EA EPA040-48A

INCL CONTROLLER FOR SPI and 3.3V

Dimension 56.2 x 96.6 mm plus FFC

FEATURES

- NON-VOLATILE DISPLAY / ZERO POWER
- 4“ WITH 480X800 DOTS
- COLORS BLACK, RED, WHITE
- 3-LINE SPI-INTERFACE: MOSI, CLK, CS
- 4-LINE SPI-INTERFACE: MOSI, CLK, CS, D/C
- OPERATING TEMP. RANGE (T_{OP} 0°C - +40°C)
- SINGLE SUPPLY 3.3V
- ZIFF CONNECTION

ORDERING CODE

4“ GRAPHIC E-PAPER 480x800, BLACK, WHITE, RED	**EA EPA040-48ABWR**

ACCESSORIES

• FPC CONNECTOR 24 PINS, 0.5mm, BOTTOM CONTACT	**EA WF050-24S**
• FPC CONNECTOR 24 PINS, 0.5mm, TOP CONTACT	**EA WF050-24T**
• PROGRAMMER BOARD FOR USB / PC-WIN	**EA 9782-2USB**

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CONTENT

1. GENERAL DESCRIPTION

· 3.97”(diagonal), 480 x 800 dots, Red/Black and White, E-paper module.
· Viewing Direction: ALL.
· Pure reflective mode
· White reflectance above 30%
· Contrast ratio above 8:1
· Ultra low power consumption
· Bi-stable display
· Waveform stored in On-chip OTP
· SPI interface.

2. MECHANICAL SPECIFICATIONS

The mechanical detail is shown on last page, summarized in table below.

Parameter	Specifications	Unit
Outline dimensions	56.2(W) x 96.6(H) x 0.9(D) (Exclude FPC)	mm
Display Active Area	51.84(W) x 86.4(H)	mm
Display format	480 x 800	dots
Color configuration	Red & Black & White	-
Dot size	0. 108 (W) x 0.108(H)	mm
Weight	TBD	grams

3. PIN DESCRIPTION

Pin	Symbol	I/O	Function
1	NC	-	No Connection.
2	GDR	O	N-Channel MOSFET Gate Drive Control.
3	RESE	I	Current Sense Input for the Control Loop.
4	NC	-	No Connection.
5	VDHR	C	Positive Source driving voltage 1.
6	TSCL	O	I2C Interface to digital temperature sensor Clock pin.
7	TSDA	I/O	I2C Interface to digital temperature sensor Data pin.
8	BS	I	Bus Interface selection pin. BS: L = 4-lines serial peripheral interface(SPI); H = 3- lines serial peripheral interface(SPI) - 9 bit SPI
9	BUSYN	O	Busy state output pin.
10	RSTN	I	Reset signal input. Active Low.
11	DC	I	Data /Command control pin (SPI)
12	CSB	I	Chip select signal (SPI)
13	SCL	I	Serial Clock pin (SPI).
14	SDA	I	Serial Data pin (SPI).
15	VDDIO	P	Voltage supply for interface logic pins.
16	VDD	P	Voltage supply.
17	VSS	P	Ground.
18	VDDD	C	Core logic power pin. VDDD can be regulated internally from VDD. A capacitor should be connected between VDDD and VSS.
19	VPP	P	Power Supply for OTP Programming.
20	VSH	P	Positive Source driving voltage 2.
21	VGH	C	Positive Gate driving voltage.
22	VSL	C	Negative Source driving voltage.
23	VGL	C	Negative Gate driving voltage.
24	VCOM	C	VCOM driving voltage.

Note

1. Recommended connector: EA WF050-24S or XF3M-2415-1B.

2. PIN Type:

P: Power supply; I: Input; O: Output; I/O = Bi-directional Pin (Input/Output); C: Capacitor Pin

4. ABSOLUTE MAXIMUM RATINGS

4.1 ELECTRICAL MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VDD	-0.3	4.0	V	1,2

Note

1. VDD, GND must be maintained.

2. The modules may be destroyed if they are used beyond the absolute maximum ratings.

4.2 ENVIRONMENTAL CONDITION

Item	Symbol	Rating	Remark
Operating temperature	Topr	0 to +40°C	Note 1
Storage temperature range	Tstg	-25 to +70°C	Note 2
Optimal Storage temperature range	Tstgo	23±2 °C	
Optimal Storage humidity	RHost	55%RH	

Note

1. We guarantee the single pixel display quality for 0-35℃, but we only guarantee the barcode readable for 35-40℃. Normal use is recommended to refresh every 24 hours.

2. Tttg is the transportation condition, the transport time is within 10 days for -25℃~0℃ or 40℃~60℃.

3. When the three-color product is stored. The display screen should be kept white and face up. In addition, please be sure to refresh the e-paper every three months. We suggest that the full black and full white picture could be added to clear the screen after the module is refreshed for long time, the display effect would be better.

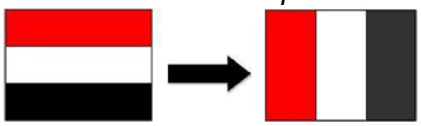
4. Product cannot sustain extreme storage conditions for long time.

5. ELECTRICAL SPECIFICATIONS

At Ta = 25 °C, VDD= 2.8V, GND=0V.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage	VDD-GND		2.2	3.0	3.7	V
Input signal voltage	VIH		0.8VDD	-	VDD	V
	VIL		GND	-	0.2VDD	V
Typical operating current	Iopr		-	18	30	mA
Peak Current	Ipeak			170	-	mA
Deep sleep current	Islp		-	2	-	uA
Image update time	-	25°C		18	-	sec

Note: The typical power/current is measured using associated 25℃ with following pattern transition: from horizontal scan pattern to vertical scan pattern.



6. OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
White Reflectivity	R	White	30	35	-	%	
Contrast Ratio	Cr	θ=0° Φ=0°	8:1	-	-	-	
2 Gray level	Gn		-	KS+(WS-KS)*n(m-1)	-	L*	
Black State L* value	KS		-	13	14		
Black State a* value			-	3	4		
White State L* value	WS		63	65	-		
Red State L* value	RS		25	28	-		
Red State a* value			36	40	-		
Image update duration	Panel			27		sec	
Refresh		While usage		once a day (suggested)			
Image Update		Storage and transportation		to white screen			

7. AC CHARACTERISTICS

7.1 MCU INTERFACE SELECTION

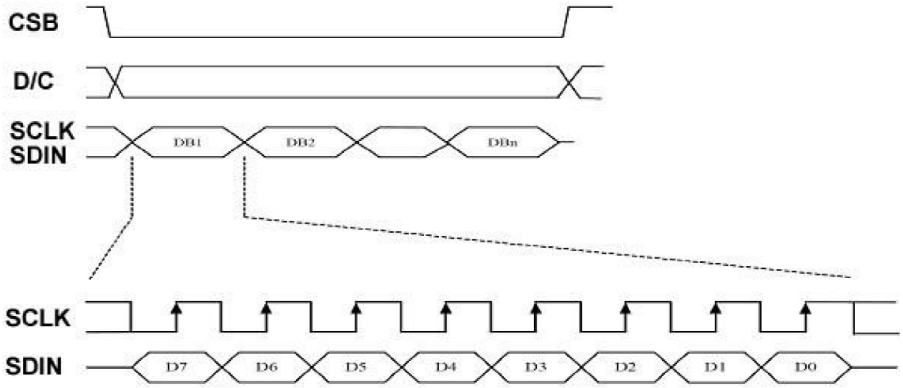
MCU interface consist of 2 data/command pins and 3 control pins. The pin assignment at different interface mode is summarized in Table 10-4-1. Different MCU mode can be set by hardware selection on BS pins. The display panel only supports 4-wire SPI or 3-wire SPI interface mode.

Pin Name	Data/Command Interface		Control Signal		
Bus interface	**SDA**	**SCL**	**CSB**	**D/C**	**RSTN**
4-wire SPI	SDIN	SCLK	CSB	D/C	RSTN
3-wire SPI	SDIN	SCLK	CSB	L	RSTN

7.2 MCU SERIAL INTERFACE (4-WIRE SPI)

The serial interface consists of serial clock SCLK, serial data SDIN, D/C, CSB. In 4-wire SPI mode, SCL acts as SCLK, SDA acts as SDIN.

SDIN is shifted into an 8-bit shift register on every rising edge of SCLK in the order of D7, D6, ... D0. D/C is sampled on every eighth clock and the data byte in the shift register is written to the Graphic Display Data (RAM) or command register in the same clock. Under serial mode, only write operations are allowed.



Function	CSB	D/C	SCLK
Write command	L	L	↑
Write data	L	H	↑

7.3 MCU SERIAL INTERFACE (3-WIRE SPI)

The 3-wire serial interface consists of serial clock SCLK, serial data SDIN and CSB. In 3-wire SPI mode, SCL acts as SCLK, SDA acts as SDIN. The operation is similar to 4-wire serial interface while D/C pin is not used. There are altogether 9-bits will be shifted into the shift register on every ninth clock in sequence: D/C bit, D7 to D0 bit. The D/C bit (first bit of the sequential data) will determine the following data byte in the shift register is written to the Display Data RAM (D/Cbit = 1) or the command register (D/C bit = 0). Under serial mode, only write operations are allowed.

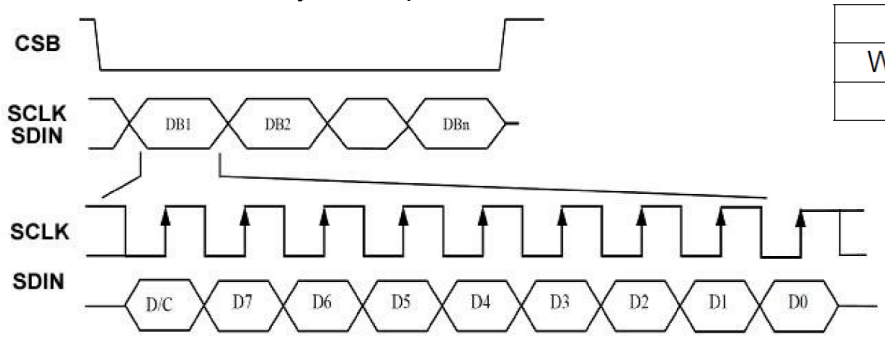
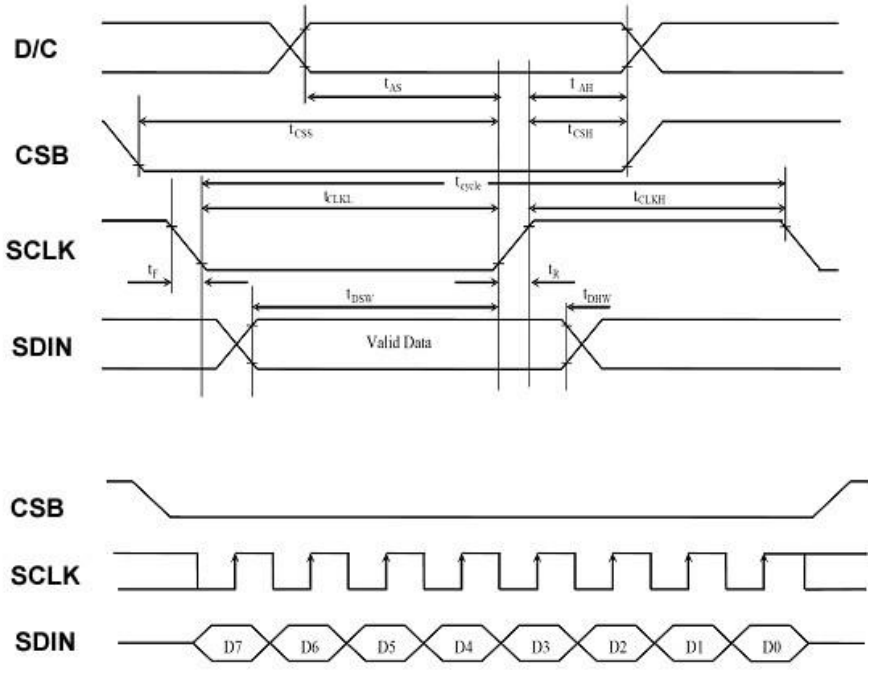


Figure 10-4-3: Write procedure in 3-wire SPI mode

Function	CSB	D/C	SCLK
Write command	L	Tie	↑
Write data	L	Tie	↑

7.4 INTERFACE TIMING

Symbol	Parameter	Min.	Typ.	Max.	Unit
t_{cycle}	Clock Cycle Time	250	-	-	ns
t_{AS}	Address Setup Time	150	-	-	ns
t_{AH}	Address Hold Time	150	-	-	ns
t_{CSS}	Chip Select Setup Time	120	-	-	ns
t_{CSH}	Chip Select Hold Time	60	-	-	ns
t_{DSW}	Write Data Setup Time	50	-	-	ns
t_{DHW}	Write Data Hold Time	15	-	-	ns
t_{CLKL}	Clock Low Time	100	-	-	ns
t_{CLKH}	Clock High Time	100	-	-	ns
t_R	Rise Time [20% ~ 80%]	-	-	15	ns
t_F	Fall Time [20% ~80%]	-	-	15	ns



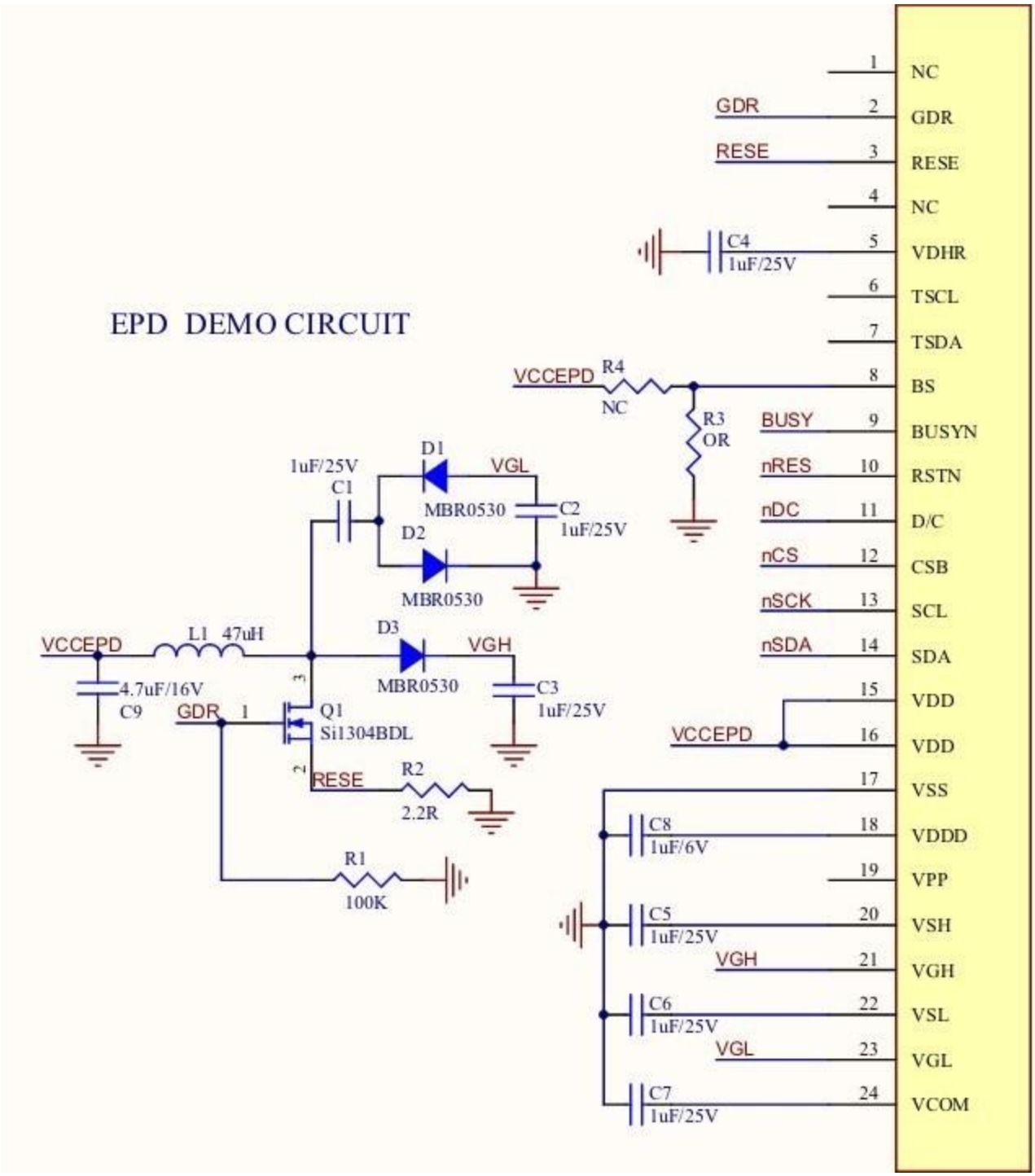
8. RELIABILITY TEST

Test Item	Test condition	Remark
High Temperature Storage	Ta = 70°C, RH=40%, 240 hrs	IEC 60 068-2-2Bp
Low Temperature Storage	Ta = -25°C, 240 hrs, in white pattern	IEC 60 068-2-1Ab
High Temperature Operation	Ts = 40°C, RH=35%, 240 hrs	IEC 60 068-2-2Bp
Low Temperature Operation	Ta = 0°C, 240 hrs	IEC 60 068-2-2Ab
High Temperature/Humidity Storage	+40°C, 80%RH, 240 hrs	IEC 60 068-2-3CA
High Temperature/Humidity Operation	+50°C, 80%RH, 240 hrs	
Thermal Shock	-25°C /30 min ~ +70°C /30 min for a total 10 cycles, Start with cold temperature and end with high temperature.	IEC 60 068-2-14
Package Vibration Test	Random Vibration : 1.04G, from 10 t0 500Hz, 1 hours for each direction of X. Y. Z.	Full packed for shipment
Package Drop Test	Height: 60cm 1 corner, 3 edges, 6 surfaces	Full packed for shipment
Electro Static Discharge	Air ±4kV; Contact ±2kV	IEC 62179, IEC 62180

9. SUGGESTIONS FOR USING E-PAPER MODULES

9.1. The E-paper Panel / Module is manufactured from fragile materials such as glass and plastic, and may be broken or cracked if dropped. Please handle with care. Do not apply force such as bending or twisting to the E-paper panel.
9.2. The display module should not be exposed to harmful gases, such as acid and alkali gases, which corrode electronic components.
9.3. Do not apply pressure to the E-paper panel in order to prevent damaging it.
9.4. Do not connect or disconnect the interface connector while the E-paper panel is in operation.
9.5. Refresh display content once a day typically to achieve best contrast and clear colors.
9.6. Do not stack the E-paper panels / Modules.
9.7. Keep the E-paper Panel / Module in the specified environment and original packing boxes when storage in order to avoid scratching and keep original performance.
9.8. Do not disassemble or reassemble the E-paper panel.
9.9. Use a soft dry cloth without chemicals for cleaning. Please don’t press hard for cleaning because the surface of the protection sheet film is very soft and without hard coating. This behavior would make dent or scratch on protection sheet.
9.10. Please be mindful of moisture to avoid its penetration into the E-paper panel, which may cause damage during operation.
9.11. It’s limited temperature operation product. Please be mindful the temperature different to make frost or dew on the surface of E-paper panel. Moisture may penetrate into the E-paper panel because of frostor dew on surface of E-paper panel, and makes E-paper panel damage.
9.12. High temperature, high humidity, sunlight or fluorescent light may degrade the E-paper panel’s performance. Please do not expose the unprotected E-paper panel to high temperature, high humidity, sunlight, or fluorescent for long periods of time. Please store the E-paper panel in controllable environment of warehouse and original package; means without sunlight, without condensation and within temperature range of 15ºC to 35ºC and humidity from 30%RH to 60%RH.

10. TYPICAL APPLICATION CIRCUIT WITH 4-LINE SPI INTERFACE



11. CONTOUR DRAWING