



**SPECIFICATION
FOR
LCM Module
KD024QVFMD012**

MODULE:	KD024QVFMD012
CUSTOMER:	

REV	DESCRIPTION	DATE
1.0	FIRST ISSUE	2015.04.15
1.1	SECOND ISSUE	2015.12.21
1.2	Update PIN Define	2016.07.27

STARTEK	INITIAL	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

CUSTOMER	INITIAL	DATE
APPROVED BY		

Revision History

Date	Rev. No.	Page	Summary
2015.04.15	V1.0	ALL	FIRST ISSUE
2015.12.21	V1.1	3	SECOND ISSUE
2016.07.27	V1.2	7	Update PIN Define

ISO 9001:2008 ISO/TS16949:2009

Contents

* Description	4
1. Block Diagram.....	5
2. Outline dimension	6
3. Input terminal Pin Assignment.....	7
4. LCD Optical Characteristics	9
4.1 Optical specification.....	9
4.2 Measuring Condition	9
4.3 Measuring Equipment	9
5. Electrical Characteristics	11
5.1 Absolute Maximum Rating (Ta=25 VSS=0V)	11
5.2 DC Electrical Characteristics	11
5.3 LED Backlight Characteristics	12
6. AC Characteristic	14
6.1 Display Parallel 8/16-bit Interface Timing Characteristics (8080 system)	14
6.2 Display Serial Interface Timing Characteristics (3-line SPI system)	16
6.3 Display Serial Interface Timing Characteristics (4-line SPI system)	17
6.4 Parallel RGB Interface Timing Characteristics	18
6.5 Reset Timing Characteristics.....	19
7. LCD Module Out-Going Quality Level.....	21
7.1 VISUAL & FUNCTION INSPECTION STANDARD	21
7.1.1 Inspection conditions.....	21
7.1.2 Definition	21
7.1.3 Sampling Plan.....	22
7.1.4 Criteria (Visual).....	23
8. Reliability Test Result.....	27
8.1 Condition.....	27
9. Cautions and Handling Precautions.....	28
9.1 Handling and Operating the Module	28
9.2 Storage and Transportation.....	28
10. Packing.....	29

*** Description**

This is a color active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorphous silicon TFT as a switching device. This model is composed of a Transmissive type TFT-LCD Panel, driver circuit, back-light unit. The resolution of a 2.4" TFT-LCD contains 240x320 pixels, and can display up to 65K/262K colors.

*** Features**

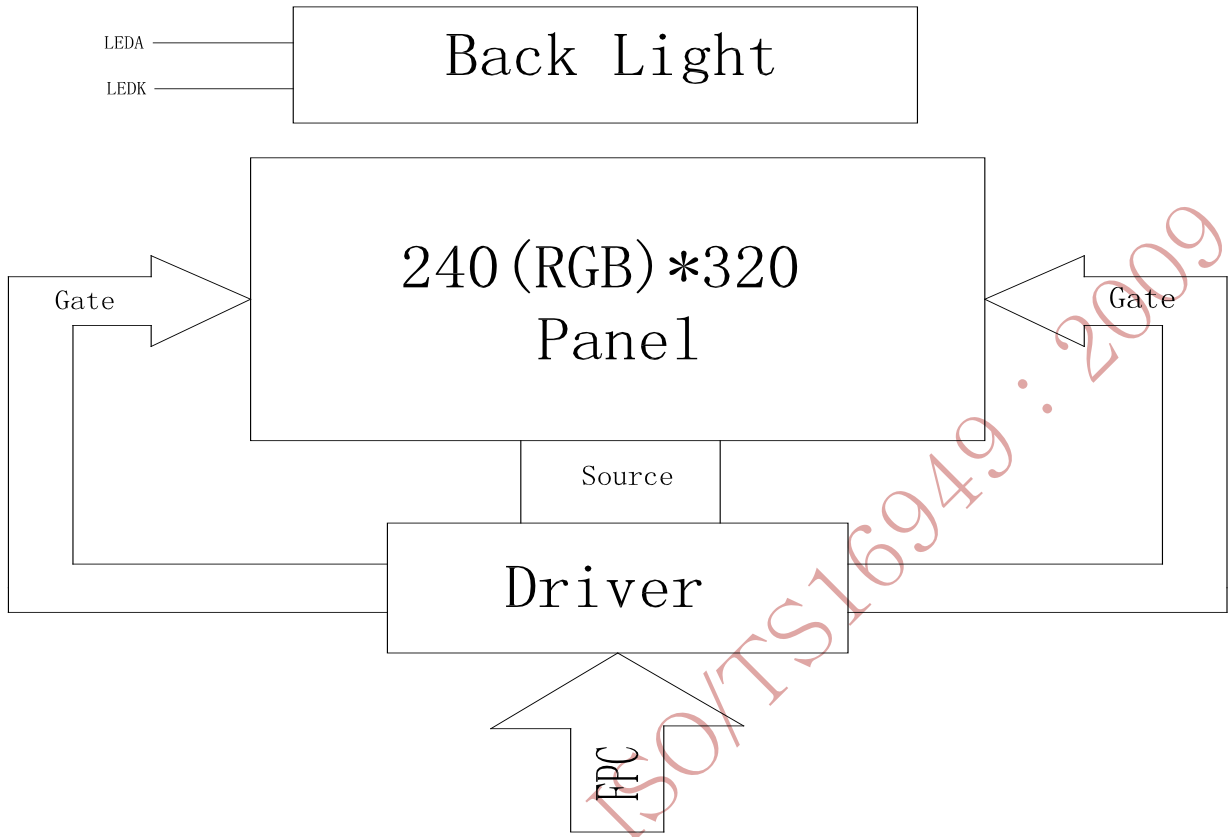
- Low Input Voltage: 3.3V(TYP)
- Display Colors of TFT LCD: 65K/262K colors
- Interface: 8/9/16/18Bit MCU Interface
3/4SPI+16/18Bit RGB Interface
3-line/4-line Serial Interface

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	36.72(H)*48.96(V) (2.4inch)	mm	-
Driver element	TFT active matrix	-	-
Display colors	65K/262K	colors	-
Number of pixels	240(RGB)*320	dots	-
Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.153(H)*0.153(V)	mm	-
Viewing angle	ALL	o'clock	-
Controller IC	ST7789V	-	-
Display mode	Transmissive/Normally Black	-	-
Operating temperature	-20~+70	°C	-
Storage temperature	-30~+80	°C	-

*** Mechanical Information**

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)		42.72		mm	-
	Vertical(V)		60.26		mm	-
	Depth(D)		2.1		mm	-
Weight			TBD		g	-

1. Block Diagram

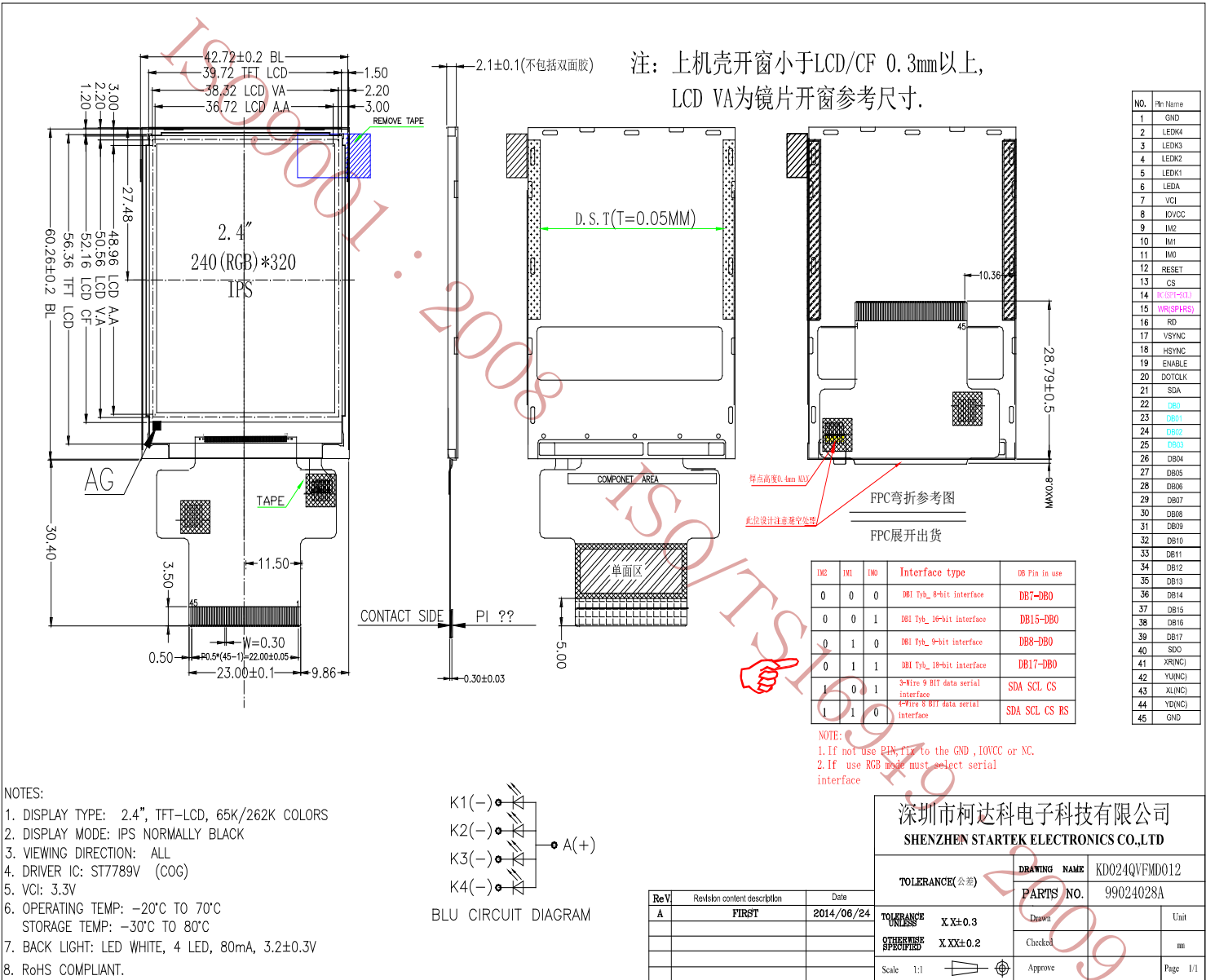


ISO9001 : 2008
 ISO/TS16949 : 2009

Part. No	KD024QVFMD012	REV	V1.2	Page 5 of 29
	常备库存 Standing Stock	长期供货 Long Time supply	支持小量 NO MOQ	品种齐全 In Full Range



2. Outline dimension



Part. No

KD024QVFM012

REV

V1.2

Page 6 of 29

常备库存
Standing Stock

长期供货
Long Time supply

支持少量
NO MOQ

品种齐全
In Full Range

3. Input terminal Pin Assignment

NO.	SYMBOL	DISCRIPTION	I/O
1	GND	Ground.	P
2	LEDK4	Cathode pin OF backlight	P
3	LEDK3	Cathode pin OF backlight	P
4	LEDK2	Cathode pin OF backlight	P
5	LEDK1	Cathode pin OF backlight	P
6	LEDKA	Anode pin of backlight	P
7	VCI	Supply voltage(3.3V).	P
8	IOVCC	Supply voltage(1.65-3.3V).	P
9	IM2	MPU Parallel interface bus and serial interface select If use RGB Interf ace must select serial interface. Fix this pin at VCI and GND.	I
10	IM1		I
11	IM0		I
12	RESET	This signal will reset the device and must be applied to properly initialize the chip.	I
13	CS	Chip select input pin ("Low" enable). fix this pin at VCI or GND when not in use.	I
14	DC(SPI-SCL)	-Display data/command selection pin in parallel interface. -This pin is used to be serial interface clock. DC='1': display data or parameter. DC='0': command data. -If not used, please fix this pin at VDDI or DGND.	I
15	WR(SPI-RS)	-Write enable in MCU parallel interface. - Display data/command selection pin in 4-line serial interface. - Second Data lane in 2 data lane serial interface. -If not used, please fix this pin at VDDI or DGND.	I
16	RD	Serves as a read signal and MCU read data at the rising edge. fix this pin at VCI or GND when not in use.	I
17	VSYNC	Frame synchronizing signal for RGB interface operation. fix this pin at VCI or GND when not in use.	I
18	HSYNC	Line synchronizing signal for RGB interface operation.	I

Part. No	KD024QVFMD012	REV	V1.2	Page 7 of 29
----------	---------------	-----	------	--------------

常备库存
Standing Stock

长期供货
Long Time supply

支持少量
NO MOQ

品种齐全
In Full Range

		fix this pin at VCI or GND when not in use.	
19	ENABLE	Data enable signal for RGB interface operation. fix this pin at VCI or GND when not in use.	I
20	DOTCLK	Dot clock signal for RGB interface operation. Fix this pin at VCI or GND when not in use.	I
21	SDA	Serial input signal. The data is latched on the rising edge of the SCL signal. fix this pin at VCI or GND when not in use.	I
22-39	DB0-DB17	18-bit parallel bi-directional data bus for MCU system and RGB interface mode . Fix to GND level when not in use	I/O
40	SDO	SPI interface output pin. -The data is output on the falling edge of the SCL signal. -If not used, let this pin open.	O
41	XR	Touch panel Right Glass Terminal	A/D
42	YU	Touch panel Top Film Terminal	A/D
43	XL	Touch panel LIFT Glass Terminal	A/D
44	YD	Touch panel Bottom Film Terminal	A/D
45	GND	Ground.	P

ISO9001:2008

ISO/TS16949:2009

4. LCD Optical Characteristics

4.1 Optical specification

Item	Symbol	Condition	Min.	Typ.	Max.	Unit.	Note
Contrast Ratio	CR	$\Theta=0$	600	800			
Response time	Rising	T_R	Normal viewing angle	--	16	21	msec
	Falling	T_F		--	19	24	
Color gamut	S(%)		--	70	--	%	
Color Filter Chromaticity	White	W_X		0.290	0.310	0.330	
		W_Y		0.316	0.336	0.356	
	Red	R_X		0.627	0.647	0.667	
		R_Y		0.297	0.317	0.337	
	Green	G_X		0.255	0.275	0.295	
		G_Y		0.562	0.582	0.602	
	Blue	B_X		0.120	0.140	0.160	
		B_Y		0.068	0.088	0.108	
Viewing angle	Hor.	Θ_L	CR>10	--	80	--	
		Θ_R		--	80	--	
	Ver.	Θ_U		--	80	--	
		Θ_D		--	80	--	
Option View Direction	Free						

4.2 Measuring Condition

- Measuring surrounding: dark room
- Ambient temperature: $25\pm 2^\circ\text{C}$
- 15min. warm-up time.

4.3 Measuring Equipment

Part. No	KD024QVFMD012	REV	V1.2	Page 9 of 29
----------	---------------	-----	------	--------------

常备库存
Standing Stock

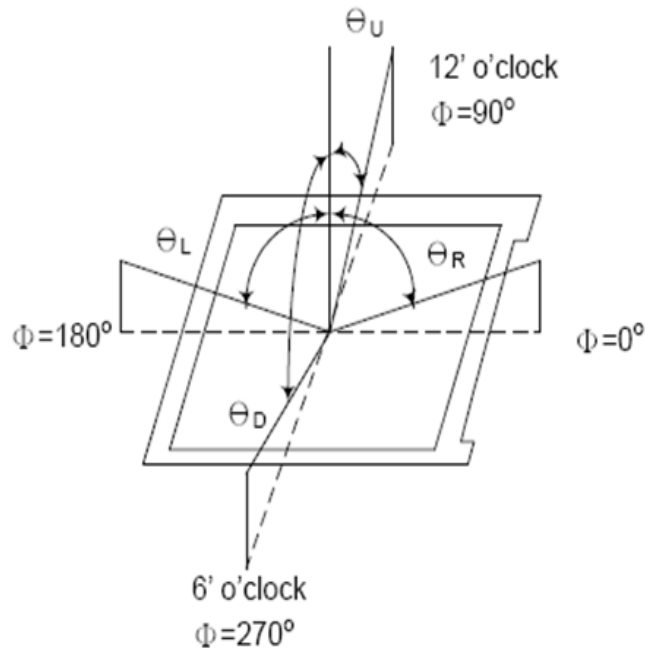
长期供货
Long Time supply

支持少量
NO MOQ

品种齐全
In Full Range

- FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

Note (1) Definition of Viewing Angle:



Note (2) Definition of Contrast Ratio (CR) :
measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$



Part. No	KD024QVFMD012	REV	V1.2	Page 10 of 29
	常备库存 Standing Stock	长期供货 Long Time supply	支持小量 NO MOQ	品种齐全 In Full Range

5. Electrical Characteristics

5.1 Absolute Maximum Rating (Ta=25 VSS=0V)

Characteristics	Symbol	Min.	Max.	Unit
Digital Supply Voltage	VCC	-0.3	4.6	V
Digital interface supply Voltage	VDDIO	-0.3	4.6	V
Operating temperature	T _{OP}	-20	+70	°C
Storage temperature	T _{ST}	-30	+80	°C

NOTE: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

5.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	VCC	2.4	2.8	3.3	V	
Digital interface supply Voltage	VDDIO	1.65	1.8	3.3	V	
Normal mode Current consumption	IDD	--	7	--	mA	
Level input voltage	V _{IH}	0.7V _{DDIO}		VDDIO	V	
	V _{IL}	GND		0.3V _{DDIO}	V	
Level output voltage	V _{OH}	0.8VDDIO		VDDIO	V	
	V _{OL}	GND		0.2VDDIO	V	

Part. No	KD024QVFMD012	REV	V1.2	Page 11 of 29
----------	---------------	-----	------	---------------

常备库存
Standing Stock

长期供货
Long Time supply

支持小量
NO MOQ

品种齐全
In Full Range

5.3 LED Backlight Characteristics

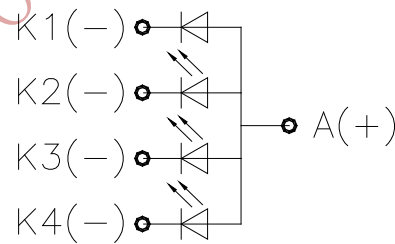
The back-light system is edge-lighting type with 4 chips White LED

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I_F	60	80	--	mA	
Forward Voltage	V_F	--	3.2	--	V	
LCM Luminance	L_V	500	--	--	cd/m ²	Note3
LED life time	Hr	50000	--	--	Hour	Note1,2
Uniformity	AVg	80	--	--	%	Note3

Note (1) LED life time (Hr) can be defined as the time in which it continues to operate under the condition:

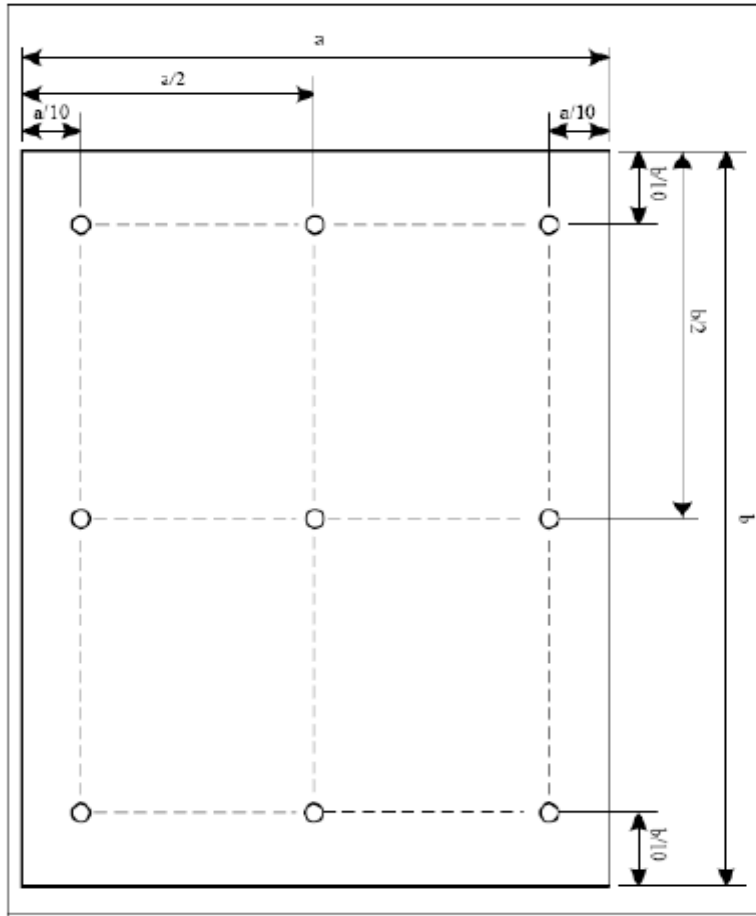
$T_a=25\pm3\text{ }^\circ\text{C}$, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note (2) The "LED life time" is defined as the module brightness decrease to 50% original brightness at $T_a=25\text{ }^\circ\text{C}$ and $I_L=80\text{mA}$. The LED lifetime could be decreased if operating I_L is larger than 80mA. The constant current driving method is suggested.



BLU CIRCUIT DIAGRAM

NOTE 3: Luminance Uniformity of these 9 points is defined as below:



$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

$$\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$$

ISO9001

Part. No	KD024QVFMD012	REV	V1.2	Page 13 of 29
----------	---------------	-----	------	---------------

常备库存
Standing Stock

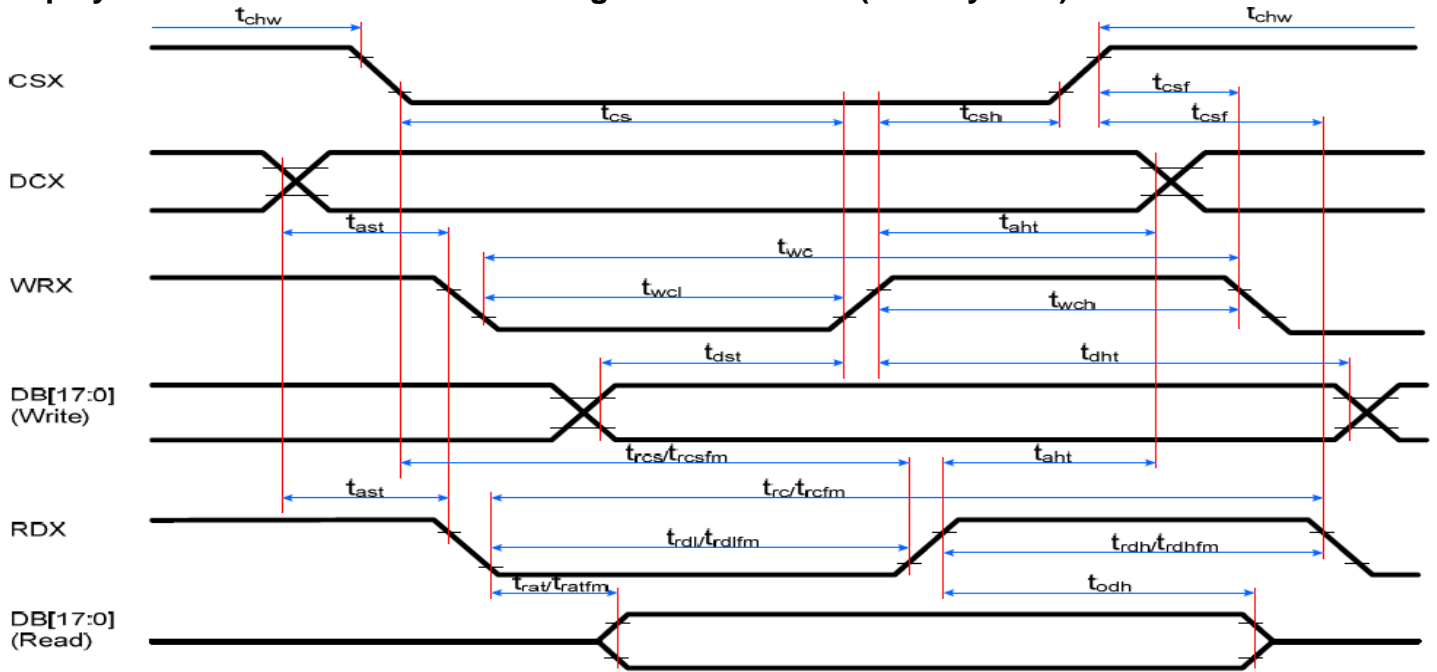
长期供货
Long Time supply

支持小量
NO MOQ

品种齐全
In Full Range

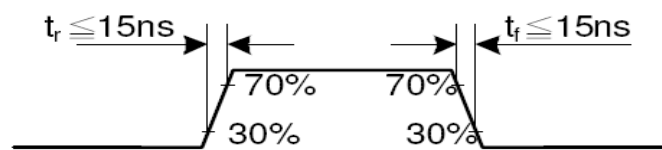
6. AC Characteristic

6.1 Display Parallel 8/16-bit Interface Timing Characteristics (8080 system)

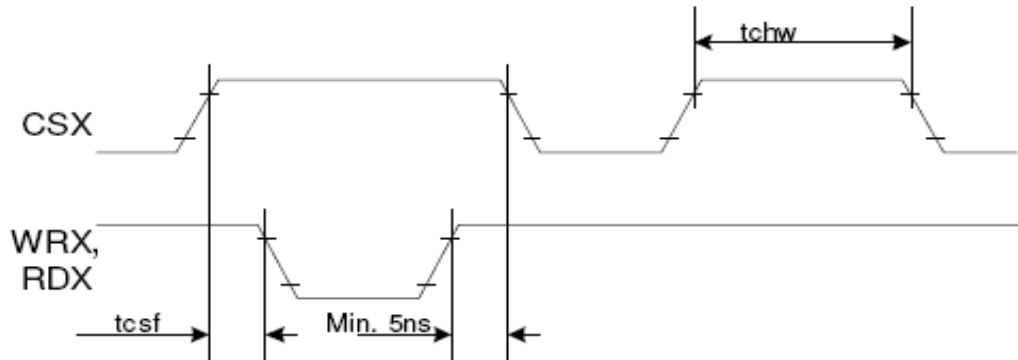


Signal	Symbol	Parameter	min	max	Unit	Description
DCX	t_{ast}	Address setup time	0	-	ns	
	t_{aht}	Address hold time (Write/Read)	10	-	ns	
CSX	t_{chwh}	CSX "H" pulse width	0	-	ns	
	t_{cs}	Chip Select setup time (Write)	15	-	ns	
	t_{rcs}	Chip Select setup time (Read ID)	45	-	ns	
	t_{rcsfm}	Chip Select setup time (Read FM)	355	-	ns	
	t_{csf}	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	t_{wc}	Write cycle	66	-	ns	
	t_{wrh}	Write Control pulse H duration	15	-	ns	
	t_{wrl}	Write Control pulse L duration	15	-	ns	
RDX (FM)	t_{rcfm}	Read Cycle (FM)	450	-	ns	
	t_{rdhfm}	Read Control H duration (FM)	90	-	ns	
	t_{rdlfm}	Read Control L duration (FM)	355	-	ns	
RDX (ID)	t_{rc}	Read cycle (ID)	160	-	ns	
	t_{rdh}	Read Control pulse H duration	90	-	ns	
	t_{rdl}	Read Control pulse L duration	45	-	ns	
D[17:0], D[15:0], D[8:0], D[7:0]	t_{dst}	Write data setup time	10	-	ns	For maximum $C_L=30pF$ For minimum $C_L=8pF$
	t_{dht}	Write data hold time	10	-	ns	
	t_{rat}	Read access time	-	40	ns	
	t_{ratfm}	Read access time	-	340	ns	
	t_{rod}	Read output disable time	20	80	ns	

Note: $T_a = -30$ to 70 °C, $IOVCC=1.65V$ to $2.8V$, $V_{CI}=2.6V$ to $3.3V$, $GND=0V$

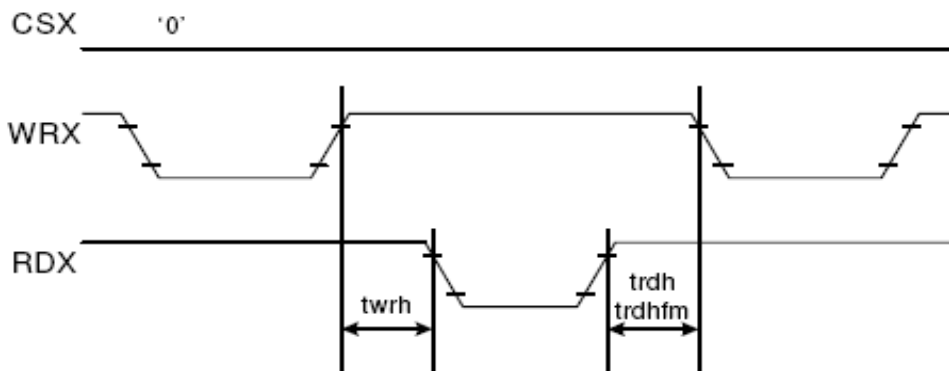


CSX timings :



Note: Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

Write to read or read to write timings:



Note: Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

ISO9000

Part. No	KD024QVFMD012	REV	V1.2	Page 15 of 29
----------	---------------	-----	------	---------------

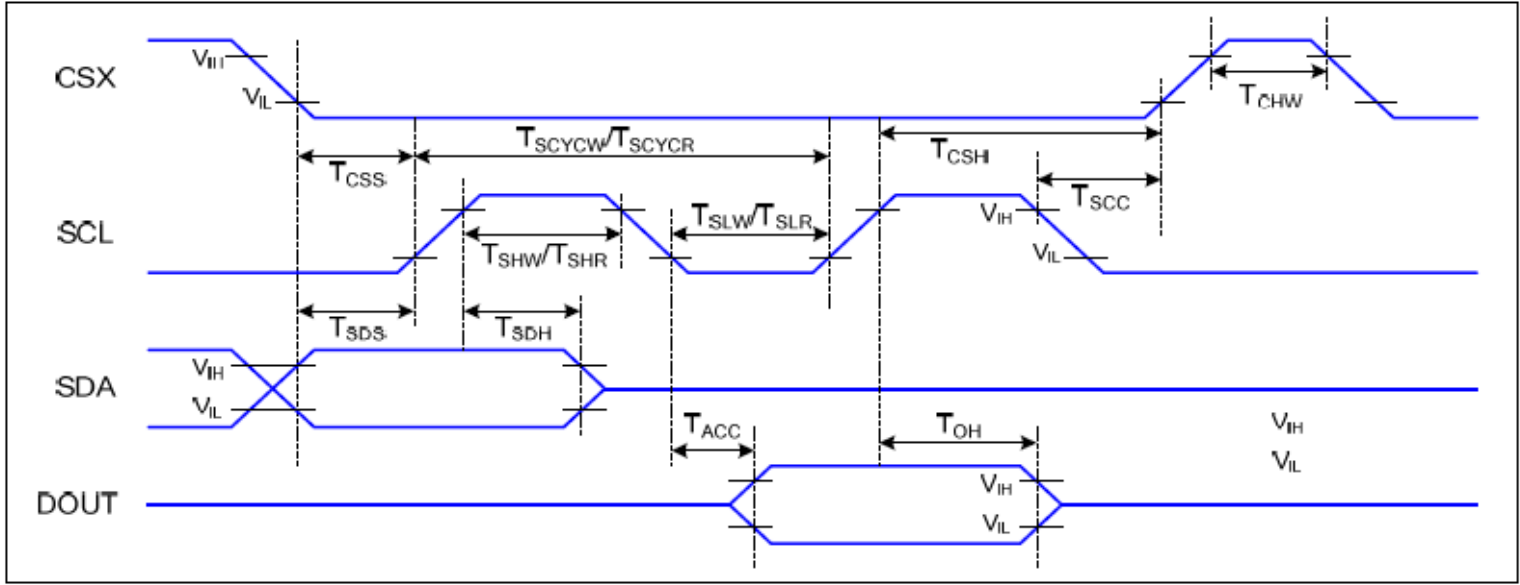
常备库存
Standing Stock

长期供货
Long Time supply

支持小量
NO MOQ

品种齐全
In Full Range

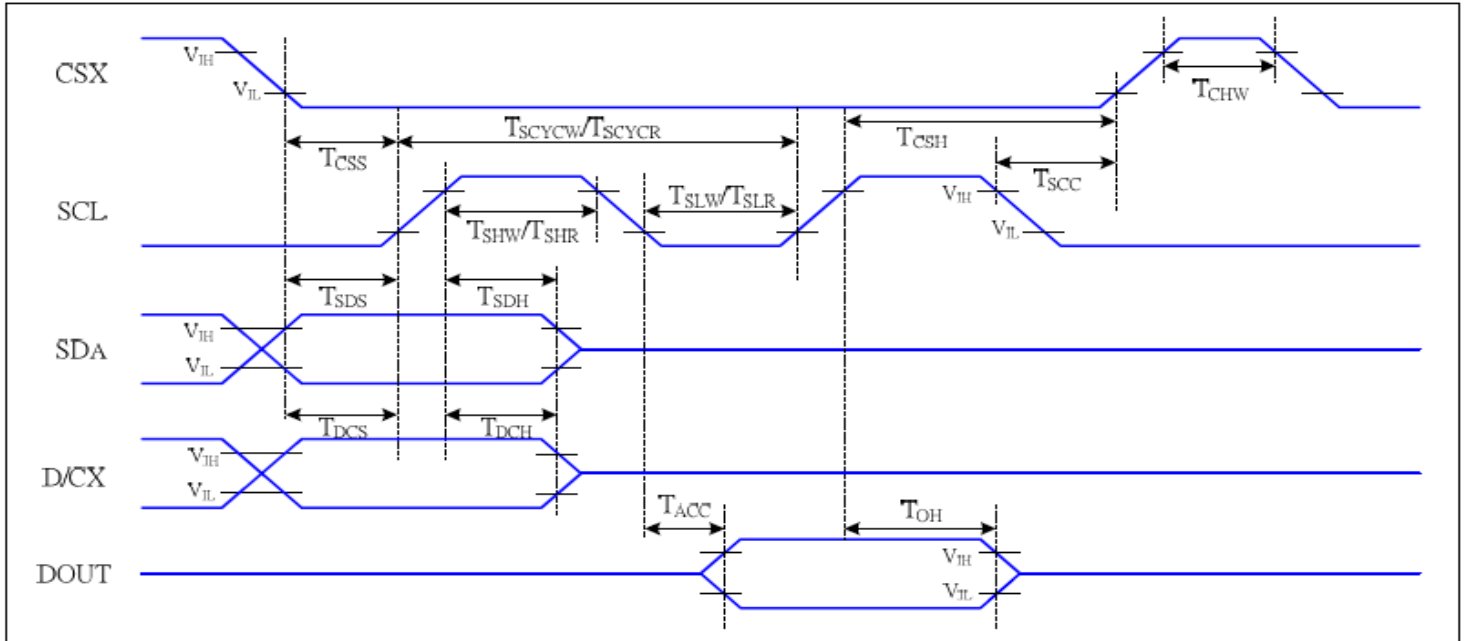
6.2 Display Serial Interface Timing Characteristics (3-line SPI system)



VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 to 70 °C

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66		ns	
	T_{SHW}	SCL "H" pulse width (Write)	15		ns	
	T_{SLW}	SCL "L" pulse width (Write)	15		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL=8pF

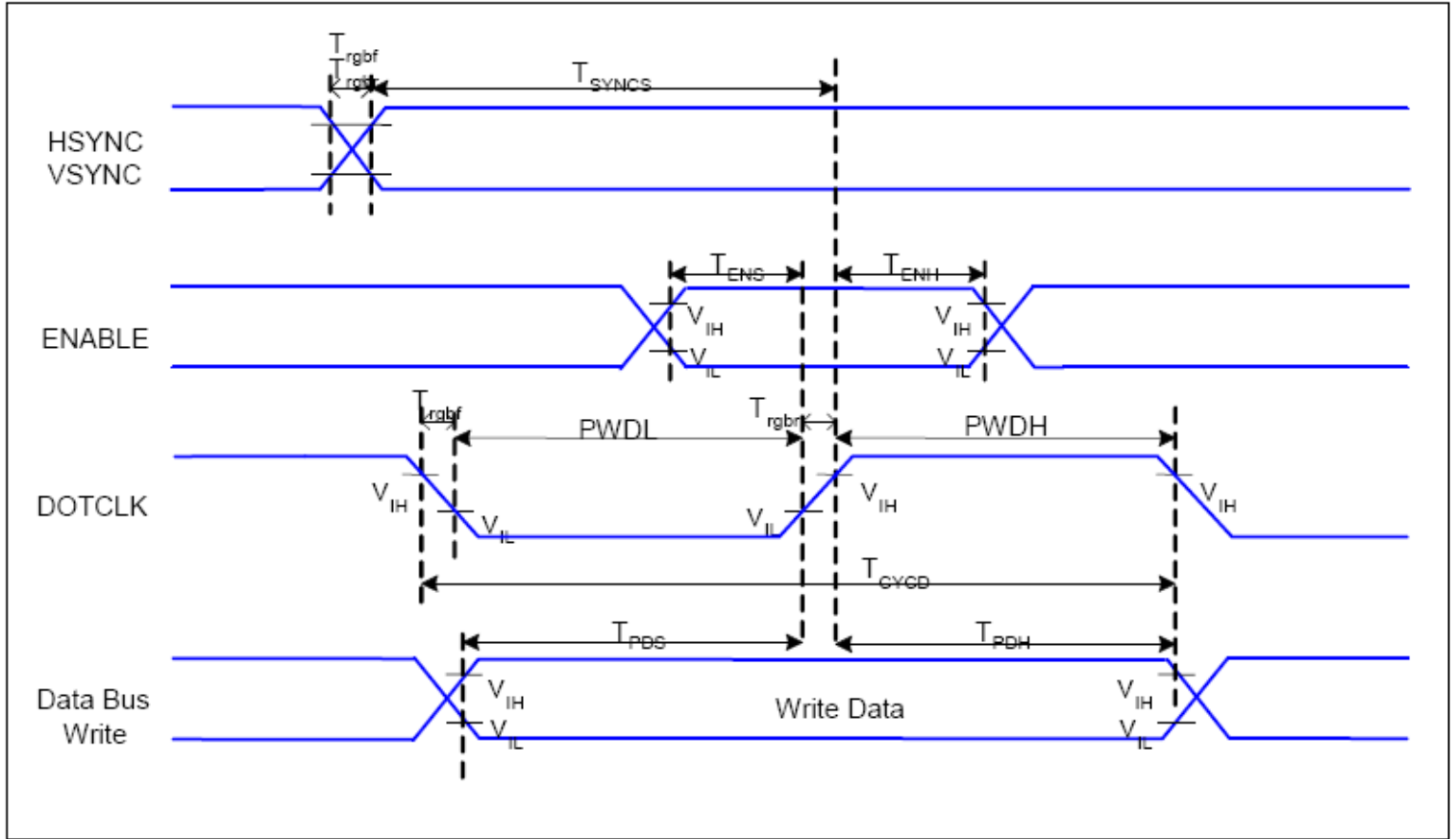
6.3 Display Serial Interface Timing Characteristics (4-line SPI system)



VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, T_a =-30 to 70 °C

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66		ns	-write command & data ram
	T_{SHW}	SCL "H" pulse width (Write)	15		ns	
	T_{SLW}	SCL "L" pulse width (Write)	15		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	-read command & data ram
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
D/CX	T_{DCS}	D/CX setup time	10		ns	
	T_{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL=8pF

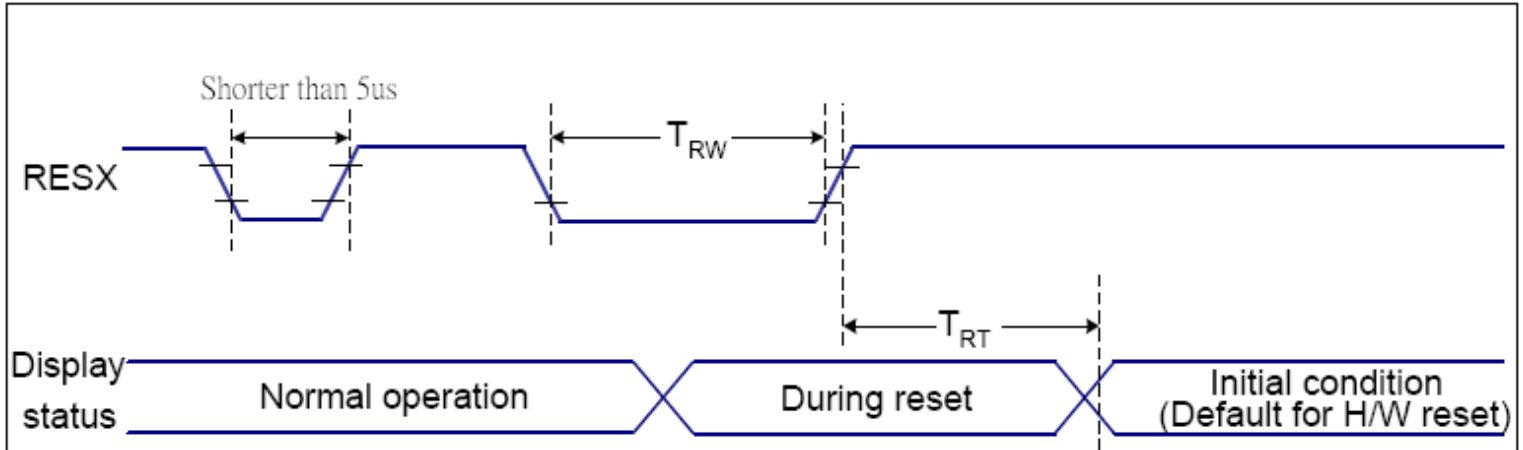
6.4 Parallel RGB Interface Timing Characteristics



$V_{DD1}=1.65$ to $3.3V$, $V_{DD}=2.4$ to $3.3V$, $AGND=DGND=0V$, $T_a=-30 \sim 70 \text{ } ^\circ\text{C}$

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC, VSYNC	T_{SYNCS}	VSYNC, HSYNC Setup Time	30	-	ns	
ENABLE	T_{ENS}	Enable Setup Time	25	-	ns	
	T_{ENH}	Enable Hold Time	25	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	60	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	60	-	ns	
	T_{CYCD}	DOTCLK Cycle Time	120	-	ns	
	Trghr, Trghf	DOTCLK Rise/Fall time	-	20	ns	
DB	T_{PDS}	PD Data Setup Time	50	-	ns	
	T_{PDH}	PD Data Hold Time	50	-	ns	

6.5 Reset Timing Characteristics



VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 ~ 70 °C

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
			120 (Note 1, 6, 7)	ms	

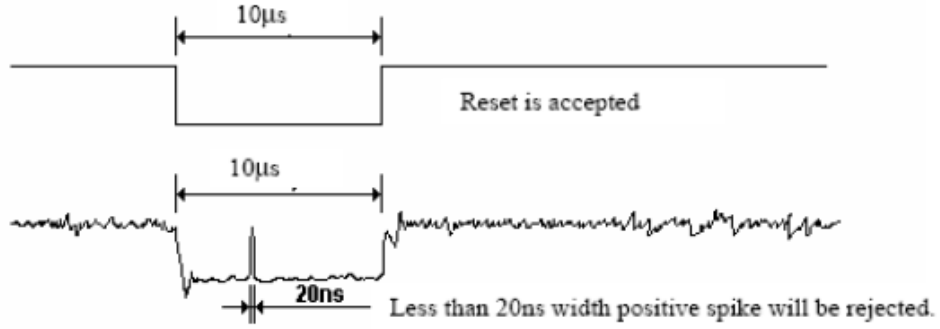
Notes:

- The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.
- Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

- During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.

- Spike Rejection also applies during a valid reset pulse as shown below:



5. When Reset applied during Sleep In Mode.

6. When Reset applied during Sleep Out Mode.

7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

ISO9001 : 2008 ISO/TS16949

Part. No	KD024QVFMD012	REV	V1.2	Page 20 of 29
----------	---------------	-----	------	---------------

常备库存
Standing Stock

长期供货
Long Time supply

支持小量
NO MOQ

品种齐全
In Full Range

7. LCD Module Out-Going Quality Level

7.1 VISUAL & FUNCTION INSPECTION STANDARD

7.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

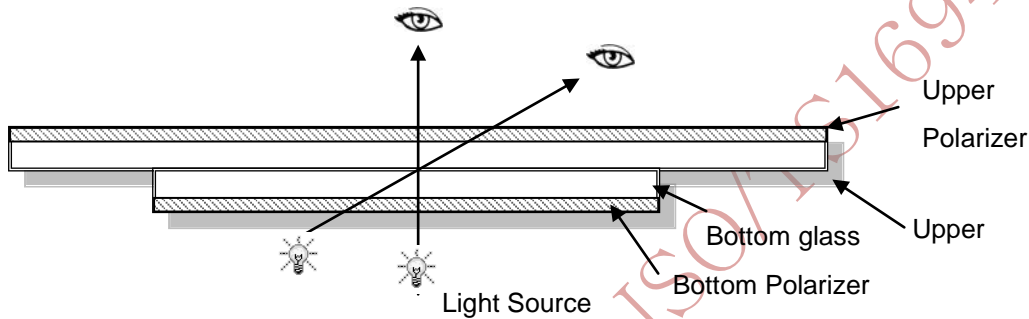
Temperature : $25\pm 5^{\circ}\text{C}$

Humidity : $65\%\pm 10\%\text{RH}$

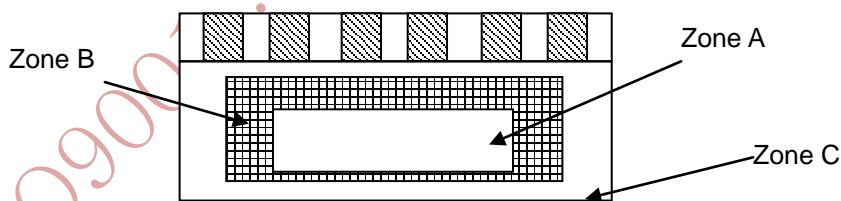
Viewing Angle : Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance:30-50cm



7.1.2 Definition



Zone A : Effective Viewing Area(Character or Digit can be seen)

Zone B : Viewing Area except Zone A

Zone C : Outside (Zone A+Zone B) which can not be seen after assembly by customer .)

Note:

As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer.

Part. No	KD024QVFMD012	REV	V1.2	Page 21 of 29
	常备库存 Standing Stock	长期供货 Long Time supply	支持小量 NO MOQ	品种齐全 In Full Range

7.1.3 Sampling Plan

According to GB/T 2828-2003 ; , normal inspection, Class II

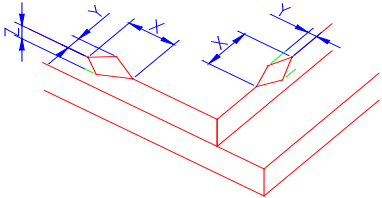
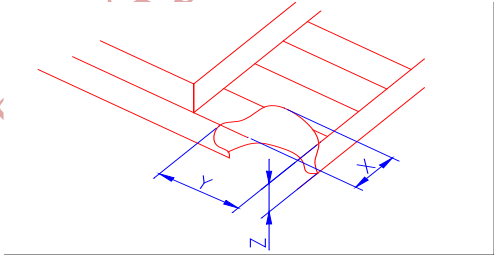
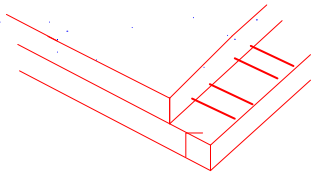
AQL:

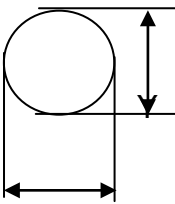
Major defect	Minor defect
0.65	1.5

LCD: Liquid Crystal Display , TP: Touch Panel , LCM: Liquid Crystal Module

No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. 4) TP no function	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Soldering appearance	Good soldering , Peeling off is not allowed.	
6	LCD/Polarizer/TP	Black/White spot/line, scratch, crack, etc.	

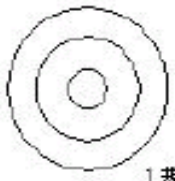


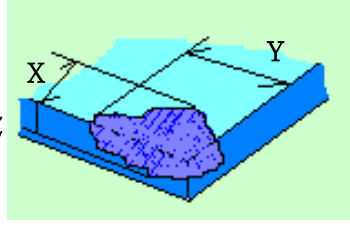
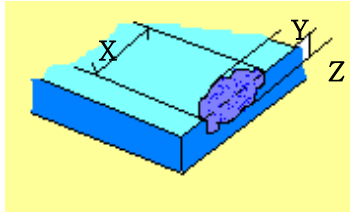
7.1.4 Criteria (Visual)

Number	Items	Criteria(mm)						
1.0 LCD Crack/Broken NOTE: X: Length Y: Width Z: Height L: Length of ITO, T: Height of LCD	(1) The edge of LCD broken	 <table border="1" data-bbox="866 667 1441 815"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td><Inner border line of the seal</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	<Inner border line of the seal	≤T
X	Y	Z						
≤3.0mm	<Inner border line of the seal	≤T						
	(2)LCD corner broken	 <table border="1" data-bbox="932 1155 1377 1254"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td>≤L</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	≤L	≤T
X	Y	Z						
≤3.0mm	≤L	≤T						
	(3) LCD crack	 <p style="text-align: center;">Crack Not allowed</p>						

Number	Items	Criteria (mm)																										
2.0	Spot defect  $\Phi = (X+Y)/2$	① light dot (LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain)																										
		<table border="1"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.10$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.10 < \Phi \leq 0.20$</td> <td colspan="3">3(distance $\geq 10\text{mm}$)</td> </tr> <tr> <td>$0.20 < \Phi \leq 0.25$</td> <td colspan="3">2</td> </tr> <tr> <td>$\Phi > 0.25$</td> <td colspan="3">0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.10$	Ignore			$0.10 < \Phi \leq 0.20$	3(distance $\geq 10\text{mm}$)			$0.20 < \Phi \leq 0.25$	2			$\Phi > 0.25$	0					
		Zone Size (mm)		Acceptable Qty																								
			A	B	C																							
		$\Phi \leq 0.10$	Ignore																									
		$0.10 < \Phi \leq 0.20$	3(distance $\geq 10\text{mm}$)																									
		$0.20 < \Phi \leq 0.25$	2																									
		$\Phi > 0.25$	0																									
		② Dim spot (LCD/TP/Polarizer dim dot, light leakage, dark spot)																										
		<table border="1"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.1$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.10 < \Phi \leq 0.20$</td> <td colspan="3">3(distance $\geq 10\text{mm}$)</td> </tr> <tr> <td>$0.20 < \Phi \leq 0.30$</td> <td colspan="3">2</td> </tr> <tr> <td>$\Phi > 0.30$</td> <td colspan="3">0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.1$	Ignore			$0.10 < \Phi \leq 0.20$	3(distance $\geq 10\text{mm}$)			$0.20 < \Phi \leq 0.30$	2			$\Phi > 0.30$	0					
Zone Size (mm)	Acceptable Qty																											
	A	B	C																									
$\Phi \leq 0.1$	Ignore																											
$0.10 < \Phi \leq 0.20$	3(distance $\geq 10\text{mm}$)																											
$0.20 < \Phi \leq 0.30$	2																											
$\Phi > 0.30$	0																											
③ Polarizer accidented spot																												
<table border="1"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.2$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.3 < \Phi \leq 0.5$</td> <td colspan="3">2(distance $\geq 10\text{mm}$)</td> </tr> <tr> <td>$\Phi > 0.5$</td> <td colspan="3">0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.2$	Ignore			$0.3 < \Phi \leq 0.5$	2(distance $\geq 10\text{mm}$)			$\Phi > 0.5$	0											
Zone Size (mm)		Acceptable Qty																										
	A	B	C																									
$\Phi \leq 0.2$	Ignore																											
$0.3 < \Phi \leq 0.5$	2(distance $\geq 10\text{mm}$)																											
$\Phi > 0.5$	0																											
Line defect (LCD/TP /Polarizer black/white line, scratch, stain)																												
<table border="1"> <thead> <tr> <th rowspan="2">Width(mm)</th> <th rowspan="2">Length(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.03$</td> <td>Ignore</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.03 < W \leq 0.05$</td> <td>$L \leq 3.0$</td> <td colspan="3">$N \leq 2$</td> </tr> <tr> <td>$0.05 < W \leq 0.08$</td> <td>$L \leq 2.0$</td> <td colspan="3">$N \leq 2$</td> </tr> <tr> <td>$0.08 < W$</td> <td colspan="4">Define as spot defect</td> </tr> </tbody> </table>	Width(mm)	Length(mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.03$	Ignore	Ignore			$0.03 < W \leq 0.05$	$L \leq 3.0$	$N \leq 2$			$0.05 < W \leq 0.08$	$L \leq 2.0$	$N \leq 2$			$0.08 < W$	Define as spot defect			
Width(mm)			Length(mm)	Acceptable Qty																								
	A	B		C																								
$\Phi \leq 0.03$	Ignore	Ignore																										
$0.03 < W \leq 0.05$	$L \leq 3.0$	$N \leq 2$																										
$0.05 < W \leq 0.08$	$L \leq 2.0$	$N \leq 2$																										
$0.08 < W$	Define as spot defect																											

3.0	Polarizer Bubble	Zone			Acceptable Qty		
		Size (mm)		A	B	C	
		$\Phi \leq 0.2$		Ignore			Ignore
		$0.2 < \Phi \leq 0.4$		3 (distance $\geq 10 \mu\text{m}$)			
		$0.4 < \Phi \leq 0.6$		2			
$0.6 < \Phi$		0					
4.0	SMT	According to IPC-A-610C class II standard . Function defect and missing part are major defect ,the others are minor defect.					

		TP bubble/ accidented spot	Size Φ (mm)		Acceptable Qty			
					A	B	C	
			$\Phi \leq 0.1$		Ignore			Ignore
			$0.1 < \Phi \leq 0.25$		3 (distance \geq			
			$0.25 < \Phi \leq 0.3$		2			
$0.3 < \Phi$		0						
		Assembly deflection	beyond the edge of backlight $\leq 0.15\text{mm}$					

5.0	TP Related	Newton Ring	<p>Newton Ring area > 1/3 TP area NG</p> <p>Newton Ring area ≤ 1/3 TP area OK</p>			 <p>1 规律性</p>  <p>2 非规律性</p>  <p>似牛顿环</p>					
			<p>TP corner broken</p> <p>X : length Y : width Z : height</p>	<table border="1"> <tr> <td>X</td> <td>Y</td> <td>Z</td> </tr> <tr> <td>X ≤ 3.0mm</td> <td>Y ≤ 3.0mm</td> <td>Z < LCD thickness</td> </tr> </table> <p>* Circuitry broken is not allowed.</p>	X	Y	Z	X ≤ 3.0mm	Y ≤ 3.0mm	Z < LCD thickness	
			X	Y	Z						
X ≤ 3.0mm	Y ≤ 3.0mm	Z < LCD thickness									
<p>TP edge broken</p> <p>X : length Y : width Z : height</p>	<table border="1"> <tr> <td>X</td> <td>Y</td> <td>Z</td> </tr> <tr> <td>X ≤ 6.0mm</td> <td>Y ≤ 2.0mm</td> <td>Z < LCD thickness</td> </tr> </table> <p>* Circuitry broken is not allowed.</p>	X	Y	Z	X ≤ 6.0mm	Y ≤ 2.0mm	Z < LCD thickness				
X	Y	Z									
X ≤ 6.0mm	Y ≤ 2.0mm	Z < LCD thickness									

Criteria (functional items)

Number	Items	Criteria (mm)
1	No display	Not allowed
2	Missing segment	Not allowed
3	Short	Not allowed
4	Backlight no lighting	Not allowed
5	TP no function	Not allowed

8. Reliability Test Result

8.1 Condition

Item	Condition	Sample Size	Test Result	Note
Low Temperature Operating Life test	-20°C, 96HR	3ea	pass	-
Thermal Humidity Operating Life test	70°C90%RH, 96HR	3ea	pass	-
Temperature Cycle ON/OFF test	-20°C ↔ 70°C, ON/OFF, 20CYC	3ea	pass	(1)
High Temperature Storage test	80°C, 96HR	3ea	pass	-
Low Temperature Storage test	- 30°C, 96HR	3ea	pass	-
ESD test	150pF, 330Ω , ±6KV(Contact)/± 8KV(Air), 5 points/panel, 10 times/point	3ea	pass	
Thermal Shock Resistance	The sample should be allowed to stand the following 5 cycles of operation: TSTL for 30 minutes -> normal temperature for 5 minutes -> TSTH for 30 minutes -> normal temperature for 5 minutes, as one cycle, then taking it out and drying it at normal temperature, and allowing it stand for 24 hours	3ea	pass	
Box Drop Test	1 Corner 3 Edges 6 faces, 66cm(MEDIUM BOX)	1box	pass	-

Note (1) ON Time over 10 seconds, OFF Time under 10 seconds

Part. No	KD024QVFMD012	REV	V1.2	Page 27 of 29
----------	---------------	-----	------	---------------

常备库存
Standing Stock

长期供货
Long Time supply

支持少量
NO MOQ

品种齐全
In Full Range

9. Cautions and Handling Precautions

9.1 Handling and Operating the Module

- (1) When the module is assembled, it should be attached to the system firmly.
Do not warp or twist the module during assembly work.
- (2) Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.
- (3) Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
- (4) Do not allow drops of water or chemicals to remain on the display surface.
If you have the droplets for a long time, staining and discoloration may occur.
- (5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane.
Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static; it may cause damage to the CMOS ICs.
- (9) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (10) Do not disassemble the module.
- (11) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (12) Pins of I/F connector shall not be touched directly with bare hands.
- (13) Do not connect, disconnect the module in the "Power ON" condition.
- (14) Power supply should always be turned on/off by the item 6.1 Power On Sequence & 6.2 Power Off Sequence

9.2 Storage and Transportation.

- (1) Do not leave the panel in high temperature, and high humidity for a long time.
It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%
- (2) Do not store the TFT-LCD module in direct sunlight.
- (3) The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
- (4) It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module.
In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
- (5) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.

Part. No	KD024QVFMD012	REV	V1.2	Page 28 of 29
	常备库存 Standing Stock	长期供货 Long Time supply	支持小量 NO MOQ	品种齐全 In Full Range

10. Packing

----TBD-----

ISO9001 : 2008 ISO/TS16949 : 2009

Part. No	KD024QVFMD012	REV	V1.2	Page 29 of 29
	常备库存 Standing Stock	长期供货 Long Time supply	支持小量 NO MOQ	品种齐全 In Full Range