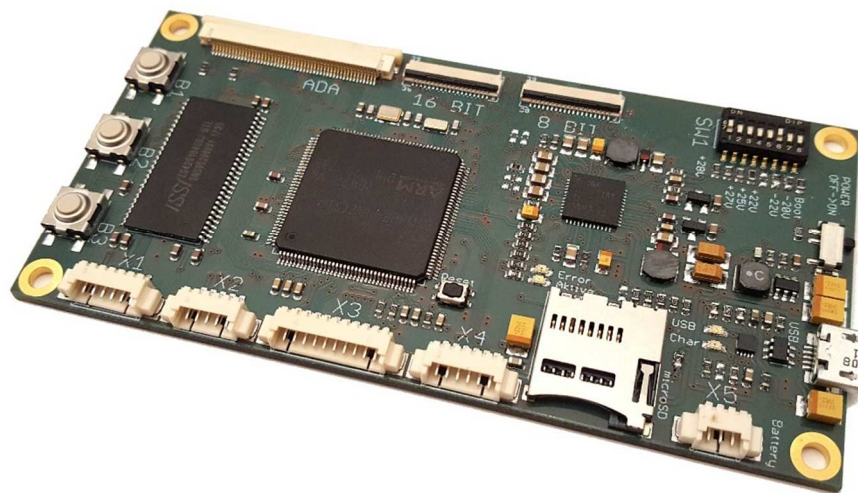


Preliminary Specification



EPD Driver Board

February 2018

Revision History

Rev.	Date	Chapter	Description	by
1.0	20.02.2018	All	First draft	Ryb
1.1	16.03.2018	4.4	Description of the new function	Ryb
1.2	18.04.2018	6.2	Extension	Ryb
1.4	01.05.2018	7	Serial numbers	Ryb
1.5	28.06.2018	6.1	SPI1 Connector X1 pin out	Ryb
1.6	10.08.2018	6.2	Height of the board	Ryb

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1. General description

The Electronic Paper Display (EPD) Driver Board is an advanced controller board to manage EPD displays. It is developed as an easy solution to drive the standard EPD displays. The board supports multiply display choice. Display content can be transferred over USB or presented from the SD memory card. The EPD Driver Board can be driven from battery. The EPD Driver Board's functionality can be extended by customized assembly or firmware configuration.

2. General features

- Supports driving EPD Panels with resolution up to 2200x1650 pixels, 16 colors grey scale and 8-/16-bit interface
- Direct driving of EPD by onboard microcontroller without extra graphic or timing controller
- Integrated temperature sensor
- MicroUSB Interface for connecting to PC for data communication
- On board microSD slot
- Open command interface for driving different EPD panels
- Stand alone functionality from battery 3.7V or USB 5V
- Mechanical dimensions 100mm x 50mm x 7mm with one side assembly
- RoHS compliant

3. System configuration

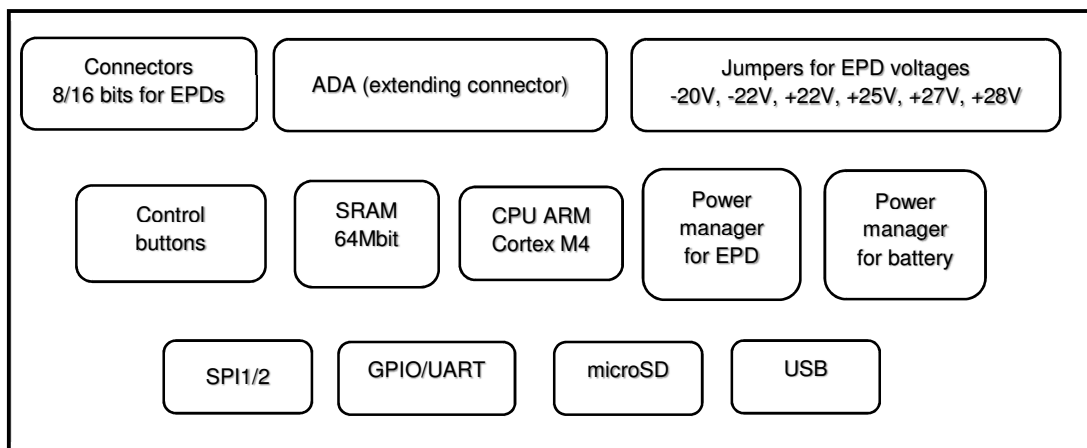


Figure 1: Block diagram of EPD-Driver

Power manager

Power manager is not integrated in the default assembly. Battery charging can be realized over USB. To start charging the battery and USB cable must be connected simultaneously. Charging starts automatically and does not influence the board functions.

Approximate charging time for the battery with capacity 300mAh is 3 hours.

Light indication

There are two LEDs indicating the state of the communication with display and flash memory.

LED No.	Color mode	Description
LED Aktive	Green blinking slow	Board is active
	Green blinking quickly	Data is streaming
LED Error	Red on	No flash memory
	Red blinking	Config-file error

Light indication for battery power mode

If the battery manager is used (depended on the assembly version) two LEDs show the USB connection and battery state.

LED No.	Color mode	Description
LED USB	Green constant	USB is connected
LED Charging	Red on	Battery charging
	Red off	Battery is fully charged

4.2. Operation of the EPD-Driver

To start working with the board please follow the next procedure:

1. Put flash memory
2. Connect display to the wished EPD connector
3. Connect battery to the connector X5 or connect USB cable to power source
4. Set power switch in the position "ON"
5. Control that LED Display is lightning green and blinking slowly
6. Choose the wished function by means of buttons
7. Set power switch in the position "OFF" after end of work

For battery charge connect battery and USB cable. LED Battery is lightning red. After full charge, the red LED will be off.

4.3. Image update on the SD memory card

The graphic files have to be configured according to the using panel and requirements of the EPD driver. The EPD driver supports BMP-files as 24 bits true color image. The resolution of the picture must not exceed the resolution of the EPD. The smaller images will be centered and displayed in the native resolution without scaling.

Names of the files do not have to be longer as 11 signs, e.g. "004Plan.bmp". The number of the files is limited by 65563 and the volume of the using SD memory.

The image files are to save as separate files in the main folder on the memory card.

4.4. Adjust of config.ini file

The file of configuration allows to set the board's output parameters according to the driving EPD display. The config.ini file is placed in the main folder of SD card. If there is no any config.ini file or any mistake takes place the board shows an error by LED Error lightning.

There are several main settings, which can be critical for the panel usage. The example below describes the configuration for ES133TT3. The comments (#) explain the command lines.

```
# Config File v0.2
# Information file for EPD-Display

# Hardware version 3.0
HARDWARE_VR=30

# Software version 1.1
SOFTWARE_VR=11

#Display Size in inch
SCREEN_SIZE=13.3

#Display Resolution in Pixel -> see the datasheet of the EPD panel
DISPLAY_RES_X=1600
DISPLAY_RES_Y=1200

#Grayscale parameters: ON – 16 grades, OFF – 2 grades(black/white)
GRAYSCALE=ON
#Display data transfer bus -> see the datasheet of the EPD panel
BITS_NR=8
```

#VCOM in Millivolt -> see the label on the connected EPD panel
example on the picture below
VCOM=-1930

#Contrast -> varies from 0 up to 100%
CONTRAST=50

#Timer settings -> slideshow timer can be set ON or OFF
TIMER=OFF
#Time in Millisecond -> time till the picture update
TIME=60000

#END of file

4.5. Jumpers for gate voltage setup

Following the specification of an EPD use an assembled DIP switch to set up the requested EPD gate supply voltages.

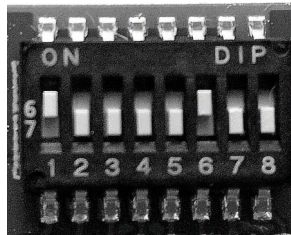


Figure 3: SW1 Jumpers for gate voltage setup

The supported values for the gate supply voltage of EPDs are shown in the table below.

Jumper	Function
1	+28V
2	+27V
3	+25V
4	+22V
5	customized value (optional)
6	-20V
7	-22V
8	Boot

4.6. Firmware update

The firmware of the EPD Driver can be easily updated via USB. There is the recommended flash procedure to follow.

1. Set the switch 8 on the SW1 (see figure 3) in the position "ON"
2. Connect USB cable from host to the board
3. Turn the power on
4. By means of provided software choose a new bin-file to flash and start an update process (please follow the software instructions)
5. After successful update turn the board off
6. Set the switch 8 on the SW1 (see figure 3) in the position "OFF"
7. Restart the board.

5. Electrical characteristics

5.1. Absolute maximum ratings

Parameter	Symbol	Value	Unit
Supply Voltage Range	V_{DD}	-0.3V~4.0V	V
Input Voltage Range	V_{IN}	-0.3 to $V_{DD}+0.3$	V
Operational Temperature Range	T_{OPR}	-10 to +60	°C
Storage Temperature	T_{ST}	-40 to +80	°C

5.2. DC characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage Range	V_{DD}				
USB		4.75	5.0	5.25	V
Battery		3.2	-	3.7	V
Power consumption					
Active mode					mA
Sleep mode					mA
Deep mode					uA
Negative power supply source	V_{NEG}		-15		V
Positive power supply source	V_{POS}		15		V
Negative power supply gate	V_{EE}	-22	-	-20	V
Positive power supply gate	V_{GG}	22	-	28	V
Common connection	V_{COM}	-5.11		0	V

6. Mechanical characteristics

6.1. Connectors pin assignment

Connector	Housing	Mating Part	Function
X1	53261-06 (Molex)	51021-0600 (Molex)	SPI1
X2	53261-05 (Molex)	51021-0500 (Molex)	Debug
X3	53261-10 (Molex)	51021-1000 (Molex)	Serial interface & GPIO
X4	53261-06 (Molex)	51021-0600 (Molex)	SPI2
X5	53261-03 (Molex)	51021-0300 (Molex)	Battery
ADA	5-1734592-0	FFC/FPC,50pins,0.5mm	Extending adapter board
8 BIT	FH39-39S-0.3SHW	39 pins, 0.3 mm.	8 Bits EPDs
16 BIT	FH39-39S-0.3SHW	39 pins, 0.3 mm.	16 Bits EPDs
MicroUSB	47346-0001 (Molex)	Micro USB	Charging, Datatransfer
MicroSD	MEM2051-00-195-00	Micro SD card	Micro SD card

SPI1 Connector X1

Type: 53261-06 (Molex)

Mating Type: 51021-0600 (Molex)

Pin No.	Symbol	Description	Note
1	VCC	3.3V DC	
2	SPI1_CS		
3	SPI1_SCK		
4	SPI1_MISO		
5	SPI1_MOSI		
6	GND	GND	

UART/GPIO Connector X3

Type: 53261-10 (Molex)

Mating Type: 51021-1000 (Molex)

Pin No.	Symbol	Description	Note
1	VCC	3.3V DC	
2	GPIO_1		
3	GPIO_2		
4	EN_BOARD	EPD-Board enable	
5	USART3_TX		
6	USART3_RX		
7	USART3_CK		
8	USART3_CTS		
9	USART3_RTS		
10	GND	GND	

SPI2 Connector X4

Type: 53261-06 (Molex)

Mating Type: 51021-0600 (Molex)

Pin No.	Symbol	Description	Note
1	GND	GND	
2	SPI2_MOSI		
3	SPI2_MISO		
4	SPI2_SCK		
5	SPI2_CS		
6	VCC	3.3V DC	

Battery Connector X5

Type: 53261-0371 (Molex)

Mating Type: 51021-0300 (Molex)

Pin No.	Symbol	Description	Note
1	Vin	3.3V DC	
2	TS		
3	GND	GND	

MicroUSB Connector

Type: 47346-0001 (Molex)

Mating Type: MicroUSB

Pin No.	Symbol	Description	Note
1	VBUS	5V DC	
2	USB_DM		
3	USB_DP		
4	USB_ID		
5	GND	GND	

MicroSD Slot

Type: 49225-0821 (Molex)

Pin No.	Symbol	Description	Note
1	SD_D2		
2	SD_D3		
3	SD_CMD		
4	VCC	3.3V DC	
5	SD_CLK		
6	GND	GND	
7	SD_D0		
8	SD_D1		
9	SD_CD	GND	

EPD Connector 8 bit

Type: FH39-39S-0.3SHW

Pin No.	Symbol	Description	Note
1	VNEG	Negative power supply source driver	-15V
2	VPOS	Positive power supply source driver	+15V
3	VSS	VSS Ground	GND
4	VDD	Digital power supply drivers	
5	XCL	Clock source driver	
6	XLE	Latch enable source driver	
7	XOE	Output enable source driver	
8	VSS	VSS Ground	SHR
9	VSS	VSS Ground	CE1
10	VDD	Digital power supply drivers	CE2
11	STL	Start pulse source driver	SPH
12	D0	Data signal source driver	
13	D1	Data signal source driver	
14	D2	Data signal source driver	
15	D3	Data signal source driver	
16	D4	Data signal source driver	
17	D5	Data signal source driver	
18	D6	Data signal source driver	
19	D7	Data signal source driver	
20	GND	Ground	GND
21	NC	No connection	
22	VCOM	Common connection	
23	VGG	Positive power supply gate driver	
24	VEE	Negative power supply gate driver	
25	NC	No connection	
26	NC	No connection	
27	MODE1	Output mode selection gate driver	MODE2*
28	MODE1	Output mode selection gate driver	MODE1*
29	VSS	VSS Ground	RL*
30	VSS	VSS Ground	
31	VSS	VSS Ground	
32	STV	Start pulse gate driver	SPV
33	CKV	Clock gate driver	CKV
34	BORDER	Border connection	
35	VSS	VSS Ground	UCE*
36	VSS	VSS Ground	UCE*
37	VSS	VSS Ground	NC*
38	VSS	VSS Ground	NC*
39	NC	No connection	

EPD Connector 16 bit

Type: FH39-39S-0.3SHW

Pin No.	Symbol	Description	Note
1	VNEG	Negative power supply source driver	-15V
2	VPOS	Positive power supply source driver	+15V
3	VCOM	Common connection	
4	VSS	VSS Ground	
5	VSS	VSS Ground	
6	CKH	Clock source driver	
7	VSS	VSS Ground	
8	LEH	Latch enable source driver	
9	OEH	Output enable source driver	
10	STH	Start pulse source driver	
11	VSS	VSS Ground	
12	D0	Data signal source driver	
13	D1	Data signal source driver	
14	D2	Data signal source driver	
15	D3	Data signal source driver	
16	D4	Data signal source driver	
17	D5	Data signal source driver	
18	D6	Data signal source driver	
19	D7	Data signal source driver	
20	VSS	VSS Ground	
21	D8	Data signal source driver	
22	D9	Data signal source driver	
23	D10	Data signal source driver	
24	D11	Data signal source driver	
25	D12	Data signal source driver	
26	D13	Data signal source driver	
27	D14	Data signal source driver	
28	D15	Data signal source driver	
29	VSS	VSS Ground	
30	MODE1	Output mode selection gate driver	
31	STV	Start pulse gate driver	
32	CKV	Clock gate driver	
33	BORDER	Border connection	
34	VSS	VSS Ground	
35	VDD	Digital power supply drivers	
36	VSS	VSS Ground	
37	VSS	VSS Ground	
38	VEE	Negative power supply gate driver	
39	VGG	Positive power supply gate driver	

Adapter Connector

Type: FFC/FPC-50pins, 0.5mm / 5-1734592-0

Pin No.	Symbol	Description	Note
1	VNEG	Negative power supply gate driver	
2	NC	NO Connection	
3	VGH	Positive power supply gate driver	
4	Mode2	Output mode selection gate driver	
5	VDD	Digital power supply drivers	
6	Mode1	Output mode selection gate driver	
7	CKV	Clock gate driver	
8	STV	Start pulse gate driver	
9	VSS	Ground	
10	VCOM_TFT	Common voltage	
11	VDD	Digital power supply drivers	
12	VSS	Ground	
13	XCL	Clock source driver	
14	D0	Data signal source driver	
15	D1	Data signal source driver	
16	D2	Data signal source driver	
17	D3	Data signal source driver	
18	D4	Data signal source driver	
19	D5	Data signal source driver	
20	D6	Data signal source driver	
21	D7	Data signal source driver	
22	VSS	Ground	NC*
23	D8	Data signal source driver	
24	D9	Data signal source driver	NC*
25	D10	Data signal source driver	
26	D11	Data signal source driver	
27	D12	Data signal source driver	
28	D13	Data signal source driver	
29	D14	Data signal source driver	
30	D15	Data signal source driver	
31	XSTL	Start pulse source driver	
32	XLE	Latch enable source driver	
33	XOE	Output enable source driver	
34	ISEL	Input data bus width (8 bit or 16 bit)	
35	NC	NO Connection	
36	VPOS	Positive power supply source driver	
37	NC	NO Connection	
38	VNEG	Negative power supply source driver	

Pin No.	Symbol	Description	Note
39	VCOM_FPL	Common Voltage	
40	NC	NO Connection	
41	STV2	Start pulse gate driver 2	
42	G640	Detect IC function	
43	S400	Detect IC function	
44	S320	Detect IC function	
45	NC	NO Connection	
46	G640	Detect IC function	
47	S400/S320	Detect IC function	
48	S320/S400	Detect IC function	
49	G640	Detect IC function	
50	STL2	Data shift start pulse 2	

Button B1

Function “Up” or “Previous picture”.

Button B2

Function “Clear screen”.

Button B3

Function “Down” or “Next picture”.

Button “Reset”

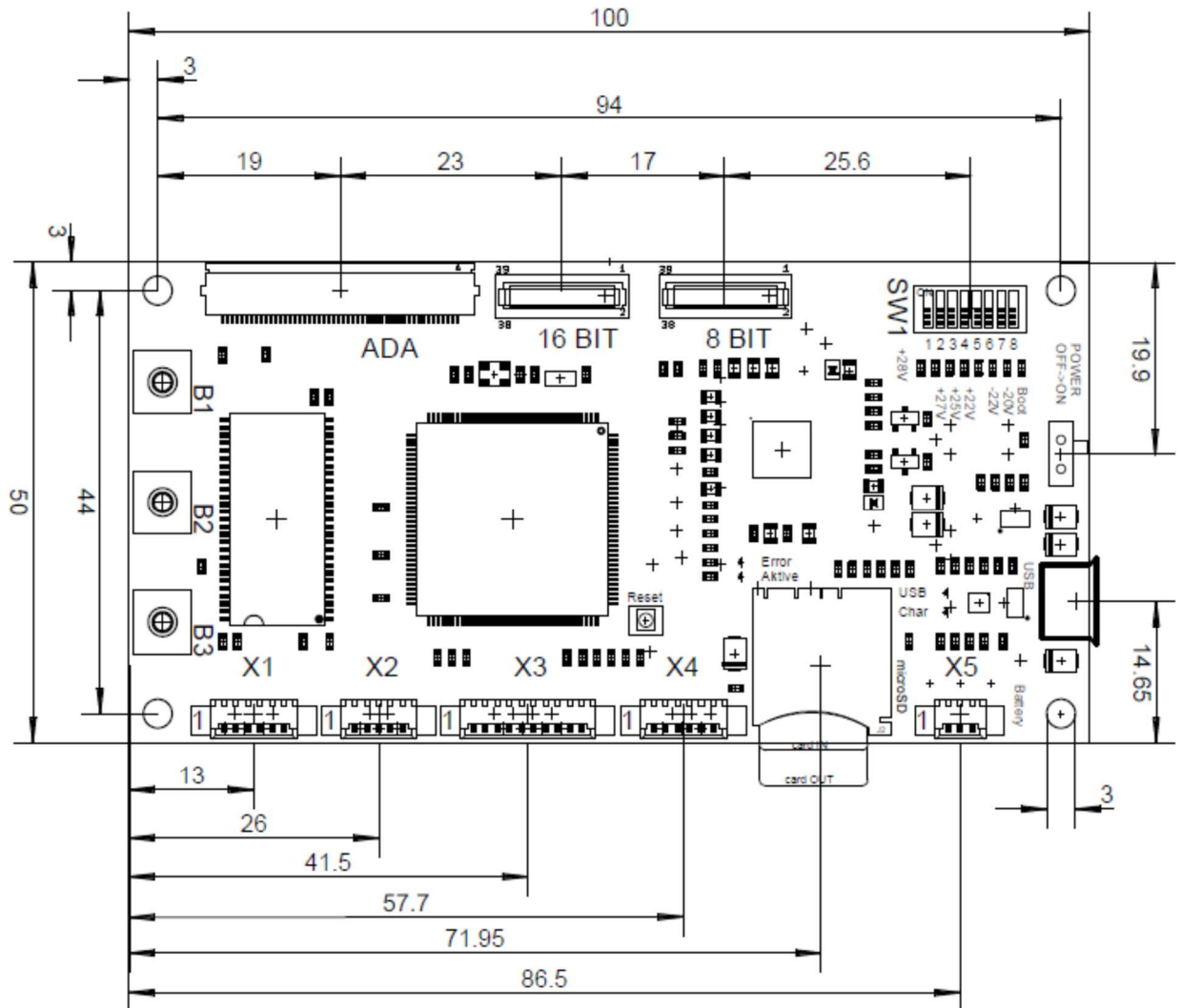
Function of the manual reset for the microcontroller of the board.

Switch “Power”

Power switch for the microcontroller and whole periphery of the board. Battery and USB VCC are not included in the circuit, managed by the switch, and work undependable.

6.2 Physical dimensions

Outline parameters: 100mm (L) x 50mm (W) x 7.0mm (H)



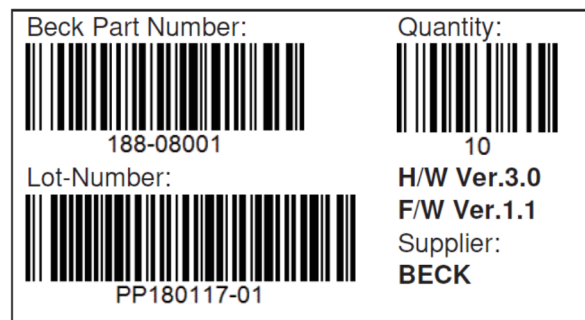
Note that all dimensions are in mm.

7. Serial numbers

Each EPD Driver board is labeled and has its unique serial number on. The label contains the following information:

- Beck article number
- Board serial number
- Lot's quantity
- Firmware version
- Supplier Beck

An example of the label is shown on the picture below:



Serial number looks in general in following way:

"PP180423-XX"

PP - Acronym for the SMT producer;
180423 - Manufactured on year/month/date (e.g. 2018/04/23);
XX - Manufacturing sequence of product (starting from 01).