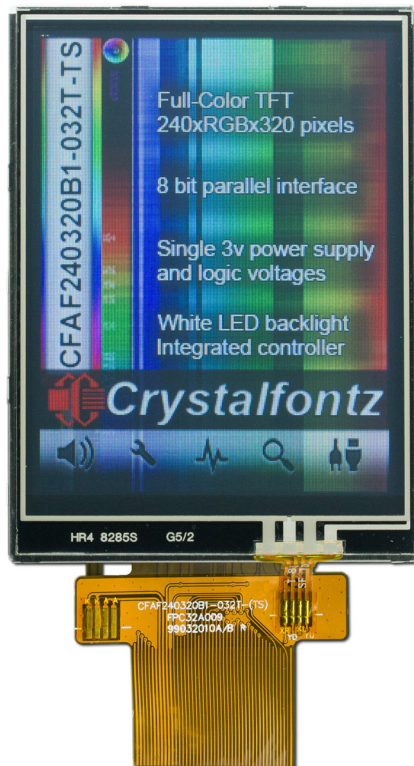




DISPLAY MODULE DATASHEET



Datasheet Release 2016-09-13
for
[CFAF240320B1-032T-TS](#)

Crystalfontz America, Incorporated

12412 East Saltese Avenue
Spokane Valley, WA 99216-0357

Phone: 888-206-9720

Fax: 509-892-1203

Email: support@crystalfontz.com

URL: www.crystalfontz.com



CONTENTS

GENERAL INFORMATION	3
DISPLAY DESCRIPTION	4
Additional Features	4
Display Module Outline Drawing	5
System Block Diagram	6
ELECTRICAL CHARACTERISTICS	7
OPTICAL CHARACTERISTICS	9
AC CHARACTERISTICS	12
INTERFACE PIN FUNCTION	15
DISPLAY MODULE RELIABILITY AND LONGEVITY	17
Reliability Test Results	17
Display Module Reliability	18
Display Module Longevity (EOL / Replacement Policy)	18



GENERAL INFORMATION

Datasheet Revision History

Datasheet Release: 2015-11-16 for the CFAF240320B1-032T-TS display module.
2016-09-13 Modified backlight information.

About Variations

We work continuously to improve our products. Because display technologies are quickly evolving, these products may have component or process changes. Slight variations (for example, contrast, color, or intensity) between lots are normal. If you need the highest consistency, whenever possible, order and arrange delivery for your production runs at one time so your displays will be from the same lot.

About Volatility

This display module has volatile memory.

The Fine Print

Certain applications using CrystalFontz America, Inc. products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications"). CRYSTALFONTZ AMERICA, INC. PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. Inclusion of CrystalFontz America, Inc. products in such applications is understood to be fully at the risk of the customer. In order to minimize risks associated with customer applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazard. Please contact us if you have any questions concerning potential risk applications.

CrystalFontz America, Inc. assumes no liability for applications assistance, customer product design, software performance, or infringements of patents or services described herein. Nor does CrystalFontz America, Inc. warrant or represent that any license, either express or implied, is granted under any patent right, copyright, or other intellectual property right of CrystalFontz America, Inc. covering or relating to any combination, machine, or process in which our products or services might be or are used.

All specifications in Datasheets and on our website are, to the best of our knowledge, accurate but not guaranteed. Corrections to specifications are made as any inaccuracies are discovered.

Company and product names mentioned in this publication are trademarks or registered trademarks of their respective owners.

Copyright © 2015 by CrystalFontz America, Inc., 12412 East Saltese Avenue, Spokane Valley, WA 99216-0357 U.S.A



DISPLAY 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 3.2" TFT-LCD contains 240x320 pixels, and can display up to 65K colors.

* Features

- Low Input Voltage: 3.3V(TYP)
- Display Colors of TFT LCD: 65K colors
- RGB Interface: 8BIT/16BIT MCU

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	48.60(H)*64.80(V) (3.2inch)	mm	-
Driver element	TFT active matrix	-	-
Display colors	65K	colors	-
Number of pixels	240(RGB)*320	dots	-
Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.2025(H)*0.2025(V)	mm	-
Viewing angle	12:00	o'clock	-
Controller IC	ST7789V	-	-
Display mode	Transmissive/ Normally White	-	-
Operating temperature	-20~+70	°C	-
Storage temperature	-30~+80	°C	-

* Mechanical Information

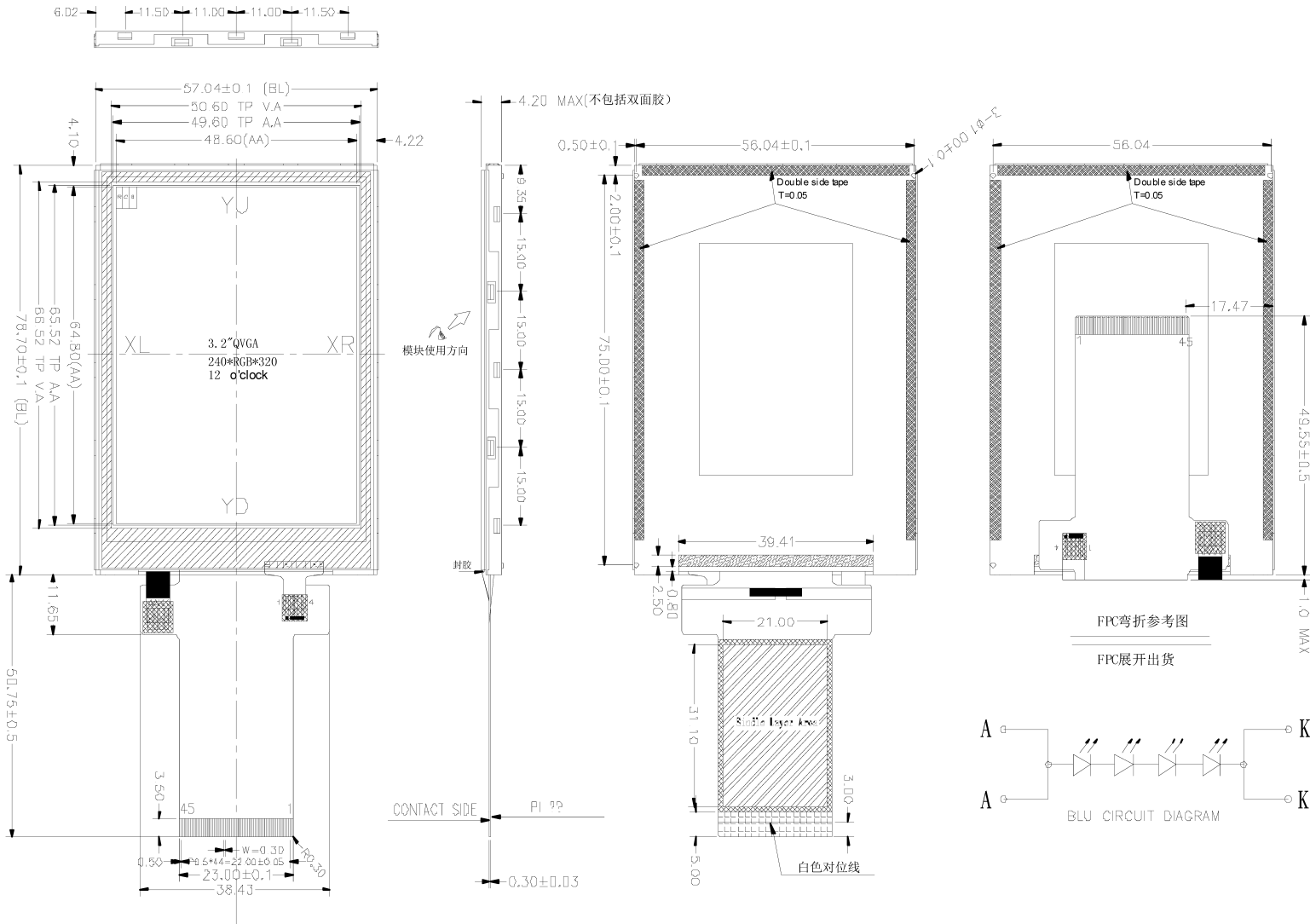
Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)		57.04		mm	-
	Vertical(V)		78.70		mm	-
	Depth(D)		4.20		mm	-
Weight			TBD		g	-

ADDITIONAL FEATURES

- Interface choices are 8-bit or 16-bit parallel. Sample code is available for download under the Datasheets & Files tab for this display.
- For additional information, see the [Sitronix ST7789V](#) controller datasheet on our website.
- This display is RoHS compliant. Crystalfontz America Incorporated is ISO 9001:2008 certified.



DISPLAY MODULE OUTLINE DRAWING



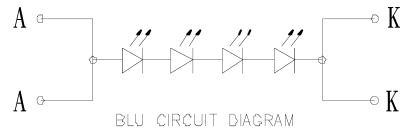
NOTES:

1. DISPLAY TYPE: 3.2", TFT-LCD, 65K/262K COLORS
2. DISPLAY MODE: T/N NORMALLY WHITE
3. VIEWING DIRECTION: 12:00
4. DRIVER IC: ST7789V(COG)
5. VCC: 3.3V(TYP)
6. OPERATING TEMP: -20°C TO 70°C
STORAGE TEMP: -30°C TO 80°C
7. BACK LIGHT: LED WHITE, 4 LED serial, 15-20mA, 12.8±0.2V
8. RoHS COMPLIANT.

Drawing deemed accurate, but not guaranteed.

Pin Description

Pin	Name
1	NC
2	IMD
3	NC
4	NC
5	RESET
6	NC
7	NC
8	NC
9	NC
10	DB17
11	DB16
12	DB15
13	DB14
14	DB13
15	DB12
16	DB11
17	DB10
18	DB9
19	DB8
20	DB7
21	DB6
22	DB5
23	DB4
24	DB3
25	DB2
26	DB1
27	DB0
28	RD
29	WR
30	RS
31	NC
32	NC
33	NC
34	CS
35	GND
36	VCC
37	LED-
38	LED+
39	GND
40	NC
41	X-(XR)
42	Y-(YD)
43	X+(XL)
44	Y+(YU)
45	NC

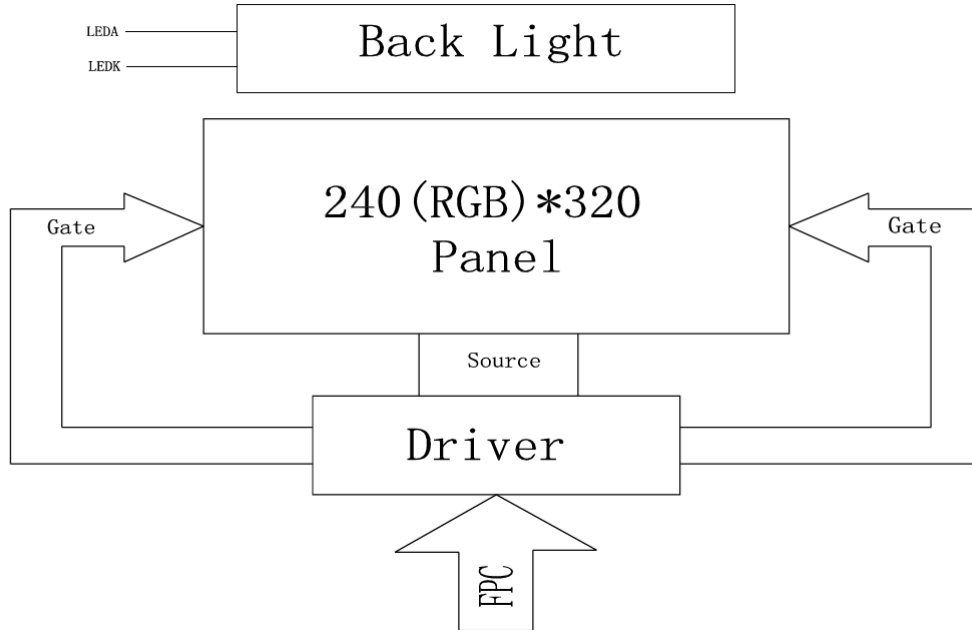


FPC弯折参考图

FPC展开出货



SYSTEM BLOCK DIAGRAM





ELECTRICAL CHARACTERISTICS

This display module uses an LED backlight. LED backlights are easy to use, but they are also easily damaged.

CAUTION

Ensure that you have proper current and voltage control for your backlight before connecting the backlight circuit.

These are stress ratings only. Functional operation of the display module at these or any other conditions beyond those listed under Recommended DC Characteristics below is not implied. Stresses beyond those listed above can cause permanent damage.

Prolonged exposure at temperatures outside of the operating range may cause permanent damage to the module.

ESD (ELECTRO-STATIC DISCHARGE)

The circuitry is industry standard CMOS logic and is susceptible to ESD damage. Please use industry standard anti-static precautions as you would for any other static sensitive devices such as expansion cards, motherboards, or integrated circuits. Ground your body, work surfaces, and equipment.



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

Characteristics	Symbol	Min.	Max.	Unit
Digital Supply Voltage	VDD	-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

5.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	VDD	2.4	3.3	4.2	V	
Digital interface supply Voltage	VDDIO	1.65	3.3	4.2	V	
Normal mode Current consumption	IDD	--	8	--	mA	
Level input voltage	V _{IH}	0.7V _{DDIO}		V _{DDIO}	V	
	V _{IL}	GND		0.3V _{DDIO}	V	
Level output voltage	V _{OH}	0.8V _{DDIO}		V _{DDIO}	V	
	V _{OL}	GND		0.2V _{DDIO}	V	

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		15	20	mA	
Forward Voltage	V _F	--	12.8 (Typ)	--	V	

CAUTION

Do not drive the LEDs at any current over their rated maximum of 20mA (15mA recommended for longer life). Be aware that the forward voltage of white LEDs can vary (LED to LED, batch to batch, and over time) by a significant amount. We recommend using a constant current LED power supply such as the AP3036, NCP5007, FAN5333, or similar to drive the LEDs. Do not use a constant voltage source to drive the LEDs.



OPTICAL CHARACTERISTICS

4.1 Optical specification

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Transmittance (without Polarizer)	T(%)	—	—	18.0	—	—	
Contrast Ratio	CR	$\theta=0$	400	500	—	—	(1)(2)
Response time	Rising	T_R	—	4	8	msec	(1)(3)
	Falling	T_F	—	12	24		
Color gamut	S(%)			60		%	
Color chromaticity (CIE1931)	White	W_x	0.283	0.303	0.323	(1)(4) CF glass (C-light)	
		W_y	0.305	0.325	0.345		
	Red	R_x	0.606	0.626	0.646		
		R_y	0.314	0.334	0.354		
	Green	G_x	0.257	0.277	0.297		
		G_y	0.529	0.549	0.569		
Blue	B_x	0.122	0.142	0.162			
	B_y	0.102	0.122	0.142			
Viewing angle	Hor.	θ_L	35	45	—	CR>10	
		θ_R	35	45	—		
	Ver.	θ_U	35	50	—		
		θ_D	10	20	—		
View Direction	12 O'clock						(5)

4.2 Measuring Condition

- Measuring surrounding: dark room

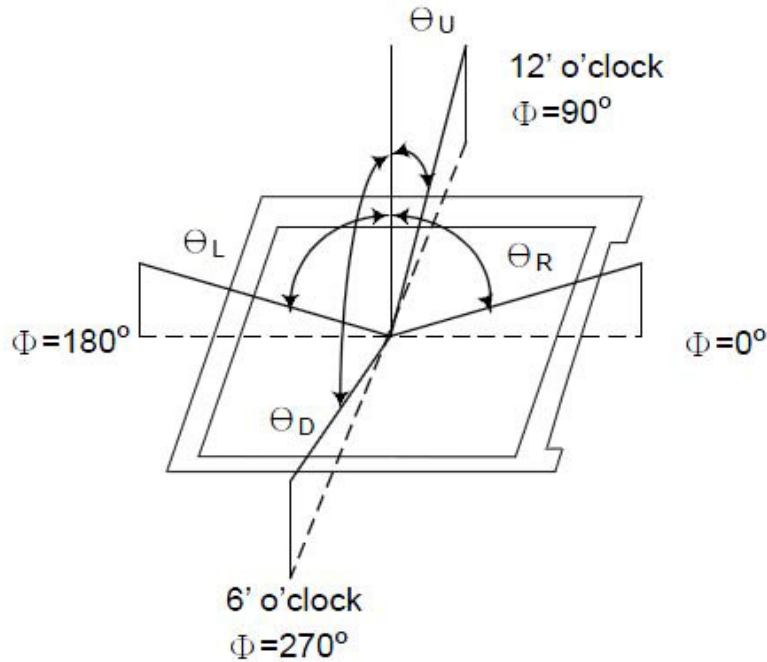


- Ambient temperature: $25\pm 2^{\circ}\text{C}$
- 15min. warm-up time.

4.3 Measuring Equipment

- 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 :

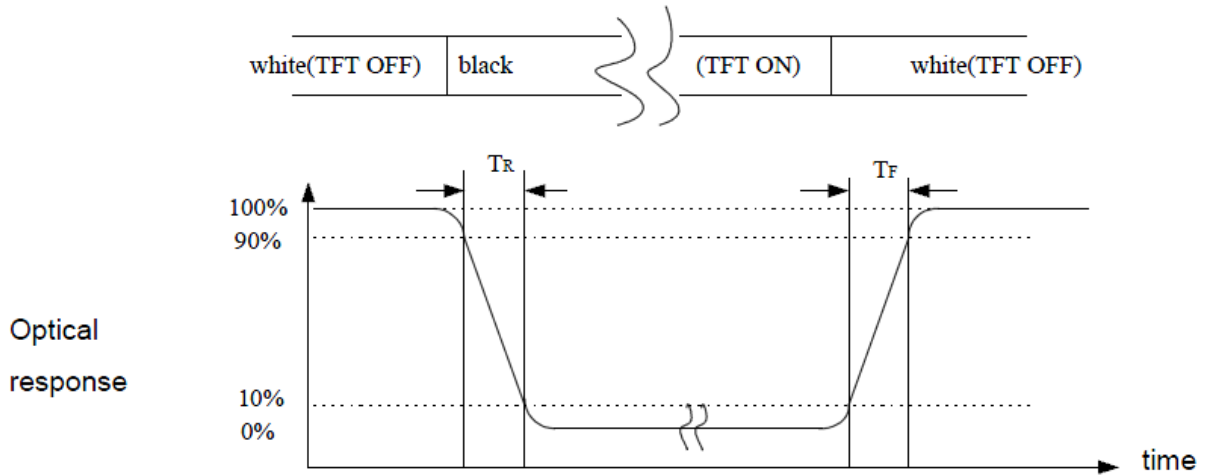


Note (2) Definition of Contrast Ratio(CR) :
measured at the center point of panel

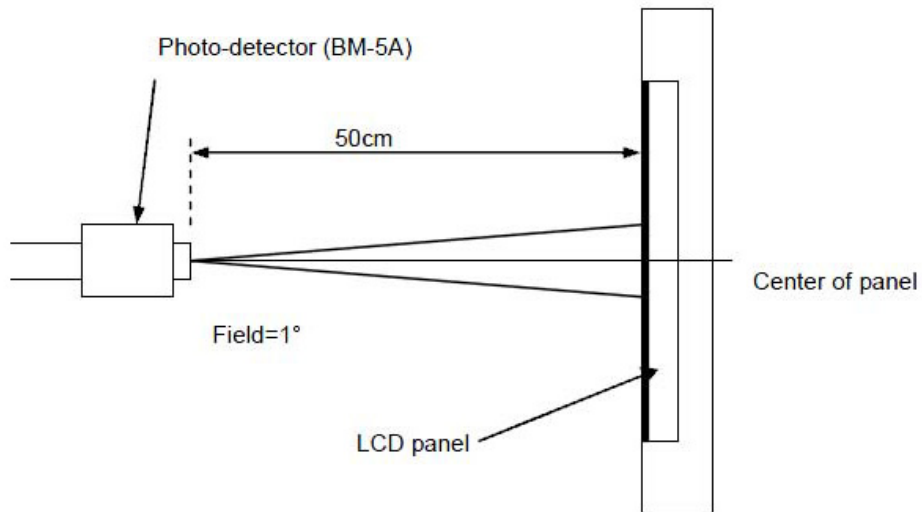
$$\text{CR} = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$



Note (3) Definition of Response Time : Sum of T_R and T_F



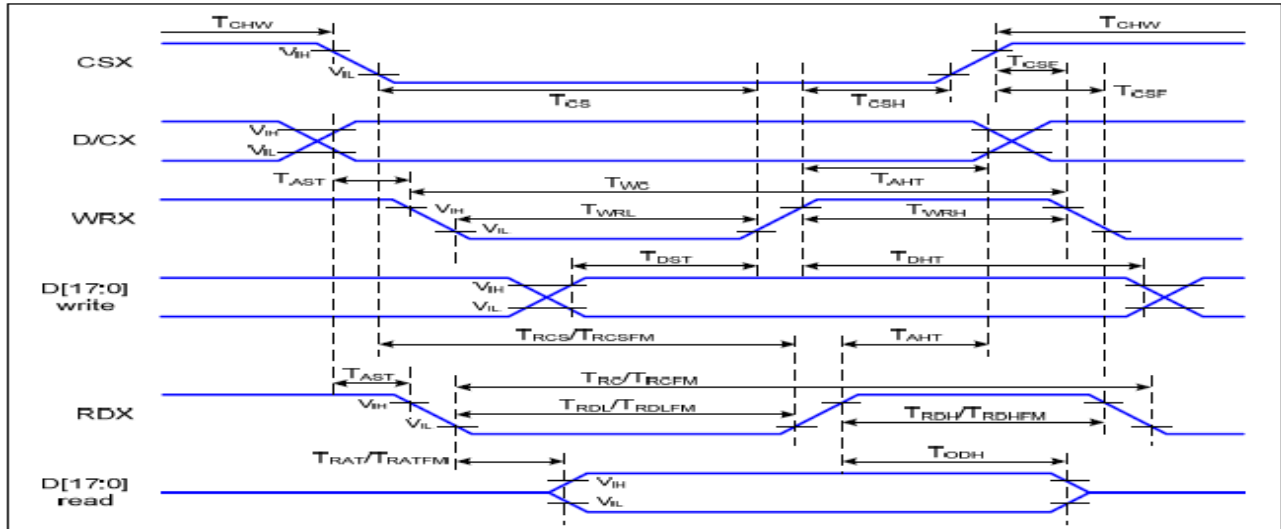
Note (4) Definition of optical measurement setup





AC CHARACTERISTICS

7.1. Display Parallel Interface Timing Characteristics :18/16/9/8-bit bus



Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	T_{AST}	Address setup time	0		ns	-
	T_{AHT}	Address hold time (Write/Read)	10		ns	
CSX	T_{CHW}	Chip select "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	
	T_{CSH}	Chip select hold time	10		ns	
WRX	T_{WC}	Write cycle	66		ns	-
	T_{WRH}	Control pulse "H" duration	15		ns	
	T_{WRL}	Control pulse "L" duration	15		ns	
RDX (ID)	T_{RC}	Read cycle (ID)	160		ns	When read ID data
	T_{RDH}	Control pulse "H" duration (ID)	90		ns	
	T_{RDL}	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	T_{RCFM}	Read cycle (FM)	450		ns	When read from frame memory
	T_{RDHFM}	Control pulse "H" duration (FM)	90		ns	
	T_{RDLFM}	Control pulse "L" duration (FM)	355		ns	
D[17:0]	T_{DST}	Data setup time	10		ns	For CL=30pF



T_{DHT}	Data hold time	10		ns
T_{RAT}	Read access time (ID)		40	ns
T_{RATFM}	Read access time (FM)		340	ns
T_{ODH}	Output disable time	20	80	ns

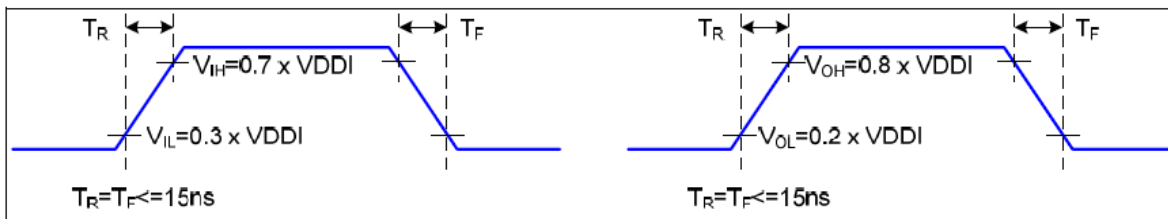


Figure 2 Rising and Falling Timing for I/O Signal

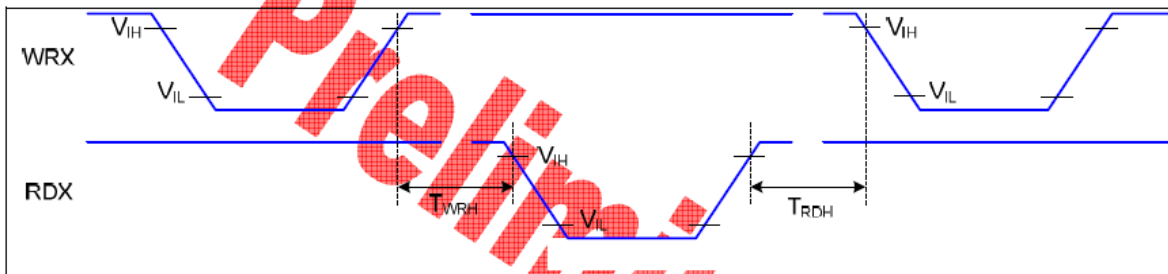


Figure 3 Write-to-Read and Read-to-Write Timing

Note: The rising time and falling time (T_r , T_f) of input signal and fall time are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

2 Reset Timing Characteristics

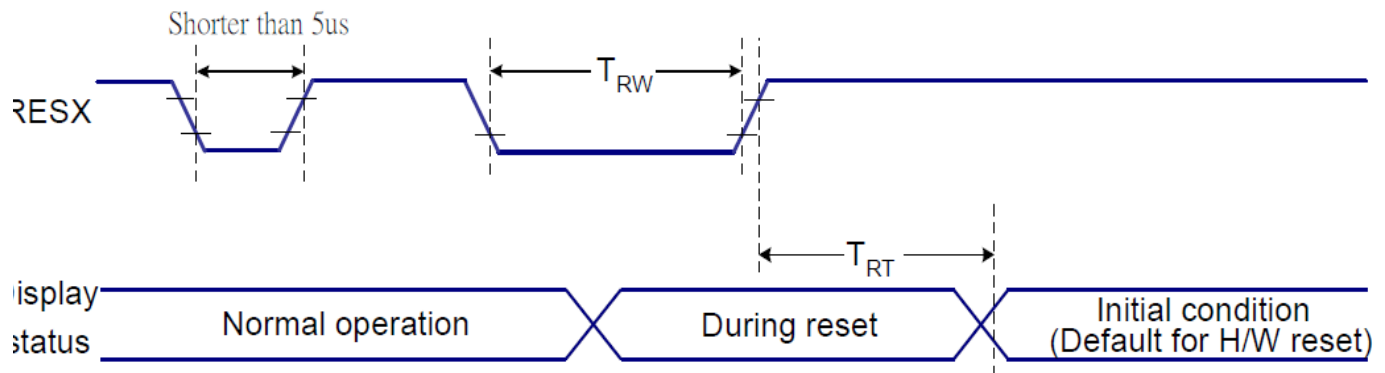


Figure 7 Reset Timing



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

Table 8 Reset Timing

Notes:

1. 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.
2. 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

3. 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.

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



INTERFACE PIN FUNCTION

NO.	SYMBOL	DISCRIPTION	I/O
1	NC	NC	
2	IM0	MPU Parallel interface bus and serial interface. H:8 Bit ,DB17-DB10 used. L:16 Bit,DB17-DB10.DB8-DB1used.	
3	NC	NC.	I
4	NC	NC	
5	RESET	Reset pin. Setting either pin low initializes the LSI. Must be reset after power is supplied.	I
6	NC	NC	
7	NC	NC	
8	NC	NC	
9	NC	NC	
10-27	DB17-DB0	16/18-bit parallel bi-directional data bus for MCU interface mode. Fix to GND level when not in use.	I/O
28	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
29	WR	Write strobe signal in DBI type B operation	I
30	RS	Display data/ command selection pin	I
31	NC	NC	
32	NC	NC	
33	NC	NC	
34	CS	Chip select input pin ("Low" enable). fix this pin at VCI or GND when not in use.	I
35	VSS	Ground.	P
36	VCC	Supply voltage(3.3V).	P
37	LED-	Cathode pin OF backlight	P
38	LED+	Anode pin of backlight	P
39	VSS	Ground.	P



40	NC	NC	
41	XR(NC)	Touch panel Right Glass Terminal	A/D
42	YD(NC)	Touch panel Bottom Film Terminal	A/D
43	XL(NC)	Touch panel LIFT Glass Terminal	A/D
44	YU(NC)	Touch panel Top Film Terminal	A/D
45	NC	NC	



DISPLAY MODULE RELIABILITY AND LONGEVITY

RELIABILITY TEST RESULTS

9.1 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	

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



DISPLAY MODULE RELIABILITY

PART NUMBER	SPECIFICATION
CFAF240320B1-032-TS	Brightness will be >50% of a new display module's initial brightness for at least 20,000 hours of operation when supply to each LED is below 20 mA.
<i>Under operating and storage temperature specification limitations, humidity non-condensing) RH up to 65%, and no exposure to direct sunlight. Value listed above is approximate and represents typical lifetime.</i>	

Note on display modules with white LEDs: We list the lifetime of white LEDs at 10,000 hours to emphasize that white LEDs do not have the extremely long lifetime typical of red, yellow-green, or blue LEDs. The white LEDs dim over time, especially if driven with high currents. The dimming may not be noticeable when a single display is installed. However, if a new display is installed next to a display that has been on continuously for a very long time, you will see the difference. To preserve the lifetime of white LEDs, we recommend that white LED backlights are dimmed or turned off when not needed. Also, please do not use more current than you need to achieve your brightness requirements.

DISPLAY MODULE LONGEVITY (EOL / REPLACEMENT POLICY)

CrystalFontz is committed to making all of our display modules available for as long as possible. Occasionally, a supplier discontinues a component, or a process used to make the module becomes obsolete, or the process moves to a more modern manufacturing line. In order to continue making the module, we will do our best to find an acceptable replacement part or process which will make the “replacement” fit, form, and function compatible with its predecessor.

We recognize that discontinuing a display module may cause problems for some customers. However, rapidly changing technologies, component availability, or low customer order levels may force us to discontinue (“End of Life”, EOL) a module. For example, we must occasionally discontinue a module when a supplier discontinues a component or a manufacturing process becomes obsolete. When we discontinue a module, we will do our best to find an acceptable replacement module with the same fit, form, and function.

In most situations, you will not notice a difference when comparing a “fit, form, and function” replacement display module to the discontinued module it replaces. However, sometimes a change in component or process for the replacement module results in a slight variation, perhaps an improvement, over the previous design.

Although the replacement display module is still within the stated datasheet specifications and tolerances of the discontinued module, changes may require modification to your circuit and/or firmware. Possible changes include:

- *LCD fluid, polarizers, or the LCD manufacturing process.* These items may change the appearance of the display, requiring an adjustment to V_O .
- *Backlight LEDs.* Brightness may be affected (perhaps the new LEDs have better efficiency) or the current they draw may change (new LEDs may have a different VF).
- *Controller.* A new controller may require minor changes in your code.
- *Component tolerances.* Display module components have manufacturing tolerances. In extreme cases, the tolerance stack can change the visual or operating characteristics.

Please understand that we avoid changing a display module whenever possible; we only discontinue a module if we have no other option. We publish Part Change Notices (PCN) as soon as possible.