# **ORIENT DISPLAY** MAKE THINGS POSSIBLE

# **Specification for TFT**

# AFY320240A0-3.5INTH-C2

**Revision** A



А	Orient Display
FY	ТFT Туре
320240	Resolution 320 x 240
A0	Serial A0
3.5	3.5", Module Dimension 76.90*63.90*4.67 mm
1	IPS Display
Ν	Top: -20~+70°C; Tstr: -30~+80°C
Т	Transmissive/Normally Black
Н	Hight Brightness, 900cd/m2
C2	Capacitive Touch Panel
/	Controller ST7272



# **REVISION RECORD**

Rev No.	Rev date	Contents	Remarks
0	2022-05-09	First release	Preliminary
А	2024-7-1	Update TOUCH PANEL CHARACTERISTICS	Page 4

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# **1. GENERAL INFORMATION**

No.	Item	Contents	Unit
1	LCD size	3.5 inch (Diagonal)	/
2	Display mode	Normally black/Transmissive	/
3	Viewing direction(eye)	Free	/
4	Gray scale inversion direction	-	/
5	Resolution(H*V)	320 *240 Pixels(TFT)/ 320*240 Dots(CTP)	/
6	Module size (L*W*H)	76.90*63.90*4.67	mm
7	Active area (L*W)	70.08*52.56	mm
8	Pixel pitch (L*W)	0.219*0.219	mm
9	Interface type	RGB 24bit interface(TFT)/I2C(CTP)	/
10	Color Depth	16.7M	/
11	Module power consumption	0.867	W
12	Back light type	LED	/
13	Driver IC	ST7272 OR COMPATIBLE(TFT) ST1633I(CTP)	/
14	Weight	44.2	G

# 2. ABSOLUTE MAXIMUM RATINGS

ltem	Symbol	Min.	Max.	Unit	Note
Power supply input voltage for TFT	VDD	-0.3	4.0	V	
Power supply input voltage for CTP	VCC	-0.3	6	V	
Backlight current (normal temp.)	ILED	-	50	mA	
Operation temperature	Тор	-20	+70	°C	Note1
Storage temperature	Tst	-30	+80	°C	Note1
Humidity	RH	20%	90%	/	Note1

Note1:

1).The relative humidity and temperature range are as below sketch,90%RH Max.

2). The maximum wet bulb temperature  $\leq 40^{\circ}$ C and without dewing.



# **3. ELECTRICAL CHARACTERISTICS**

TFT DC CHARACTERISTICS(at Ta=25°C)

ltem	Symbol	Min.	Тур.	Max.	Unit	Note
Power supply input voltage	VDD	3.0	3.3	3.6	V	
I/O logic voltage	VDDIO	-	-	-	V	
Input voltage 'H' level	VIH	0.7VDD	-	VDD	V	
Input voltage 'L' level	VIL	VSS	-	0.3VDD	V	
Power supply current	IVDD	-	30	-	mA	
TFT gate on voltage	VGH	-	-	-	V	
TFT gate off voltage	VGL	-	-	-	V	
Analog power supply voltage	AVDD	-	-	-	V	
TFT common electrode voltage	VCOM	-	-	-	V	Note1

Note1 : The value is just the reference value. The customer can optimize the setting value by the different D-IC VCOM must be adjusted to optimize display quality, as Crosstalk and Contrast Ratio etc..

# CTP DC CHARACTERISTICS(at Ta=25°C)

Item	Symbol	Min.	Тур.	Max.	Uni t	Note
Power supply input voltage	VCC	2.7	3.3	3.6	V	Note1
Input Power ripple	Vpp	-	-	50	mV	
I/O Signal Voltage	IOVCC	-	VCC	-	V	Note1
Input voltage 'H' level	VIH	0.85IOVCC	-	IOVCC	V	
Input voltage 'L' level	VIL	VSS	-	0.15IOVCC	V	
Operating Current (Normal Mode)	IVCC	-	16.1	24	mA	
Operating Current (Sleep mode)	IVCC	-	-	-	mA	

Note1 : If you need more information of CTP, please refer to our Spec of CTP.

# 4. BACKLIGHT CHARACTERISTICS

(at Ta=25°C,RH=60%)

ltem	Symbol	Min.	Тур.	Max.	Unit	Note
LED forward voltage	VF	17.4	19.2	20.1	V	
LED forward current	IF	-	40	-	mA	IF=20*2mA
LED power consumption	PLED	-	0.768	-	W	Note1
Number of LED	-		12		PCS	
Connection mode	-	3 in se	ries 2 in pa	rallel	/	
LED life-time	-	20000	-	-	Hrs	Note2

Note1 : Calculator value for reference : IF\*VF = PLED

Note2 : The LED life-time define as the estimated time to 50% degradation of initial brightness at Ta=25°C and IF =40mA. The LED lifetime could be decreased if operating IF is larger than 40mA.

# **5. TOUCH PANEL CHARACTERISTICS**

(at Ta=25°C)

Item	Description	Remark
Product Structure	G+G	
Surface Hardness	≤6H	Pencil,Loading 500g,45 deg
Ball-falling Test	≤60cm	Steel ball weight 64g
Touch Count Max	5 point	
I2C Slave Address*	0x70	
Origin of Coordinate*	top left corner	
FW version	0x02	

# **6. EXTERNAL DIMENSIONS**



7.	ELECTRO	- OPTICAL	CHARACTERISTICS	

ltem	Symbol	Condition	Min.	Тур.	Max.	Unit	Remark	Note
Response time	Tr+ Tf		-	30	40	ms	FIG.1	Note 1
Contrast ratio	Cr	-	640	800	-	-	FIG.2	Note 2
Surface luminance	Lv	θ=0°	600	800	-	cd/m <sup>2</sup>	FIG.2	Note 3
Luminance uniformity	Yu	θ=0°	75	80	-	%	FIG.2	Note 4
NTSC	-	θ=0°	-	50	-	%	FIG.2	Note 5
		Ø <b>=</b> 90°	70	80	-	deg	FIG.3	
Viewing onglo	0	Ø <b>=270°</b>	70	80	-	deg	FIG.3	Noto 6
viewing angle	Ø	Ø <b>=</b> 0°	70	80	-	deg	FIG.3	NOLE 0
		Ø=180°	70	80	-	deg	FIG.3	
	Red x			0.62		-		
	Red y			0.36		-		
	Green x			0.37		-	FIG.2	Note 5
CIE (x,y)	Green y	θ=0°	Тур	0.58	Тур	-		
chromaticity	Blue x	©=0 Ta=25°C	-0.04	0.15	+0.04	-	CIE1931	
	Blue y	14-20 0		0.08		-		
	White x			0.32		-		
	White y			0.34		-		

# Note1. Definition of response time

The response time is defined as the LCD optical switching time interval between "White" state and "Black"state.Rise time (T<sub>ON</sub>) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T<sub>OFF</sub>) is the time between photo detector output intensity changed from 10% to 90%. For additional information see FIG1.

# Note2.Definition of contrast ratio

Contrast ratio(Cr) is defined mathematically by the following formula.

For more information see FIG.2.

Contrast ratio= Luminance measured when LCD on the "White" state Luminance measured when LCD on the "Black" state

# Measured at the center area of the LCD

Note3.Definition of surface luminance

Surface luminance is the luminance with all pixels displaying white.

For more information see FIG.2.

Lv = Average Surface Luminance with all white pixels(P1,P2,P3, .....,Pn)

# Note4.Definition of luminance uniformity

The luminance uniformity in surface luminance is determined by measuring luminance at each test position 1 through n, and then dividing the maximum luminance of n points luminance by minimum luminance of n points luminance.For more information see FIG.2.

 $Y_{u} = \frac{\text{Minimum surface luminance with all white pixels (P1,P2,P3,...)}{Minimum surface luminance with all white pixels (P1,P2,P3,...)}$ 

Maximum surface luminance with all white pixels (P1,P2,P3,....,Pn)

# Note5. Definition of color chromaticity (CIE1931)

CIE (x,y) chromaticity, The x,y value is determined by screen active area center position P5. For more information see FIG.2.

# Note6. Definition of viewing angle

Viewing angle is the angle at which the contrast ratio is greater than 10. angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG.3.

For viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope or DMS series Instruments or compatible. For contrast ratio, Surface Luminance, Luminance uniformity and CIE, the testing data is base on TOPCON's BM-7 photo detector or compatible.



# FIG.2. Measuring method for contrast ratio, surface luminance, luminance uniformity, CIE (x,y) chromaticity

Note : The TFT module should be stabilized at a given temperature for 10 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 10 minutes in a windless room.

H,V : Active area

Light spot size  $\emptyset$ =1.5mm (CS-2000/BM-7)50cm distance or compatible distance from the LCM surface to detector lens.

Test spot position : see Figure a.

measurement instrument : TOPCON's luminance meter CS-2000/BM-7 or compatible ,see Figure b.









# 8. INTERFACE DESCRIPTION

Interface No.	Name	I/O or connect to	Description
1	LEDK	Р	Power for LED backlight(Cathode)
2	LEDA	Р	Power for LED backlight(Anode)
3	CS	I	Ground
4	VDD	Р	Power for LCD
5-12	Red(0-7)	I	Red data
13-20	Green(0-7)	I	Green data
21-28	Blue(0-7)	Ι	Blue data
29	GND	Р	Ground
30	DOTCLK	Ι	Dot clock
31	DISP	Ι	Display on/off
32	HSYNC	I	Horizontal sync input.
33	VSYNC	-	Vertical sync input
34	DE	Ι	Data enable
35	SCL	I	SPI3 Serial O'clock input signal
36	SDA	I/O	SPI3 data input signal
37	XR/NC	/	1
38	YD/NC	/	1
39	XL/NC	/	/
40	YU/NC	/	/

I: input, O: output, P: Power,NC or / : No connection

# CTP interface description;

Interface No.	Name	I/O or connect to	Description
1	RESET		Reset low
2	VDD	Р	Power Supply of CTP
3	GND	Р	Ground
4	INT		State change interrupt
5	SCL	I	Serial interface clock
6	SDA	I/O	Serial interface date

I: input, O: output, P: Power,NC or / : No connection

# 9. AC CHARACTERISTICS TFT Module AC CHARACTERISTICS



R/W: Read/Write mode control bit. R/W=1: Read mode R/W=0: Write mode





- a. Each serial command consists of 16 bits of data which is loaded one bit a time at the rising edge of serial clock SCL.
- **b.** Command loading operation starts from the falling edge of CS and is completed at the next rising edge of CS.
- **c.** The serial control block is operational after power on reset, but commands are established by the VSYNC signal. If command is transferred multiple times for the same register, the last command before the VSYNC signal is valid.
- d. If less than 16 bits of SCL are input while CS is low, the transferred data is ignored.
- e. If 16 bits or more of SCL are input while CS is low, the previous 16 bits of transferred data before then rising edge of CS pulse are valid data.
- f. Serial block operates with the SCL clock
- g. Serial data can be accepted in the power save mode.
- h. After power on reset or GRB reset, it is required 100ms delay to begin SPI communication.

# **RGB** Interface



	DE Hold Time	Tdehd	12	-	-	ns		
Ρ	Parallel 24-bit RGB Input Timing (PVDD=VDD=VDDI= 3.3V, AGND= 0V, TA=25°C)							

Tdest

12

12

-

-

ns

Parallel 24-bit RGB Input Timing Table							
	Item	Symbol	Min.	Тур.	Max.	Unit	Note
DCLK Frequency		Fclk	5	6	8	MHz	
DCLK Period		Tclk	125	167	200	ns	
	Period Time	Th	325	371	438	DCLK	
	Display Period	Thdisp		320		DCLK	
HSYNC	Back Porch	Thbp	3	43	43	DCLK	SYNC mode back porch control by H_BLANKING[7:0] setting Thbp= H_BLANKING[7:0]
	Front Porch	Thfp	2	8	75	DCLK	
	Pulse Width	Thw	2	4	43	DCLK	
	Period Time	Τv	244	260	289	HSYNC	
	Display Period	Tvdisp		240		HSYNC	
VSYNC	Back Porch	Tvbp	2	12	12	HSYNC	SYNC mode back porch control by V_BLANKING[7:0] setting Tvbp= V_BLANKING[7:0]
	Front Porch	Tvfp	2	8	37	HSYNC	
	Pulse Width	Tvw	2	4	12	HSYNC	

Note: It is necessary to keep Tvbp =12 and Thbp =43 in sync mode. DE mode is unnecessary to keep it.

DE Setup Time

DE Hold Time

# SYNC Mode



# SYNC-DE Mode



# DE Mode



# **10. POWER SEQUENCE 10.1 TFT Module POWER SEQUENCE**

10.1.1 Power On Sequence

Systen	n Control				
VDD,V	DDI, PVDD	T0			
G	RB RESET				
	DISP	T1		•	
Di	splay Signal				
Back	Backlight Power				
Symbol		Description	Min. Time	Unit	
T0	System po	wer stability to GRB RESET signal	0	ms	
T1	GRB RESET= "High" to DISP="High" 10 ms				
T2	Display Signal output to Backlight Power on 250 ms				

Display Signal output to Backlight Power on T2

Note: Display signal: DCLK; VSYNC; HSYNC; DE; DR[7:0]; DG[7:0]; DB[7:0] 4

	System Control	
	VDD,VDDI, PVDD	
	GRB RESET	
	DISP	
	Display Signal	
	Backlight Power	
_	· · · · · · · · · · · · · · · · · · ·	

Symbol	Description	Min. Time	Unit
T0	Backlight Power off to DISP="Low"	5	ms
T1	DISP="Low" to IC internal voltage discharge complete	80	ms

Note: Display signal: DCLK; VSYNC; HSYNC; DE; DR[7:0]; DG[7:0]; DB[7:0]

# **11. RELIABILITY TEST CONDITIONS**

No.	Test item	Test condition		Inspection after test
11.1	High temperature storage test	+80°C/240 hours		
11.2	Low temperature storage test	-30°C/240 hours	-30°C/240 hours	
11.3	High temperature operating test	+70°C/120 hours	+70°C/120 hours	
11.4	Low temperature operating test	-20°C/120 hours		Inspection after
11.5	Temperature cycle storage test	-30°C ~ 25°C ~ +80°C/10cycles (30min.) (10min.) (30min.)		2~4hours storage at room temperature, the sample shall be free from defects : 1.Current changing value before test and after test is 50% larger; 2. Function defect : Non-display,abnormal-d isplay,missing lines, Short lines ITO
11.6	High temperature high humidity test	+50°C*90% RH/120 hours		
11.7	Vibration test	Frequency : 250 r/min Amplitude : 1 inch Time: 45min		
		Drop direction: 1 corner/3 edges/6 sides 10 times		
		Packing weight(kg)	Drop height(cm)	corrosion;
11.8	Drop test	<11	80±1.6	3.Visual defect : Air bubble in the LCD,Seal
		11≦G<21	60±1.2	leak,Glass crack.
		21≦G<31	50±1.0	
		31≦G<40	40±0.8	
11.9	ESD test	Air discharge: ±8KV, 10times Contact discharge: ±4KV, 10times		

Remark :

1. The test samples should be applied to only one test item.

2.Sample size for each test item is 3~5pcs.

3.For High temperature high humidity test, Pure water(Resistance>10MΩ) should be used.

4.In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

5.B/L evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence B/L has. 6.Failure judgment criterion: Basic specification, Electrical characteristic, Mechanical characteristic, Optical characteristic.

# **12. INSPECTION CRITERION**

Refer to 《Inspection Criterion for TFT Products-To customer》

# **13. HANDLING PRECAUTIONS**

# 13.1 Mounting method

The LCD module consists of two thin glass plates with polarizes which easily be damaged. And since the module in so constructed as to be fixed by utilizing fitting holes in the printed circuit board. Extreme care should be needed when handling the LCD modules.

13.2 Caution of LCD handling and cleaning

When cleaning the display surface, Use soft cloth with solvent

[recommended below] and wipe lightly :

- •.lsopropyl alcohol
- •.Ethyl alcohol

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface. Do not use the following solvent :

Water

Aromatics

Do not wipe ITO pad area with the dry or hard materials that will damage the ITO patterns

Do not use the following solvent on the pad or prevent it from being contaminated :

- Soldering flux
- •.Chlorine (Cl) , Sulfur (S)

If goods were sent without being silicon coated on the pad, ITO patterns could be damaged due to the corrosion as time goes on.

If ITO corrosion happen by miss-handling or using some materials such as Chlorine (CI), Sulfur (S) from customer, Responsibility is on customer.

# 13.3 Caution against static charge

The LCD module use C-MOS LSI drivers, so we recommended that you :

Connect any unused input terminal to Vdd or Vss, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

# 13.4 Packing

Module employ LCD elements and must be treated as such.

• Avoid intense shock and falls from a height.

•. To prevent modules from degradation, do not operate or store them exposed direct to sunshine or high temperature/humidity.

# 13.5 Caution for operation

•. It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit cause the shorter LCD life.

•. An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.

•.Response time will be extremely delayed at lower temperature then the operating temperature range and on the other hand at higher temperature LCD's how dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operation temperature.

•. If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.

•.A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

•.Usage under the maximum operating temperature, 50%Rh or less is required.

•.When fixed patterns are displayed for a long time, remnant image is likely to occur.

# 13.6 Storage

In the case of storing for a long period of time for instance, for years for the purpose or replacement use, the following ways are recommended.

•.Storing in an ambient temperature 10°C to 30°C, and in a relative humidity of 45% to 75%. Don't expose to sunlight or fluorescent light.

•.Storing in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it . And with no desiccant.

•.Placing in a dark place where neither exposure to direct sunlight nor light's keeping the storage temperature range.

•.Storing with no touch on polarizer surface by the anything else.

It is recommended to store them as they have been contained in the inner container at the time of delivery from us.

# 13.7 Safety

•. It is recommendable to crash damaged or unnecessary LCD's into pieces and wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.

•.When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.

# **14. PRECAUTION FOR USE**

**14.1** A limit sample should be provided by the both parties on an occasion when the both parties agreed its necessity. Judgment by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

**14.2** On the following occasions, the handing of problem should be decided through discussion and agreement between responsible of the both parties.

•.When a question is arisen in this specification.

•.When a new problem is arisen which is not specified in this specifications.

•.When an inspection specifications change or operating condition change in customer is reported to ODNA, and some problem is arisen in this specification due to the change.

•.When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.

# **15. PACKING SPECIFICATION**

Please consult our technical department for detail information.

# **16. HSF COMPLIANCE**

•.This products complies with ROHS 2011/65/EU and 2015/863/EU、REACH 1907/2006/EC requirements, and the packaging complies with 94-62-EC.

这个产品符合 ROHS 2011/65/EU 和 2015/863/EU、REACH 1907/2006/EC 要求,包材符合 94-62-EC 指令要求。