 262k colors, 60 Hz, White picture		7.3 1		mA µA	
I_{CC2}	8 Color Partial mode	40 lines., 8 colors, 45 Hz, White picture		1.3		mA	

Note 1 visibility of ripple is very dependent of frequency. Frequencies below 1kHz will be faster give visible artefacts than high frequencies.

4.5 AC characteristics

Refer to driver specification of JBT6K71

5 Optical characteristics

All parameters specified at room temperature under typical driving conditions

| Item		Measurement conditions					Min	Typ	Max	Unit
		Light source type	Light source		Detector					
			α	ϕ	α	ϕ				
Transmissive	Contrast ratio	Back light	-	-	0	270		230		
	Luminance (average)	Back light	-	-	0	270		240		Cd/m²
	Luminance Ratio	Back light	-	-	0	270	75			%
	Viewing angle range CR>=10	Back light	-	-	0			55		deg.
					90			80		
					180			55		
					270			75		
	Response time Tr+Tf	Back light	-	-	0	270		35		ms
	Chromaticity (NTSC1931)	Back light	-	-	0	270		57		%
	White x	Back light	-	-	0	270		TBD		
	White y							TBD		
	Red x							TBD		
	Red y							TBD		
	Green x							TBD		
	Green y							TBD		
	Blue x							TBD		
	Blue y							TBD		
Reflective	Contrast ratio	Diffuse	-	-	0	270		11		
	Reflectance	Diffuse	-	-	0	270		2.1		%
	Response time Tr+Tf	Back light	-	-	0	270		40		ms
	Chromaticity (NTSC1931)	Back light	-	-	0	270		10		%
	White x	Back light	-	-	0	270		TBD		
	White y							TBD		
	Red x							TBD		
	Red y							TBD		
	Green x							TBD		
	Green y							TBD		
	Blue x							TBD		
	Blue y							TBD		

6   Definition of Optical Characteristics

6.1   Measurement device

The measurement devices used to generate product specifications within Philips MDS are the DMS systems from the firm Autromic–Melchers GmbH. Within Philips MDS DMS series 301, 703 and 803 are used.

6.2   Coordinates and Viewing angles

This document adopts right-handed x-y-z Cartesian coordinates with origin at the centre of the display active area. The z-axis is perpendicular (normal) to the screen, the x-axis is the screen horizontal, and the y-axis is the screen vertical. The x and y-axis lie in the plane of the display surface.
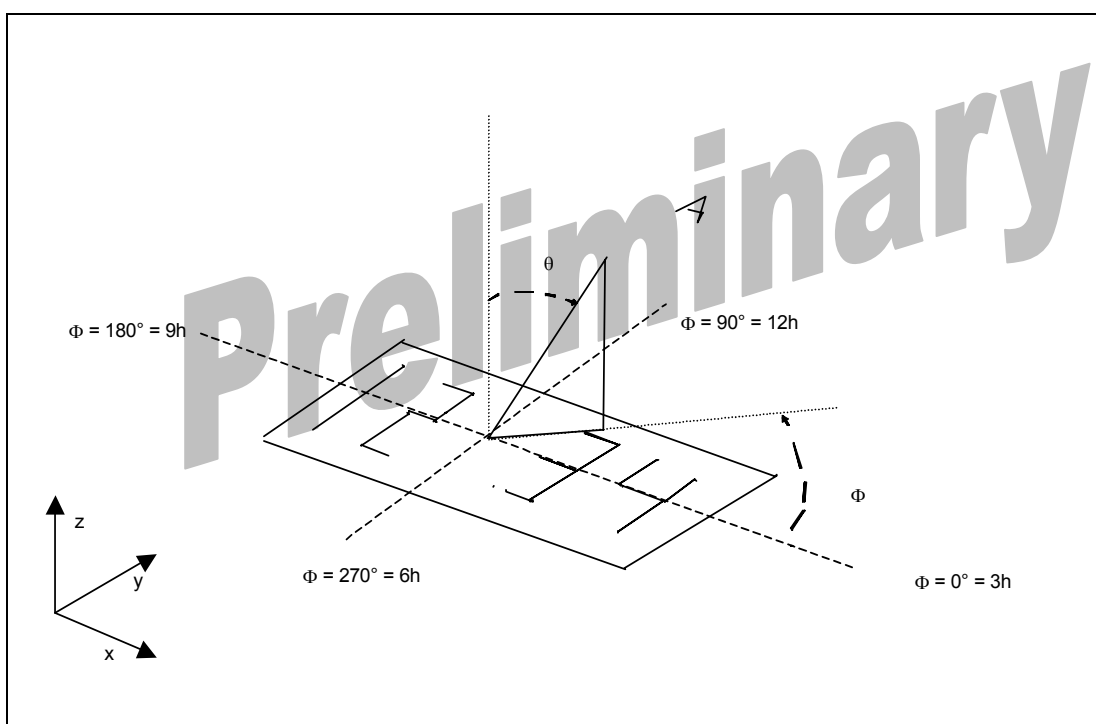
Associated with this Cartesian system is the spherical coordinate system (r, θ, Φ), where r is the radius from the centre of the display coordinate system, θ is the inclination from the z-axis (display normal, the polar axis of the spherical coordinate system), and Φ is the counter-clockwise angle from the x-axis in the x-y-plane (the display surface) as observed from the Z-axis (Φ is a right handed rotation about the z-axis starting the x-axis).

6.3   Environment

Ambient Temperature: 23 (±4)   °C
Ambient Air Pressure   68 ... 106 kPa
Ambient Relative Humidity   25 ... 85   %RH@25°C

6.4   Warm-Up Time

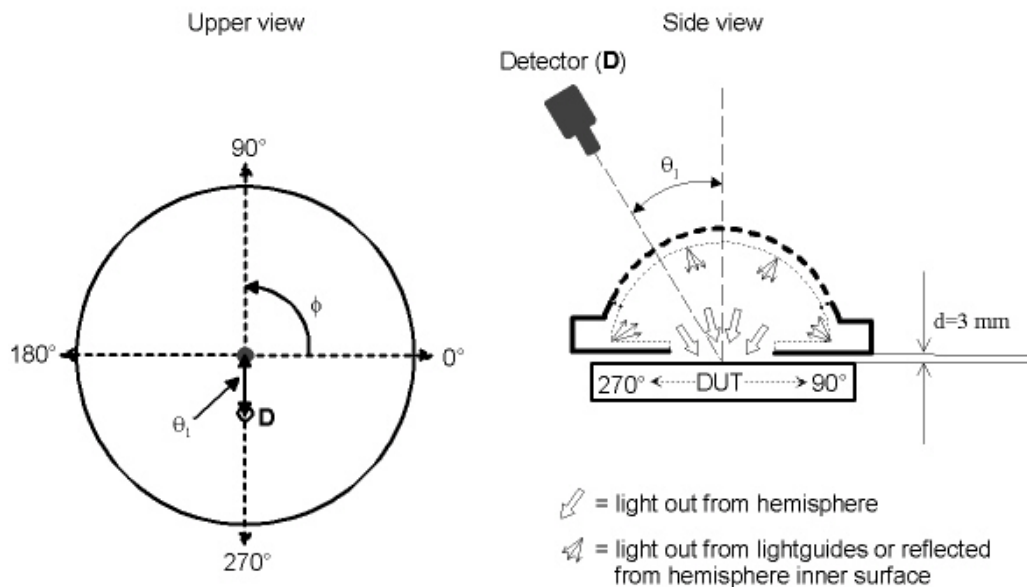The warm-up time is normally 20 minutes. Deviations are reported.

6.5   Darkroom conditions
The measurements are executed in a darkroom. The luminance is less than 1 Lux.

6.6   Measurement Set-up

Measurement Set-up for Diffuse illumination

Light source and detector configuration on DUT

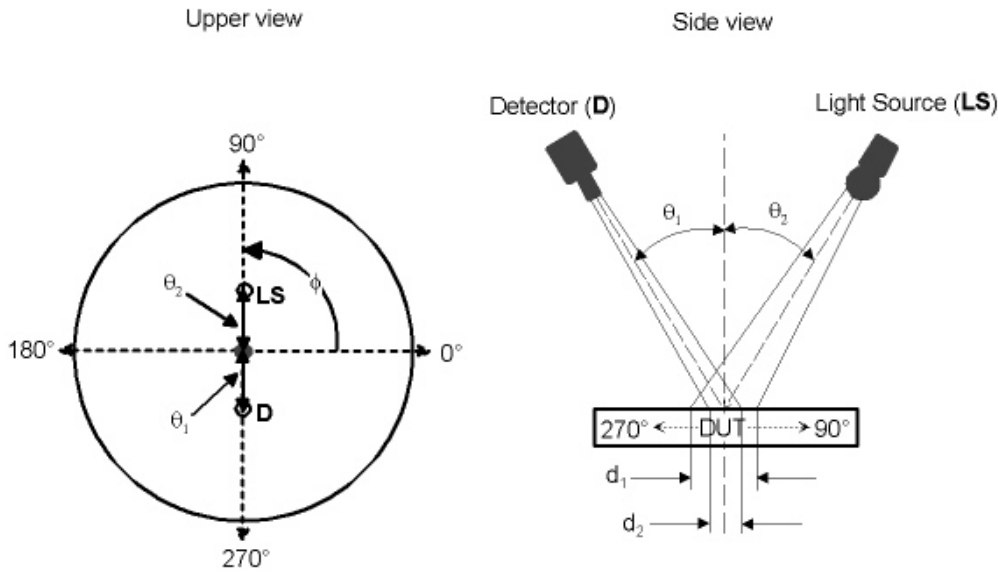Lighting: **Temperature** hemisphere, excluding specular component
Slit Opening: **Vertical Slit** (90° - 270°)
Distance: Distance between DUT and exit port of light source (working distance) is **3 mm**
Aperture size: 3mm

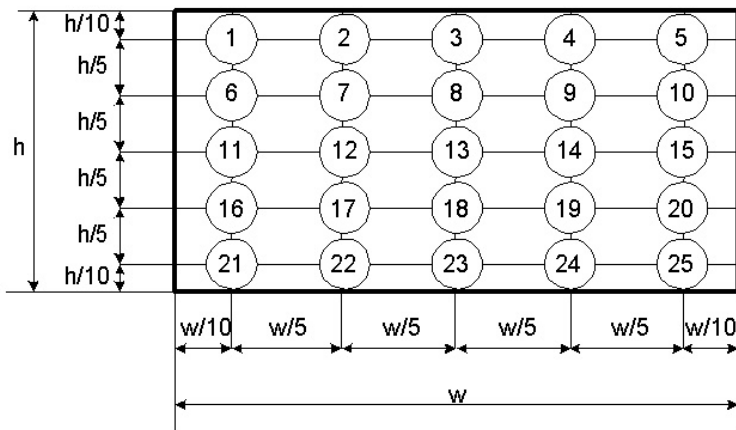Measurement Set-up for Point illumination

Light source and detector configuration on DUT

Upper view   Side view

Lighting: **PID**
Aperture size: 3mm

6.7   Measurement Points

h: height of active area
w: width of active area

7 Environmental / Reliability Tests

Test	Testname	Conditions	Duration	Method
HOT	High temperature Operation Test.	60 °C DRY	96 Hrs	Method: IEC 68-2-2 / Bb Note 1
LOT	Low temperature Operation Test.	-20 °C DRY	96 Hrs	Method: IEC 68-2-1 / Ab Note 1
HST	High temperature Storage Test.	70 °C DRY	96 Hrs	Method: IEC 68-2-2 / Bb Note 1
LST	Low temperature Storage Test.	-30 °C DRY	96 Hrs	Method: IEC 68-2-1 / Ab Note 1
AHTO	Accelerated Humidity Test Operation.	40 °C 90% RH	96Hrs	Method: IEC 68-2-3 / Ca Note 1
TST	Thermal Shock Test.	1 cycle: -30 °C (30 min); +80 °C(30 min); transition time < 10 s	10 cycles	Method: IEC 68-2-56 / Cb Note 1

Note 1: After 2 hrs recovery time at room temperature the modules are evaluated for: cosmetic defects and electrical defects.

8 EMC requirements

8.1 Scope and application

The operational EMC requirements for Philips MDS modules, which operate in an EM environment, are provided in this *PMDS EMC specification for modules*.

The table provided in section 3 contains EMC immunity requirements and emission limits applicable to an operational module The table provided in section 4 contains ESD requirements for handling a non-operational module.

8.2 Reference documents

EN 61000-6-1: Generic standards – Section 1: Immunity for residential, commercial and light-industrial environment.

EN 61000-6-4: Generic standards – Section 4: Emission standard for industrial environment

EN 55022: Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.

ETS 300-342-1: Radio Equipment and Systems (RES); Electromagnetic Compatibility (EMC) for European digital cellular telecommunications system (GSM 900 MHz and DCS 1800 MHz) Part 1: Mobile and portable radio and ancillary equipment.

IEC 62179: Non Operational ESD immunity, human body model (HBM).
IEC 62180: Non Operational ESD immunity, machine model (MM).

8.3 Operational EMC requirements

The operational EMC immunity requirements and emission limits for PMDS modules are provided in table 1: EMC specification for operational modules.

Table 1. EMC specification for operational modules

EMC phenomena	REFERENCE standard	MDS EMC Procedure	Frequency range	Level/ Limit	Test specification	Performance criteria
Electromagnetic field	IEC 61000-4-3	UZW-B1/H900-25	30MHz-1000MHz	3 V/m	1kHz sine, 80% AM	C
EFT/Burst	IEC 61000-4-4	UZW-B1/H900-26	n.a.	10 V	-8us/50us	C
					-10ns/100ns	C
Electrostatic Discharge	IEC61000-4-2	UZW-B1/H900-24	n.a.	2 kV/ 4 kV	Contact/ Air	C
Conducted RF signals	IEC 61000-4-6	UZW-B1/H900-28	150kHz-30MHz	1 V	1kHz sine, 80% AM	C
Radiated emission	IEC 61000-6-4	UZW-B1/H900-29	30 MHz-1000MHz	47 dBuV	d = 10 m	n.a.

8.4 Non operational ESD requirements

The non-operational ESD requirements for handling of PMDS modules are provided in table 2: Non-operational ESD requirements.

Table 2. Non operational ESD requirements

ESD immunity	REFERENCE standard	MDS EMC Procedure	Level/ Limit	Performance criteria	Application of test
Human Body Model	IEC 62179	UZW-B1/H900-20	2 kV[1]	No damage	All relevant pin combinations
Machine Model	IEC 62180	UZW-B1/H900-20	200 V[1]	No damage	All relevant pin combinations

[1]. If the component supplier may specify a lower immunity level, this level will be entered in the specification instead.

9 Quality description (TBD)

9.1 Inspection conditions

Item	Condition
Ambient illumination Lighting	1000 +/- 200 lux
Viewing Distance	30 +/-5 cm
Viewing Angle	90° +/- 30°
Reflections	No reflection of the light source visible in display
Inspection time	< 30sec
Inspection method	Unaided eyes only
Temperature	$+25^oC$ +/- 5^oC

Driving condition:
  Pattern
  Voltage
	
	t.b.d
	t.b.d

9.2 Foreign materials and blemishes

Dot and line defects

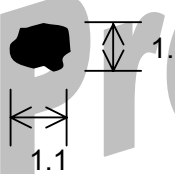| Item	Total number
Dot defect (Bright/Dark dot defect)	TBD
Line defect	TBD

Sub Pixel which contains larger than 1/2 defective area is called dot defect.

Each R,G,B element of the pixel is called Sub Pixel, 1set of RGB is called a pixel.

Opto-Mechanical defects

Item	Countable defect	Reject criteria
Circular defect (Bright/Dark Spot)	φ <= 0.1	No count
	0.1 < φ <= 0.3	A (A + B + C <= 4)
	0.3 < φ	0
Long defect (Bright/Dark line)	T <= 0.03	No count
	L <= 0.3	No count
	0.03 < T <=0.05, 0.3 < L <= 3.0	B (A + B + C <= 4)
	0.05 < T <=0.1, 0.3 < L <= 2.0	C (A + B + C <= 4)
	0.05 < T <=0.1, 2.0 < L <= 3.0	0
	T > 0.1, L > 1.5	0
Dent and Bubble	φ<=0.15	No count
	0.2 < φ <= 0.5	2
	0.3 < φ	0
Remark:	φ = (Length : L + Width : W) / 2	
	T = defect thickness, L =defect contour length	

Circular defect

Long defect