DATA SHEET

SX2.4H25-4:3 -37K

Active matrix 2.4 " colour
Analog TFT LCD module

Technical Product Specification

May 20, 2009

Signature List

This document was read and the content is in accordance with the project requirements:

Name – Title Company	Signature	Date (DD/MM/YYYY)
XiangRong Lin – Genaral Manager ShuangXiang Tech.		
Rimei Zhong– Engineering ShuangXiang Tech.		
Linqin Huang– Engineering ShuangXiang Tech.		
– Purchasing		

1 GENERAL DESCRIPTION

This module is a TFT (thin film transistor) active matrix LCD module. Each module comprises:

- a 2.4” amorphous silicon colour TFT panel
- panel driver electronics
- a 8，16-bit 80 MPU interface board
- an integrated backlight

The 2.4” diagonal display active area contains 240 (xRGB) x 320 pixels and can display 262,144 colours. The module can withstand intense environments.

2 FEATURES

- RGB stripe configuration
- 8，16-bit 80 MPU controlable parallel interface
- Display resolution 240 (xRGB) x 320 lines
- High contrast TFT LCD drive system
- High speed response
- High brightness
- Single power-supply voltage +3.2 V
- Backlight for Long lifetime LED
- Extended temperature range

3 APPLICATIONS

- MP3/MP4 Digital Multi-Media applications
- Mobile Phone, Smart Handheld Applications

.

4 QUICK REFERENCE DATA

Table 1:

PARAMETER	VALUE	UNIT
Overall dimensions Width Height Depth	 42.72 60.26 3.70 max	 mm mm mm
Screen size (diagonal)	2.4	inch
Active area dimensions Width Height	 36.72 48.96	 mm mm
Display resolution	240 x 3 x 320	pixels
Pixel dimensions Horizontal Vertical	 0.051 x 3	 mm mm
Pixel configuration	RGB vertical stripe	
Supply voltage module	+ 3.2	V
Power consumption module (nominal value without backlight)	< 0.1	W
Advised viewing direction	12 o'clock	
Maximum contrast ratio (peak viewing angle)	> 100	
Typical luminance	100	Cd/m^2
Backlight lifetime (Continuous operation at 25C; I +15mArms)	Min. 15000.	hours
Operating temperature range* - Bare module - Module installed in customer application cluster	 -10 to +60 -10 to +60	 ^oC
Storage temperature	-20 to +70	^oC
Response speed (typical)	30	ms
Module mass (without external flexible foil cable)	tbd.	g

* This is the ambient temperature set for the chamber.

5 PINNING

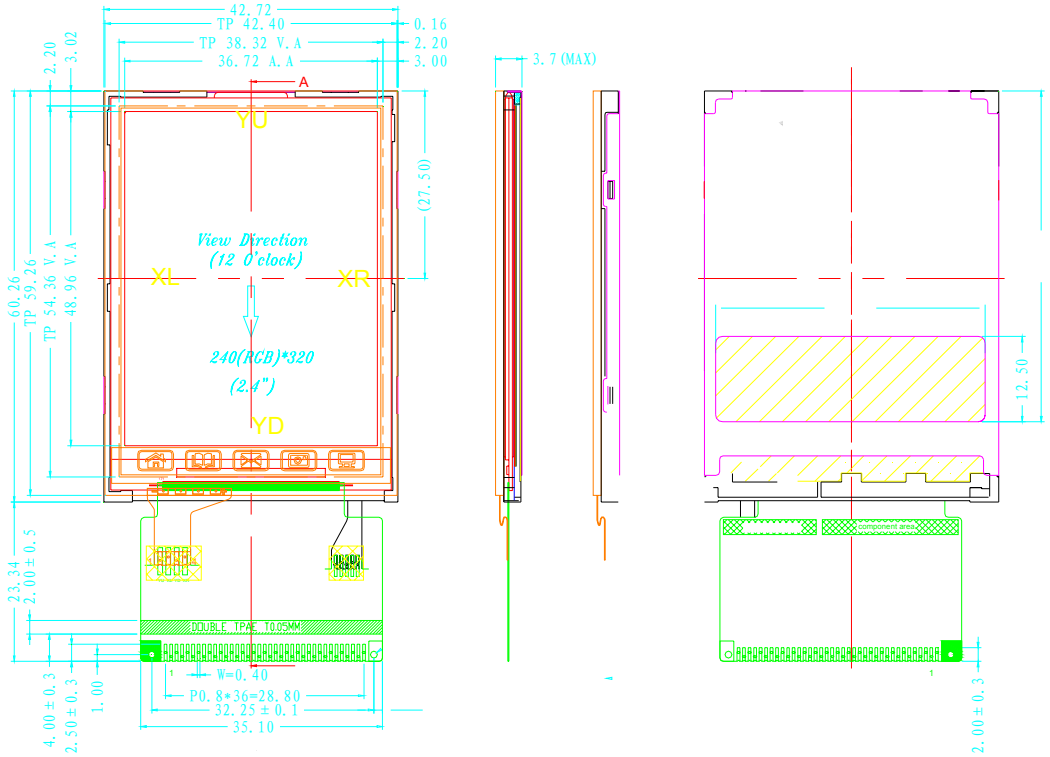
Table 2:

SYMBOL	PIN	I/O	DISCRIPTION
DB0	1		Data Bus
DB1	2		Data Bus
DB2	3		Data Bus
DB3	4		Data Bus
GND	5		Ground
VCI	6		A Power supply for the internal logic circuit (+3.2V)
/CS	7		Chip select signal. Active “L”
RS	8		Reset input pin for TFT LCD. Active Low.
/WR	9		Serves as a write signal and writes data at the rising edge.
/RD	10		Serves as a read signal and reads data at the low level.
NC	11		No connection
XL(X+)	12		Touch panel left side
YU(Y+)	13		Touch panel up side
XR(X-)	14		Touch panel right side
YD(Y-)	15		Touch panel down side
LED-A	16		Backlight LED Anode input pin (A)
LED-K1	17		Backlight LED Cathode input pin (K)
LED-K2	18		Backlight LED Cathode input pin (K)
LED-K3	19		Backlight LED Cathode input pin (K)
LED-K4	20		Backlight LED Cathode input pin (K)
NC	21		No connection
DB4	22		Date Bus
DB10	23		Date Bus
DB11	24		Date Bus
DB12	25		Date Bus
DB13	26		Date Bus
DB14	27		Date Bus
DB15	28		Date Bus
DB16	29		Date Bus
DB17	30		Date Bus
/RESET	31		Reset input pin for TFT LCD. Active Low.
VCI	32		A Power supply for the internal logic circuit (+3.2V)
VCI	33		A Power supply for the internal logic circuit (+3.2V)
GND	34		Ground
DB5	35		Date Bus
DB6	36		Date Bus
DB7	37		Date Bus

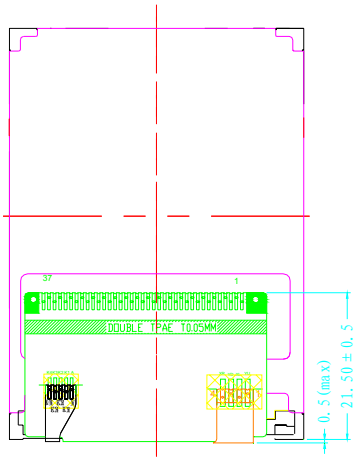
6 MECHANICAL DATA

Count drawing's modified record with customer		
VER.	DESCRIPTION	DATE
1.0	THE FIRST ISSUE	2009-04-14
1.1	Change BL.	2009-05-20

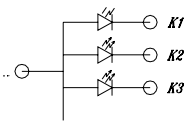
Customer Approve	



PIN	ASSIGNMENT	PIN	ASSIGNMENT	PIN	ASSIGNMENT	PIN	ASSIGNMENT
1	DB0	11	NC	21		31	/RESET
2	DB1		XL(X+)	22	DB4	32	VCI
3	DB2		YU(Y+)	23	DB10	33	VCI
4	DB3		(X-)	24	DB11	34	GND
5	GND			25	DB12	35	DB5
6	VCI			26	DB13	36	DB6
7	/CS			27	DB14	37	DB7
8	RS			28	DB15		
9	/WR	19		29	DB16		
10	/RD	20	/	30	DB17		



ITEM		ELECTRICAL & PHYSICAL DATA
LED		4pcs
Luminous		150cd/m² (TYP .Avg)
Uniformity		75% MIN. 80%(TYP)
C.I.E	X	0.265~0.325
	Y	0.270~0.330
Supply Current		60mA(fixed)
Supply Voltage		3.2V



BACKLIGHT CIRCUIT

Display Type	TFT NEGATIVE TRANSMISSIVE
Viewing Angle	12 O'CLOCK
VDD	3.0V
Operation Temperature	−10°C TO +60°C
Storage Temperature	−20°C TO +70°C
Interface	80 PARALLEL
Backlight Color	WHITE
Drive IC	IL19325
All radii without dimension	R0.3
Unspecified tolerance is	±0.2
ROHS request	Yes

				MODULE NO.	SX2.4H25-4_3-37K			LCD No.	HTT24QV2-D01
								Customer No.	
				DESIGNED	CHECKED	VERIFIED	APPROVED	File No.	
UNIT	SIZE	SCALE	PAGE	Zhong				Count Drawing	
mm	A4	FIT	1 / 1	2009-05-20					

7 ELECTRICAL CHARACTERISTICS

7.1 Block Diagram

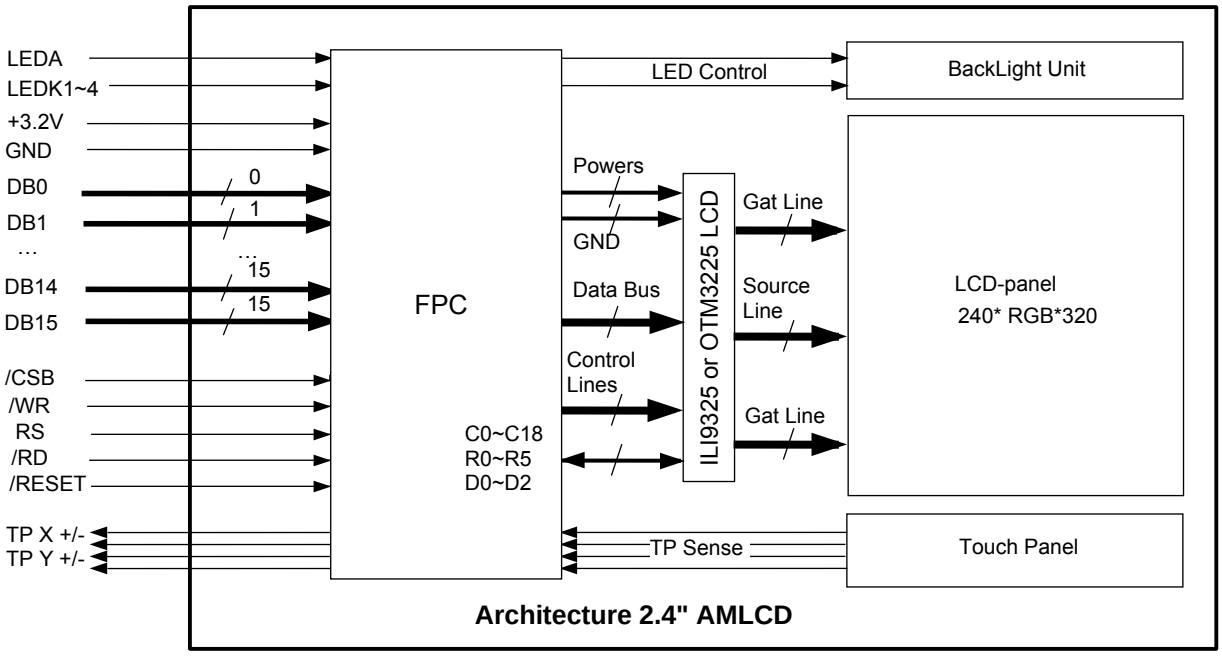


Fig. 1: Electrical architecture.

7.2 Absolute Maximum Ratings

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

Table 3:

SYMBOL	DESCRIPTION	MIN.	MAX.	UNIT
V_{DD}	power supply voltage	-0.3	5	V
V_{CI}	Input voltage	-0.3	4	V
I	Current Drain Per Pin Excluding VDD and Vss		25	mA
V_{IN}	input voltage range	VDD-0.3	VDD+0.3	V
RH	relative humidity	-	90	%
T_{stg}	storage temperature	-30	+80	^{0}C
T_{oper}	Operation temperature (see note 1) - Bare module - Module installed in customer application cluster	 -20 -20	 +70 +70	^{0}C

Notes:

1. VSS=0V
2. Absolute maximum rating is the limit value beyond which the IC may be broken. They do not assure operations.
3. Operating Temperature is the range of device-operating temperature. They do not guarantee chip performance.

7.3 Recommended Operating Conditions - Module

Table 4:

SYMBOL	DESCRIPTION	CONDITION	MIN.	TYP	MAX	UNIT
Power supply:						
V_{DD}	Operation voltage		1.4	-	3.6	V
V_{DDEXT}	Auxiliary power supply pin for V_{DD}		1.4	-	3.6	V
Reference Supply Voltage:						
V_{CI}	Booster Reference Supply Voltage Range		2.5 or V_{DD} whichever is higher	-	3.6	V
Gate Driever Output Voltage:						
V_{GH}	Gate driver Low Output Voltage		9	-	15	V
V_{GL}	Gate driver High Output Voltage		-15	-	-7	V
Input Voltage:						
V_{IH}	Input High Voltage		0.8*V_{DD}	-	V_{DD}	V
V_{IL}	Input Low Voltage		0	-	0.2*V_{DD}	V
I_{IL} / I_{IH}	Logic Input Current		-1	-	1	uA
f_{DOTCLK}	DOTCLK frequency	Display is ON	1	-	8.22	MHz
Output Voltage:						
V_{OH}	Output High Voltage	I_{OH}=-100uA	0.9*V_{DD}	-	V_{DD}	V
V_{OL}	Output Low Voltage	I_{OL}=0.5mA	0	-	0.1*V_{DD}	V

Notes:

* Unless otherwise specified, Voltage Referenced to Vss, VDD=1.6~3.6V, TA=-20~70°C

7.4 Input/Output Signal Timing

7.4.1 I80-SYSTEM INTERFACE TIMING CHARACTERISTICS

Table 5:

DESCRIPTION		SYMBOL	MIN	TYP	MAX	UNIT
Bus Cycle Time	Write	T_{CYCW}	100	-	-	ns
	Read	T_{CYCR}	300	-	-	ns
Write Low-level pulse with		PW_{LW}	50	-	500	ns
Write High-level pulse with		PW_{HW}	50	-	-	ns
Read Low-level pulse with		PW_{LR}	150	-	-	ns
Read High-level pulse with		PW_{HR}	150	-	-	ns
Write / Read rise / fall time		t_{WRr}/t_{WRf}	-	-	25	ns
Setup time	Write (RS to /CS, /WR)	t_{AS}	10	-	-	ns
	Read (RS to /CS, /RD)		5	-	-	ns
Address hold time		t_{AH}	5	-	-	ns
Write data set up time		t_{DSW}	10	-	-	ns
Write dada hold time		t_{H}	15	-	-	ns
Read data delay time		t_{DDR}	-	-	100	ns
Read data hold time		t_{DHR}	5	-	-	ns

Notes:

1) Normal Write Mode (IOVCC = 1.65~3.3V)

7.5 Timing Diagram

7.5.1 I80-SYSTEM BUS TIMING

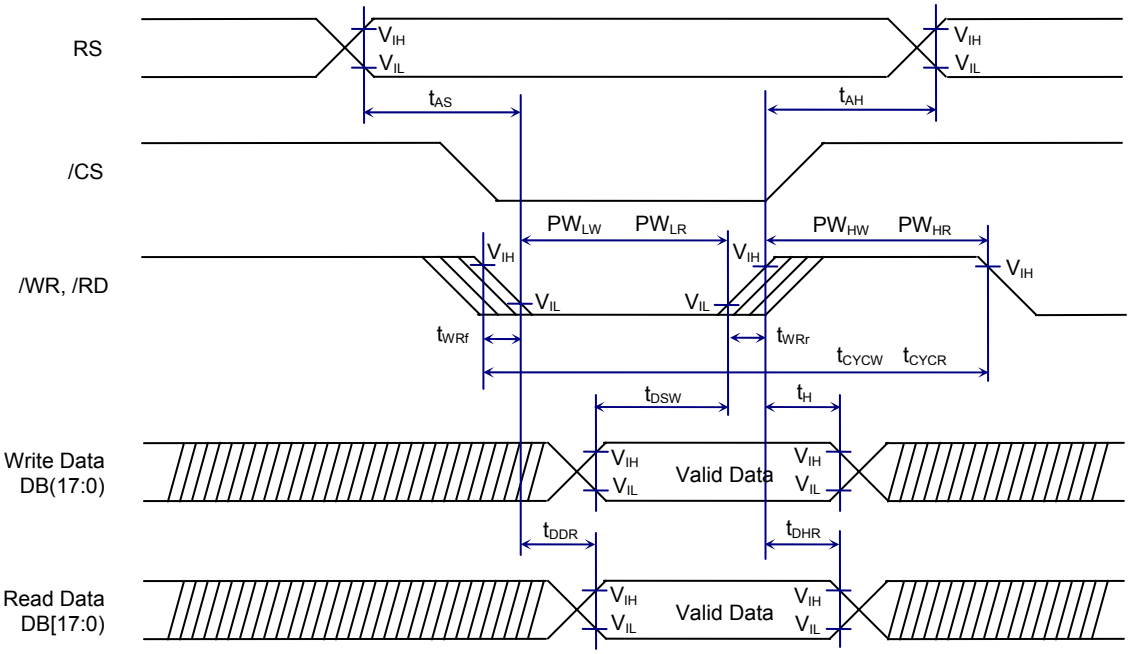


Fig. 2: i80 System Bus Time

7.5.2 WRITE TO REGISTER

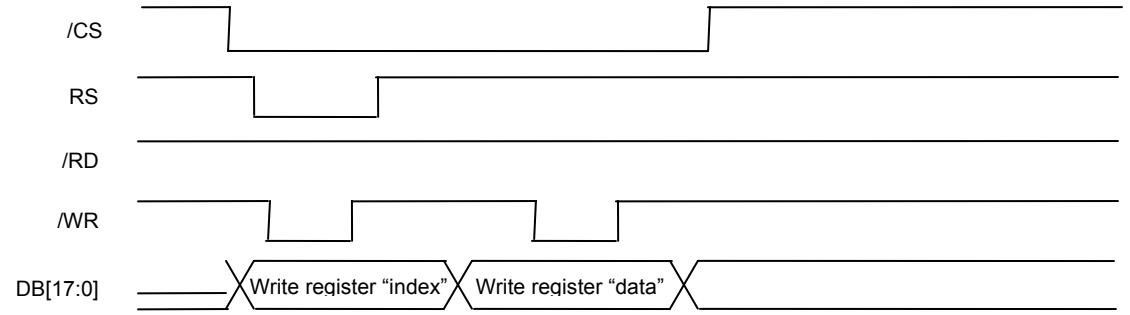


Fig. 3: i80 System Write to Register

7.5.3 READ FROM REGISTER

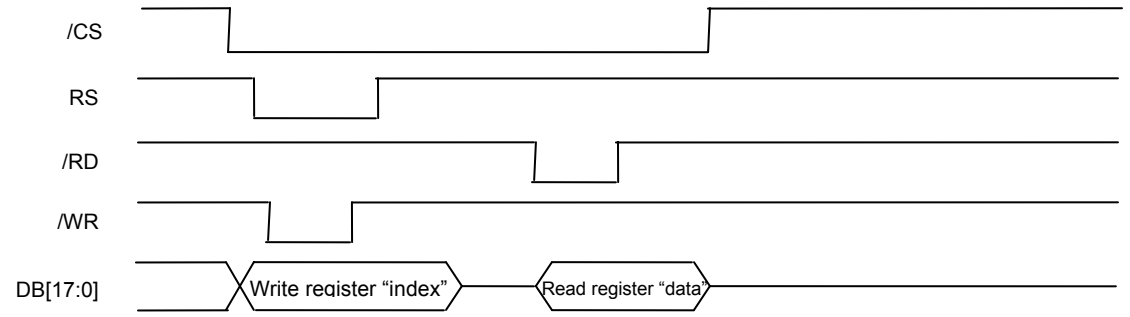


Fig. 3: i80 System Read from Register

7.6 Backlight Electrical Characteristics

Table 6:

Parameter	Symbol	Min	Typ	Max	Unit	Remark
Forward Voltage	V_F	-	3.2	-	V	Ta=25℃
Forward Current	I_F	-	60	-	mA	Ta=25℃
LED chips	-	-	4	-	PCS	

8 OPTICAL DATA

8.1 Optical characteristics

T_{amb} = +22 ± 3°C; elapsed time from switch-on is greater than 30 minutes; measurements are made perpendicular to the panel unless otherwise specified.

Table 7:

Parameter		Symbol	Conditions	Min	Typ	Max	Unit	Remark
Contrast Ratio		CR	θ =0 Normal viewing angle	-	300	-	-	
Viewing angle range =180° (9 o'clock) = 0° (3 o'clock) = 90° (12 o'clock) =270° (6 o'clock)		α	CR ≥ 10	 - - - -	 45 45 35 15		 ° (deg)	cf. note 3
Viewing direction of max. CR		$\alpha_{cr\ max}$	12 o'clock					cf. note 4
Viewing direction of grey scale inversion		α_{inv}	3 o'clock, 9 o'clock, 12 o'clock					cf. note 4
Advised viewing direction		$\alpha_{advised}$	12 o'clock					cf. note 4
Average response time		t_{res}		-	25	-	ms	cf. sec. 8.2
Reflectance		Rf	theta=15°		4.5		%	cf. note 5
Chromaticy coordinates (CIE 1931 2°)	white	x_w	peak white, I_{lamp}= 3.5 mA_{rms}	0.311	0.336	0.361		St. Dev.: σ = 0.004
		y_w	peak white, I_{lamp}= 3.5 mA_{rms}	0.306	0.331	0.356		St. Dev.: σ = 0.004
	red	x_r	I_{lamp}= 3.5 mA_{rms}		0.603			
		y_r	I_{lamp}= 3.5 mA_{rms}		0.307			
	green	x_g	I_{lamp}= 3.5 mA_{rms}		0.305			
		y_g	I_{lamp}= 3.5 mA_{rms}		0.556			
	blue	x_b	I_{lamp}= 3.5 mA_{rms}		0.130			
		y_b	I_{lamp}= 3.5 mA_{rms}		0.117			
Transmittance		T		-	17.5		%	

Notes:

1. Definition of homogeneity according to the VESA standard.
2. Measuring surrounding: dark room
3. For definition of viewing angles, cf. Fig. 7.
4. Customer is advised to use the display in the 12 o'clock direction. This direction is defined in Section 6 (Mechanical data). Grey-scale inversion occurs in 3, 9 and 12 o'clock directions. These values reflect the situation without a WVA polarizer foil (which enhances the viewing angle performance).
5. The irradiation angle and detection angle is 15° from the display surface normal. During the measurement no power and driving signal are supplied to the device. The light source is of Type C and has a luminance between 1000 and 10000 Cd/m^2 . The total aperture of the irradiating light equals 1°. The aperture angle of the detector equals 0.1° to 0.2°. The specular reflectance Rf is defined as

$$Rf = \frac{L_{\text{display}}}{L_{\text{ref}}} \times R_{\text{ref}},$$

where $L_{display}$ equals the luminance from the light source after reflection from the display surface. L_{ref} equals the luminance of the light source after reflection from calibrated reflection plate. R_{ref} equals the reflectance of the calibrated reflection plate.

8.2 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.

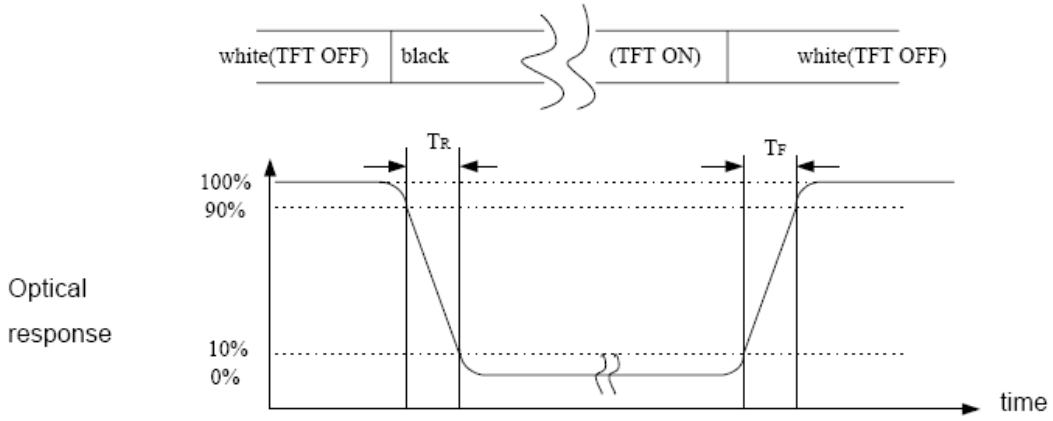
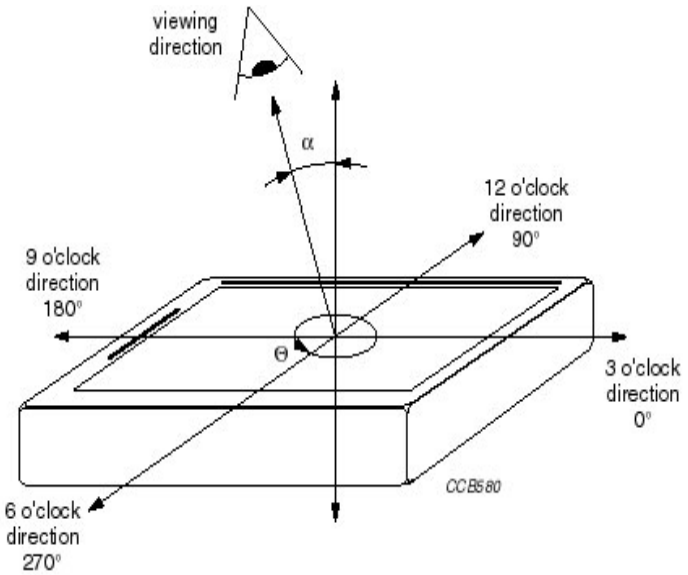


Fig. 6: Response time

8.3 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. 7: Viewing angle.

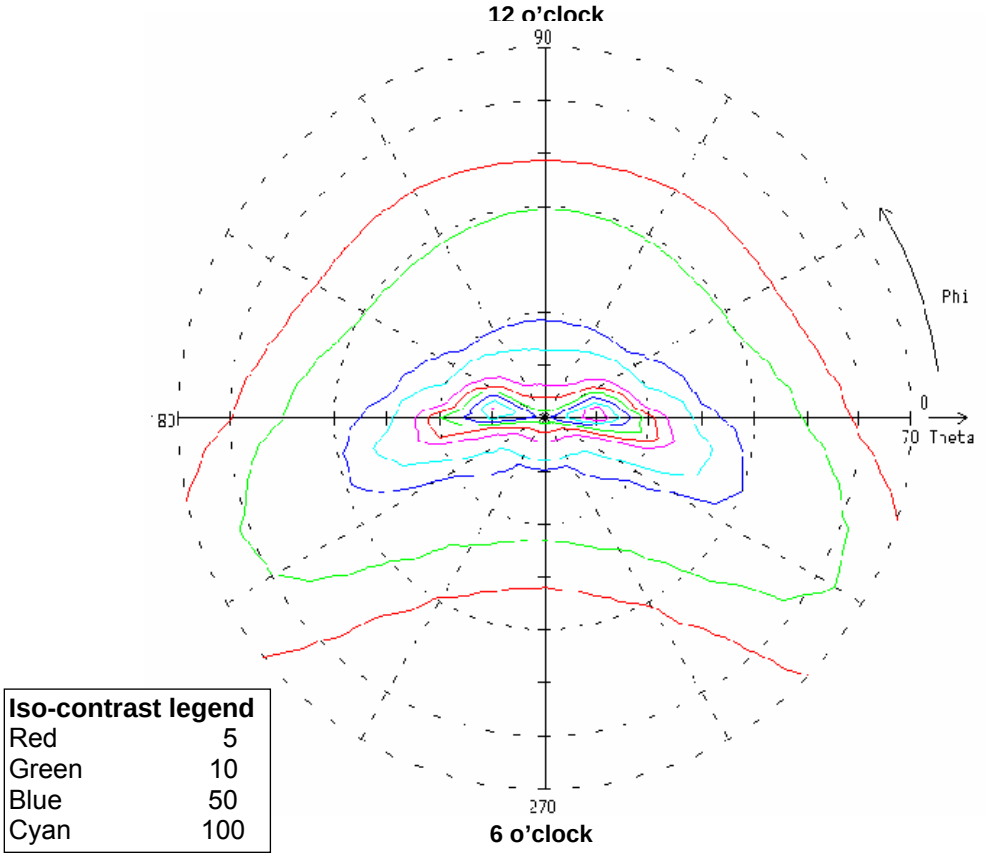


Fig. 8: Typical Iso-contrast plot.

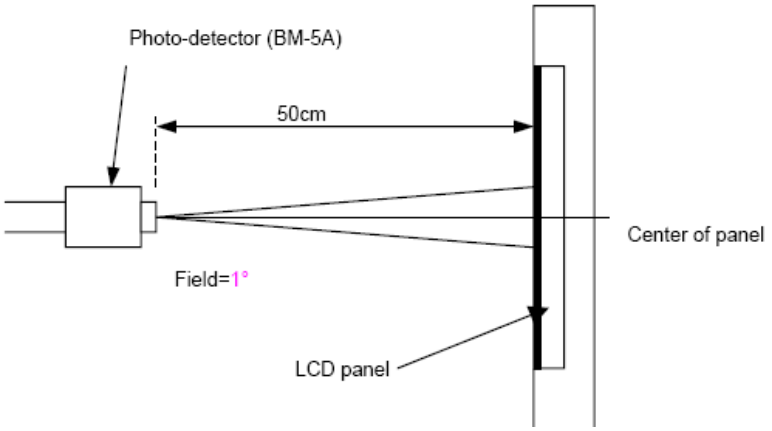


Fig. 9: Definition of optical measurement setup.

9 ENVIRONMENTAL DATA

9.1 Environmental tests

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

Table 8:

TEST	CONDITIONS	METHOD	REMARK
High temperature operating test	T_{panel} = +85^{0}C for 240 hrs	IEC 60 068-2-2Bp	Bare module
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 operating
Low temperature storage test	T_{amb} = -40^{0}C for 240 hrs	IEC 60 068-2-1Ab	module not operating
High temperature, high humidity operating test	T_{amb} = +60^{0}C, RH = 90% for 240 hrs	IEC 60 068-2-3CA	
Thermal shock	168 cycles of T_{amb} = -30^{0}C to T_{amb} = +85^{0}C	IEC 60 068-2-14Na	module not operating
UV exposure resistance	765 W/m^2 for 168 hrs	IEC 60 068-2-5Sa	module not operating
Functional temperature range	-30°C to +85°C		module operating normally
Allowed storage temperature range	-40°C to +90°C		image may be distorted; no damage done to the module

9.2 Mechanical tests

Table 9:

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 acceleration = 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

9.3 Electrostatic discharge (ESD)

Table 101:

TEST	CONDITIONS	METHOD	REMARK
Human Body model	10 kV (330 Ω, 150 pF), excluding input pin	IEC 61000-4-2	Not operating
Machine model	250V (0 Ω, 200 pF)	Mil 883C method 3015	Not operating

9.4 Electromagnetic compatability (EMC)

The target EMC level is CISPR25, level 5. An evaluation is to be performed on the different sample module deliveries. In case of discrepancy, principal and PMDS are to find a mutually acceptable solution.

*Note : The target EMC level is on module level without flexible flat cable.

10 QUALITY REQUIREMENTS

The defect categories covered in this specification 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 appearance of the complete product and the packing of the product.

10.1 Inspection conditions and test patterns

Table 11:

Item	**Conditions**	
Lighting	Fluorescent light (Day-Light Type) Display Surface illumination to be 500 - 1000 Lux.	
Temperature	25° C ± 5°C	
Driving Condition	Equipment	Product specific testtool
	Test pattern	Black, White, R, G, B
	Supply voltage	typical supply voltages given in specification
	Inspection time	≤ 1 minute

Remarks:

- Inspect at 20 inches from display.
- 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 .

10.2 Dot and line defects criteria

Table 12:

Item		**R**	**G**	**B**	**Total Number**	**Inspection pattern [2)]**
Level A Module	Bright dot defect	0	0	0	1 [1)]	(a) (e)
Level B Module	Bright dot defect	1	1	1		(a) (e)
All Level	Dark defect	cf. sec. 10.3.1				Total of (c) (d) (e)
All Level	Line defect	0				(a) (b) (c) (d) (e)

[1)] Inspection pattern:

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

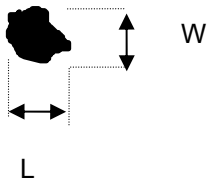
10.3 Blemishes and cosmetic anomalies

Note: The black border is the rim between the active area of the display and the metal front cover.

10.3.1 CIRCULAR DEFECTS

Table 13:

Size (mm)	Acceptable number	
	Active area	Black border
$D \leq 0.15$	No count	No count
$0.15 < D \leq 0.20$	2	
$0.20 < D \leq 0.25$	1	
$0.25 < D$	0	

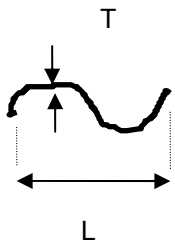


Remark: D = (Length + Width) / 2

10.3.2 LONG DEFECTS

Table 14:

Size (mm)		Acceptable number	
		Active area	Black border
$T \leq 0.02$	-	No count	No count
$T \leq 0.03$	$L \leq 3.0$	2	
$T \leq 0.05$	$L \leq 2.5$	2	
$0.05 < T$	-	0	



Remark: T = defect thickness, L = defect contour length

10.3.3 PINHOLES (BLACK BORDER ONLY).

Table 15:

Size (mm)	Acceptable number
	Black border
$D \leq 0.15$	No count
$0.15 < D$	0

Remark: D = diameter

10.3.4 PORLARIZER BUBBLE.

Remark:
(1) Bubble could be seen by eyes exigently to be judged according to black spot specification
(2) Not allow polarize jutting glass outside.

Table 16:

Size (mm)	Acceptable number	
	Active area	Black border
$\Phi \leq 0.2$	No count	No count
$0.2 < T \leq 0.5$	3	
$0.5 < T \leq 1.0$	2	
$1.0 < T$	0	
Total acceptable number	3	

10.4 Malfunctioning

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

10.5 Appearance

Not allowed are:
- Type and/or 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).

10.6 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.

11 PACKING

Refer to ShuangXiang Ke Ji standard packing method.
Package shall pass the Vertical Impact Test by Dropping and the Vibration Test as per ISO 4180 for "Complete, filled transport packages - Test Methods".

12 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.

13 MOUNTING

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

14 DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains goal specifications for product development.
Development Specification	This data sheet contains target data; supplementary data may be published later. The target data will be evaluated after production.
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.	

15 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. ShuangXiang Ke Ji customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify ShuangXiang Ke Ji for any damages resulting from such improper use or sale.

NOTES

Reading list

This document was read and the content is in accordance with the project requirements.

Name	Comment	Date	Signature

Changes

Version	Modifications	Where	Date	Name
1.0	First Issue	-	14 Apr.09	Rimei Zhong
1.1	Change BL.	Page 4,6	20 May09	Rimei Zhong