

MODEL	NO.	:	TM014EDH21

ISSUED DATE: <u>2011-06-02</u>

VERSION : Ver 2.0

# Preliminary SpecificationFinal Product Specification

#### Customer :

Approved by	Notes

#### **SHANGHAI TIANMA Confirmed :**

Prepared by	Checked by	Approved by

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MODEL NO	). :	TM014EDH2	1	
ISSUED DAT	ГЕ: <u> </u>	2011-06-02		~
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#### SHANGHAI TIANMA MICRO-ELECTRONICS

Rev	Issued Date	Description
1.0	2011-1-25	Preliminary release
1.1	2011-2-17	Change IC from HX8353E to HX8353D
1.2	2011-3-1	To correct the Luminance data
1.3	2011-3-11	Revise the mechanical drawing
1.4	2011-3-14	Revise the Chromaticity
2.0	2011-6-2	Final release

#### **Record of Revision**

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### **General Specifications**

	]	Spec		
	Size		1.44"	
	Resolution		128(RGB) X 128	
	Interface		CPU 8bit、SPI3W、SPI4W	
	Color Dept	1	65/262k	
	Technology	type	a-si	
Display Spec.	Pixel Confi	guration	RGB Stripe	
	Display Mo	de	TM NW	
	Surface Tre	atment	Clear type	
	Viewing Di	rection	6 o'clock	
	Gray Scale	e Inversion Direction	12 o'clock	
	DIM	Pixel (H x V) (mm)	0.1992(H)*0.2070(V)	
	LCM (W x H x D) (mm)		32.36*38.00*2.6	
<b>Mechanical</b>	Active Area	u(mm)	25.50*26.50	
Characteristics	With /Witho	out TSP	Without TSP	
	Weight (gra	m)	4.34	
	LED Numb	1		
Electronic		Driver IC	HX8353D	

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## **1. Absolute Maximum Ratings**

				]	Га = 25 ℃
Item	Symbol	MIN	MAX	Unit	Remark
Logic Supply Voltage	IOVCC	-0.3	4.6	V	
Analog Supply Voltage	Vdd	-0.3	4.6	V	
Input voltage	D [7:0] /CS,D/C,W/R, RD /RESET, SCL,SDA	-0.3	IOVCC+0.5	V	
Back Light Forward Current	I <sub>LED</sub>		25	mA	For each LED
Operating Temperature	T <sub>OPR</sub>	-20	70	°C	
Storage Temperature	T <sub>STG</sub>	-30	80	°C	

**Table 1.1 Absolute Maximum Rating** 

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### **2. Electrical Characteristics**

#### 2.1 LCD Module

	°0
GND=0V.Ta=25	C

	Item	Symbol	MIN	ТҮР	MAX	Unit	Remark
Logic	c Supply Voltage	IOVCC	1.65	1.8/2.8	3.3	V	
Analo	g Supply Voltage	VDD	2.5	2.8	3.3	V	
Input	Low Level	$V_{IL}$	VSSD		0.3* IOVCC	V	D [7:0],/CS,D/C,W/R, RD
Signal Voltage	High Level	$V_{\mathrm{IH}}$	0.7* IOVCC		IOVCC	V	/RESET
Output	Low Level	V <sub>OL</sub>	VSSD		0.2* IOVCC	v	
Signal Voltage	High Level	V <sub>OH</sub>	0.8* IOVCC		IOVCC	V	
	(Danal + L SI)	Black Mode (60Hz)		3.808		mW	
Power Consumption		8-color Mode		1.596		mW	
		Sleeping Mode		0.004		mW	

#### Table 2.1 LCD module electrical characteristics

#### 2.2 Backlight Unit

Ta=25℃

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I <sub>F</sub>		15	25	mA	One LED
Forward Voltage	V <sub>F</sub>		3.2		V	One LED
Backlight Power Consumption	$W_{BL}$		48		mW	One LED

#### Table 2.2 Backlight Unit Electrical Characteristics



#### Figure 2.1 LED driver circuit

#### Note1: The minimal life of LED : 20,000 hours.

Optical performance should be evaluated at  $Ta=25^{\circ}C$  only.

If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.

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### 3. Block Diagram

### LCD module diagram



Figure 3.1 LCD module diagram

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### 4. Input terminals PIN Assignment

Num	Symbol	I/O	Description	Remarks
1	LCM_ID(VDD)	0	Distinction of LCD maker	
2	LED+	Р	Back light anode	
3	LED-	Р	Back light cathode	
4	VG	-	NC	
5	XVD	-	NC	
6	VO	-	NC	
7	VM	-	NC	
8	VDD	Р	Power supply for internal analog circuits	
9	VSS	Р	Ground	
10	VDD	Р	Power supply for internal analog circuits	
11	/EXT	-	NC	
12	/CS	Ι	Chip select signal, low: chip can be accessed	
13	IF3	Ι	IF[3,1]=00:SPI 3W; IF[3,1]=01:SPI 4W	
14	IF1	Ι	IF[3,1]=10:CPU 8bit; IF[3,1]=11:CPU 8bit	
15	RESET	Ι	Reset signal	
16	RD	Ι	Read signal	
17	IOVCC	Р	Power supply for I/O system.	
18	D7	Ι	Data input, connect to GND when unused	
19	D6	Ι	Data input, connect to GND when unused	
20	D5	Ι	Data input, connect to GND when unused	
21	D4	I	Data input, connect to GND when unused	
22	D3	I	Data input, connect to GND when unused	
23	D2		Data input, connect to GND when unused	
24	D1	I	Data input, connect to GND when unused	
25	D0/SDA	Ι	Data input/Serial data pin	
26	WR	Ι	Write signal	
K			Command/Data select signal,	
27	RS/SCL	Ι	low: instruction; high: data	
			When under serial interface, it servers as SCL.	
28	VPP	-	NC	
29	GND	Р	Ground	

**Table 4.1 Input Terminal Pin Assignments** 

I/O definition: I-----Input; O---Output; P----Power

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### 5. Interface timing

#### 5.1 CPU Interface

#### **5.1.1 Interface Characteristics**



Figure 5.1 CPU Interface Characteristics

#### 5.1.2 Interface Timing Parameters

Signal	Symbol	Parameter	Min.	Max.	Unit	Description		
Ba	<b>t</b> ast	Address setup time	0	-				
RS	tант	Address hold time (Write/Read)	10	-	ns	-		
	tснw	Chip select "H" pulse width	0	-				
	tcs	Chip select setup time (Write)	15	-				
/CS	trcs	Chip select setup time (Read ID)	45	-	ne			
	<b>t</b> RCSFM	Chip select setup time (Read FM)	355	-	115	-		
	tcsF	Chip select wait time (Write/Read)	10	-				
	tcsн	Chip select hold time	10	-				
WR	twc	Write cycle	66	-				
	twĸн	Control pulse "H" duration	15 - ns		ns	-		
	twrL	Control pulse "L" duration	15	-				
	trc	Read cycle (ID)	160	-	ns	When read ID data		
RD(ID)	trdн	Control pulse "H" duration (ID)	90	-				
	<b>t</b> RDL	Control pulse "L" duration (ID)	45	-				
	<b>t</b> RCFM	Read cycle (FM)	450	-		When read from frame		
RD(FM)	<b>t</b> RDHFM	Control pulse "H" duration (FM)	90	-	ns	momony		
	<b>t</b> rdlfm	Control pulse "L" duration (FM)	355	-		memory		
	tosт	Data setup time	10	-				
	tонт	Data hold time Read access time (ID)		-	ns	For maximum Cr=20nE		
D[7:0]	<b>t</b> RAT			40		For maximum CL=30pF		
	<b>TRATEM</b>	Read access time (FM)	-	340				
	tорн	Output disable time	20	80				

	Table 5.1	CPU	Interface	Timing	Parameters
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#### 5.1.3 Register Write/Read Timing

#### 5.1.3.1 System Bus Interface Register Write Timing



Figure 5.2 Register Write Timing in Parallel Bus System Interface (for I80 series MPU)

#### 5.1.3.2 System Bus Interface Register Read Timing



Figure 5.3 Register Read Timing in Parallel Bus System Interface (for I80 series MPU)

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# 5.1.4 GRAM Write/Read timing

Register	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	DO	Command	
Command	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	0	0	1	0	1	1	0	0	2CH	
3AH	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	DO	Color	
	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	R3	R2	R1	R0	G3	G2	G1	G0	4K-Color	
03h	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	B3	B2	B1	B0	R3	R2	R1	R0	(2-nivel/3-hytes)	
	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	G3	G2	G1	G0	B3	B2	B1	B0	(2 pixes e b)(00)	
05h	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	R4	R3	R2	R1	R0	G5	G4	G3	65K-Color	
0511	х	Х	Х	Х	х	Х	х	Х	Х	Х	G2	G1	G0	B4	B3	B2	B1	B0	(1-pixel/ 2-bytes)	
06h	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	R5	R4	R3	R2	R1	R0	x	х	20214 0 - 1	
	х	Х	Х	Х	х	Х	х	Х	х	Х	G5	G4	G3	G2	G1	G0	х	х	202N-COlor (1-nivel/3hvtes)	
	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	B5	B4	B3	B2	B1	B0	х	х	(1-pixel/ 3bytes)	





#### Figure 5.5 Read from GRAM

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Units

ns

ns

ns

ns

ns

ns

ns

ns

\_

#### **5.2 SPI Interface**

#### **5.2.1 Interface Characteristics**





Chip select hold time

#### **5.2.2 Interface Timing Parameters Normal Write Mode** Spec. Conditions **Parameter** Symbol Min. Тур. Max. Serial clock cycle(Write) tSCYCW 40 RS(SCL) "H" pluse width(Write) tSHW RS(SCL) 16 RS(SCL) "L" pluse width(Write) tSLW 16 Data setup time(Write) tSDS 16 **SDA** Data hold time(Write) tSDH 16 Serial clock cycle(Read) tSCYCR 150 \_ RS(SCL) "H" pluse width(Read) tSHR RS(SCL) 60 RS(SCL) "L" pluse width(Read) tSLR 60 SDI for maximum Access Time tACC CL=30pF 10 50 For minimum CL=8pF SDO for maximum CL=30pF Output disable time tSCC 15 50 For minimum CL=8pF RS,/CS RS to Chip select tSCC 15 \_ /CS "H" pluse width tCHW /CS 40 -tCSS 60 Chip select setup time /CS tCSH 65

**Table 5.2 SPI Interface Timing Parameters** 

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#### 5.2.3 Register Read Timing



Figure 5.8 4-wire Serial Interface Protocol, Read Mode

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#### 5.2.4 GRAM Write/Read Data Format



Note: Logic high and low levels are specified as 30% and 70% of IOVCC



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#### **5.4 Reset Timing**



Figure	5.15	Reset	Timing	D
Inguit	0.10	Reser	_ mm	5

Symbol	Parameter	Related		Spec.		Note	Unit
Symbol	Farameter	Pins	Min.	Тур.	Max.	Note	Onit
tRESW	Reset low pulse width <sup>(1)</sup>	NRESET	10	-	-	-	μs
tREST	Posot complete time <sup>(2)</sup>	-	5	-	-	When reset applied during Sleep Out mode	ms
	Reset complete time	-	120	-	-	When reset applied during Sleep In mode	ms

 Table 5.3 Reset Timing Parameters



### 6. Power on/off sequence

#### 6.1 Power on Sequence



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#### 6.2 Power off Sequence



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## 7. Optical Characteristics

Item		Symbol	Condition	Min	Тур	Max	Unit	Remark
		θΤ		60	70	-		
	1	θΒ	CD > 10	50	60	-	D	
view Ang	gles	θL	$CR \le 10$	60	70	-	Degree	Note 2
		θR		60	70	-	4	
Contrast R	atio	CR	θ=0°	400	500	-	1	Note1 Note3
	<b></b>	Ton			•			Note1
Response Time		Toff	25℃	-	20	30	ms	Note4
	White	Х		0.228	0.278	0.328		
		у		0.242	0.292	0.342		
	Red	х		0.526	0.576	0.626		
		у	Backlight is	0.267	0.317	0.367		Note5,
Chromaticity	Green	Х	on	0.290	0.340	0.390		Note1
		у		0.527	0.577	0.627		
		X		0.101	0.151	0.201		
	Blue	у		0.037	0.087	0.137		
Uniformity		U	₽	-	80	_	%	Note1 Note6
NTSC				-	50	-	%	Note 5
Luminan	ce	L		150	180	-	cd/m <sup>2</sup>	Note1 Note7

Test Conditions:

- 1. For one LED:  $V_F=3.2V$ ,  $I_F=15mA$ , the ambient temperature is  $25^{\circ}$ C.
- 2. The test systems refer to Note 1 and Note 2.

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Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Note 2: Definition of viewing angle range and measurement system.

viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80).



Figure 7.1 Definition of viewing angle

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Note 3: Definition of contrast ratio

```
Contrast ratio (CR) = 

Luminance measured when LCD is on the "White" state

Luminance measured when LCD is on the "Black" state
```

"White state ": The state is that the LCD should driven by Vwhite.

"Black state": The state is that the LCD should driven by Vblack.

Vwhite: To be determined Vblack: To be determined.

Note 4: Definition of Response time

The response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time (TON) is the time between photo detector output intensity changed from 90% to 10%. And fall time (TOFF) is the time between photo detector output intensity changed from 10% to 90%.



Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.



Note 6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity (U) = Lmin/ Lmax

L----- Active area length W----- Active area width



Figure 7.2 Definition of uniformity

Lmax: The measured maximum luminance of all measurement position.

Lmin: The measured minimum luminance of all measurement position.

Note 7: Definition of Luminance:

Measure the luminance of white state at center point.



### 8. Environmental / Reliability Tests

No	Test Item	Condition	Remarks
1	High Tempera- ture Operation	Ts=+70°C , 120hrs	Note1 IEC60068-2-1:2007,GB2423.2-2008
2	Low Temperature Operation	Ta=-20°C, 120hrs	IEC60068-2-1:2007 GB2423.1-2008
3	High Tempera- ture Storage	Ta=+80℃, 120hrs	IEC60068-2-1:2007 GB2423.2-2008
4	Low Temperature Storage	Ta=-30℃, 120hrs	IEC60068-2-1:2007 GB2423.1-2008
5	High Tempera- ture & High Hu- midity Storage	Ta=+60℃, 90% RH 120 hours	Note2 IEC60068-2-78 :2001 GB/T2423.3—2006
6	Thermal Shock (Non-operation)	-30°C 30 min~+70°C 30 min, Change time:5min, 20 Cycles	Start with cold temperature, End with high temperature, IEC60068-2-14:1984,GB2423.22-2002
7	Electro Static Discharge (Op- eration)	C=150pF, R=330 $\Omega$ , 5points/panel Air:±8KV, 5times; Contact:±4KV, 5 times; (Environment: 15°C ~35°C, 30%~60%, 86Kpa~106Kpa)	IEC61000-4-2:2001 GB/T17626.2-2006
8	Vibration (Non-operation)	Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (6 hours for total) (Package con- dition)	IEC60068-2-6:1982 GB/T2423.10—1995
9	Shock (Non-operation)	$60G 6ms, \pm X, \pm Y, \pm Z 3 times,$ for each direction	IEC60068-2-27:1987 GB/T2423.5—1995
10	Package Drop Test	Height:80 cm, 1 corner, 3 edges, 6 surfaces	IEC60068-2-32:1990 GB/T2423.8—1995

Note1: Ts is the temperature of panel's surface.

Note2: Ta is the ambient temperature of sample.

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### 9. Mechanical Drawing



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## **10. Packing Drawing**

No	Item	Model (Material)	Dimen- sions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM module	TM014EDH21	32.36×38.00×2.6	0.004339	1260	
2	Tray	PET (Transmit)	485X330X13.8	0.163591	24	Anti-static
4	Dust-Proof Bag		700*545	0.021	1	
5	BOX	CORRUGATED PAPER	520*345*74	0.227	3	
6	Desiccant	Desiccant	45×35	0.0021	6	-v-
7	Carton	CORRUGATED PAPER	544×365×250	0.76	1	
8	EPE	EPE	485×330×5	0.009	3	
9	Total weight		10.89474 Kg			



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### 11. Precautions for Use of LCD Modules

- 11.1 Handling Precautions
- 11.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- 11.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.
- 11.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- 11.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- 11.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:
  - Isopropyl alcohol,
  - Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Kenton
- Aromatic solvents
- 11.1.6 Do not attempt to disassemble the LCD Module.
- 11.1.7 If the logic circuit power is off, do not apply the input signals.
- 11.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
- 11.1.8.1 Be sure to ground the body when handling the LCD Modules.
- 11.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.
- 11.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
- 11.1.8.4 The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

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- 11.2 Storage precautions
- 11.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.
- 11.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature :  $0^{\circ}$ C ~  $40^{\circ}$ C Relatively humidity:  $\leq 80\%$ 

11.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

11.3 Transportation Precautions:

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

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