

Application Note

For

2.15" Aurora Mb (V231)

With

Internal Tcon Driver IC (iTC)

Description	Interface for the 2.15" V231 EPD
Date	2016/8/5
Doc. No.	
Revision	02

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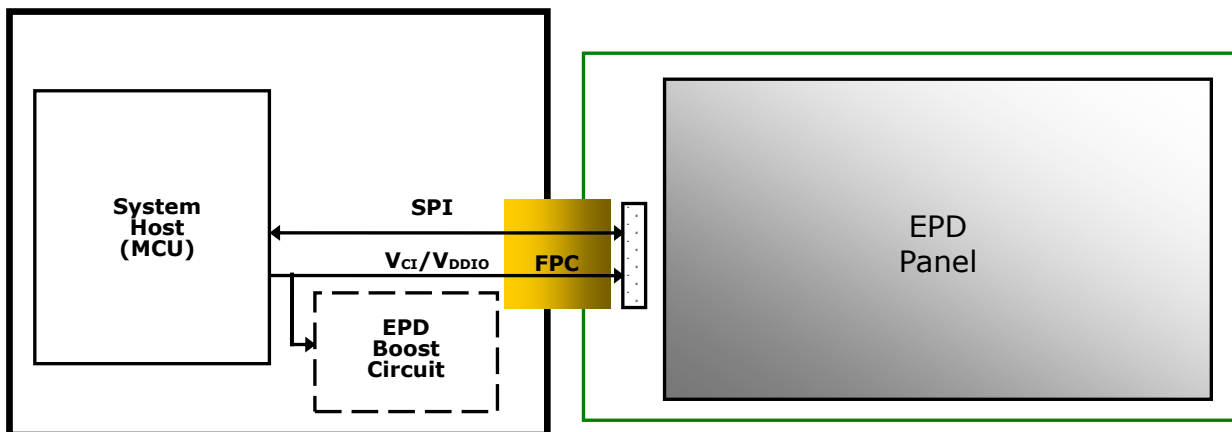
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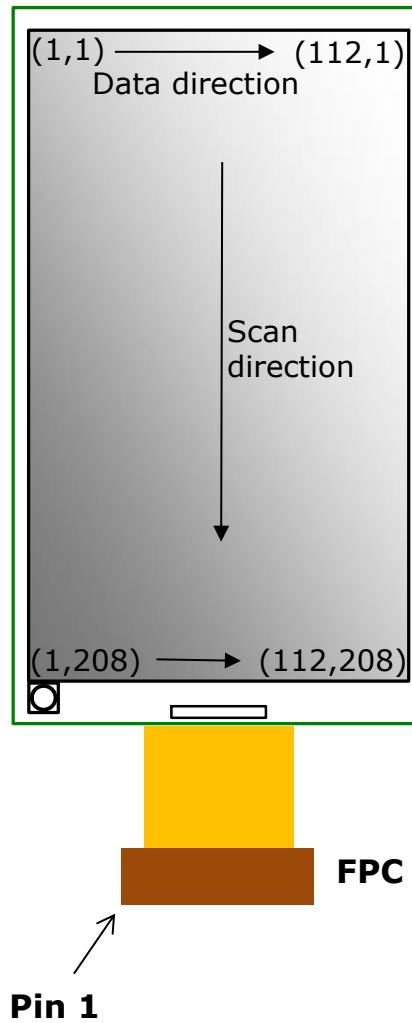
1 General Description

1.1 Overview

The document introduces how to drive the 2.15" EPD. The EPD use single driver and that embedded T-con (iTc). The major control interface of the driver is SPI. The host sends both the setting commands and the display image to driver through the SPI bus.

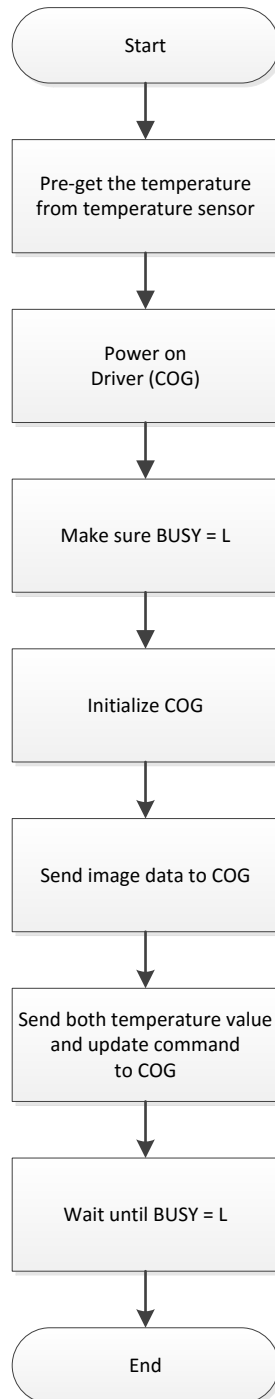


1.2 Panel drawing



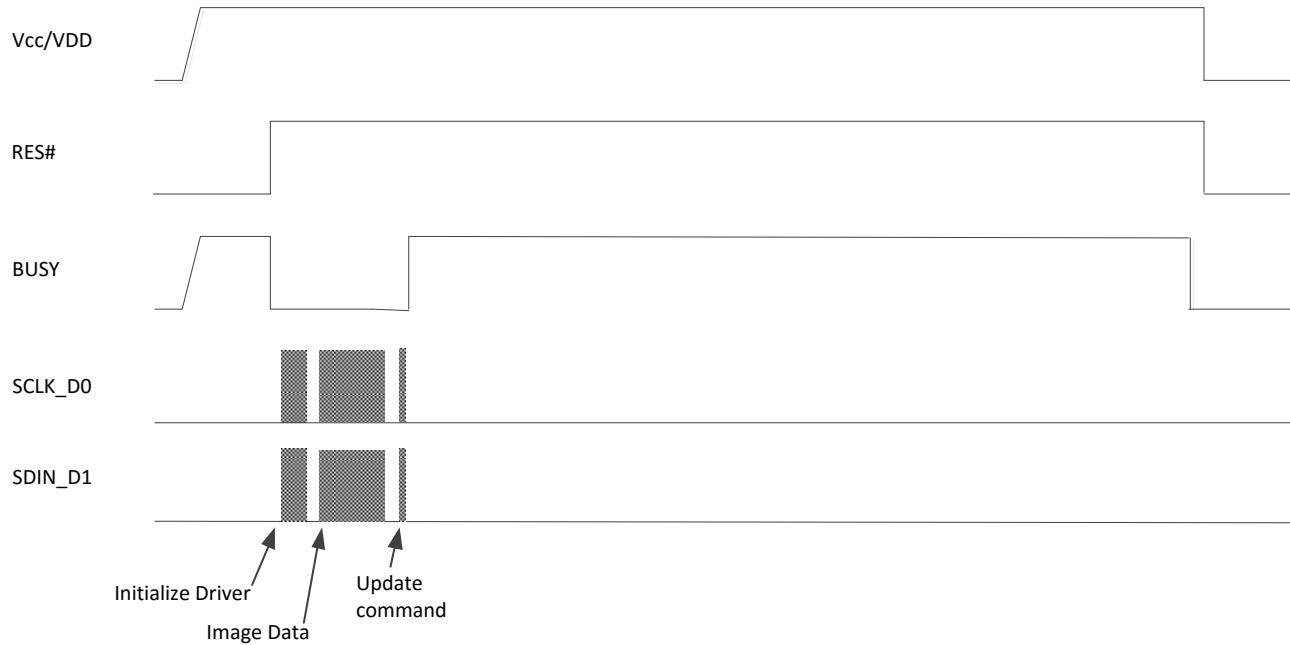
1.3 EPD Driving Flow Chart

The flowchart below provides an overview of the necessary actions to update the EPD. The steps below refer to the detailed descriptions in the respective sections.



1.4 Overall Waveform

The diagram below provides a signal control overview during an EPD update cycle.



1.5 SPI Timing Format

SPI commands are used for communicating between the MCU and the COG Driver. The SPI format used differs from the standard in that two way communications are not used, and CS is pulled high then low between clocks. When setting up the SPI timing, PDI recommends verifying both the SPI command format and SPI command timing in this section.

The maximum clock speed that the display can accept is 4MHz.

- Below is a description of the SPI Format:

SPI(0xI, 0xD₁, 0xD₂, 0xD₃, ...)

Where:

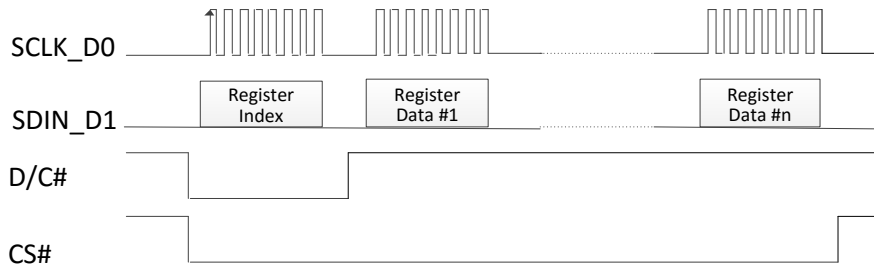
I is the Register Index and the length is 1 byte

D_{1~n} is the Register Data. The Register Data length varies from 1 to 2912 bytes depending on which Register Index is selected.

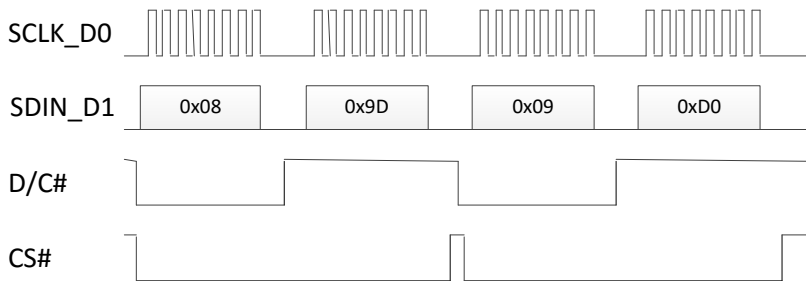
Register Index	Number Bytes of Register Data
0x01, 0x03	2
0x04, 0x05, 0x0F	1
0x11	1
0x1A	2
0x20	0
0x22	1
0x24	2912
0x2C	1
0x3A, 0x3B, 0x3C	1
0x44, 0x45	2
0x4E, 0x4F	1
0x75	3

- When SPI sends the Index, the D/C# has to pull LOW. When sending the data, the D/C# has to pull HIGH. The next page describes the detail flow chart.

- SPI command signals and flowchart:

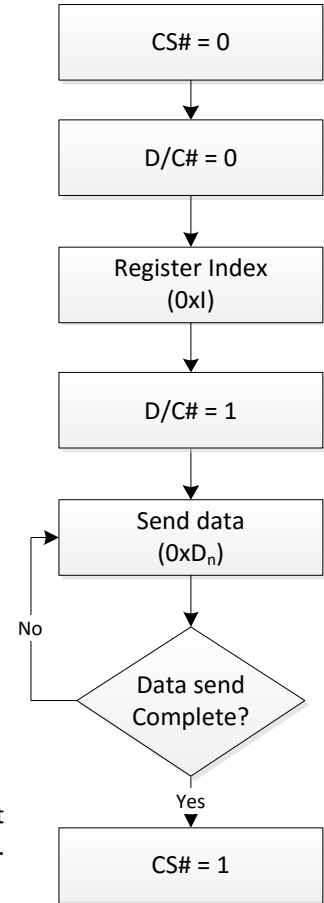


For example:
 To send two SPI commands:
 SPI((0x08,0x9D) and SPI(0x09, 0xD0)

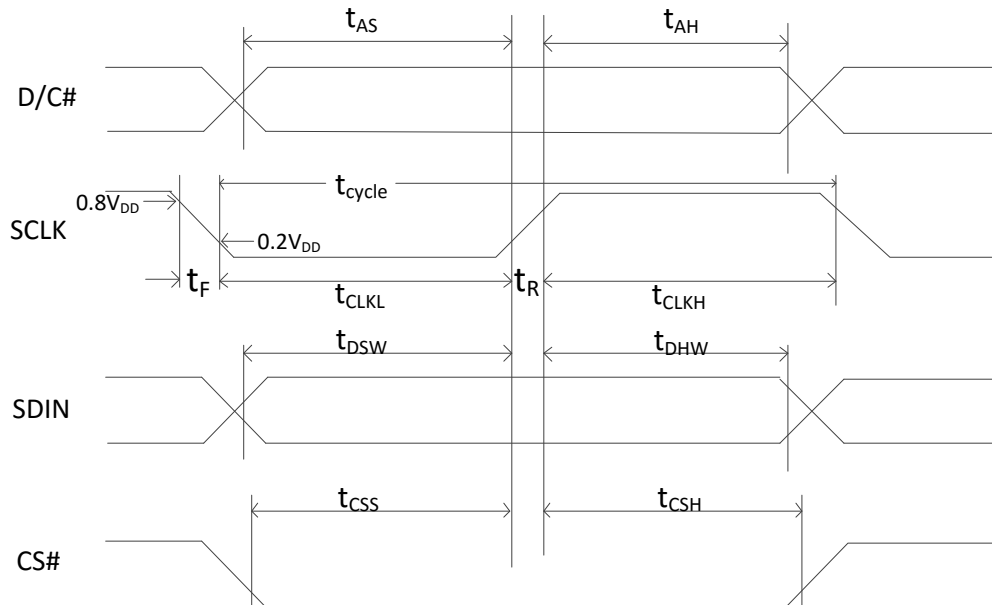


If register data is larger than two bytes, you must input data continuously without setting Register Index again.

SPI(0xI₁,0xD₁D₂)



- SPI command timing

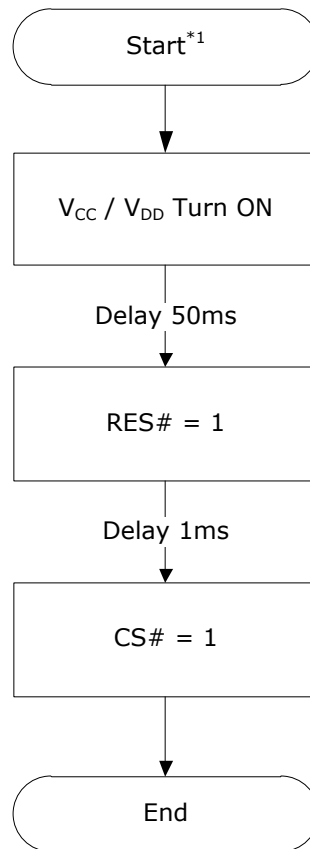


VCC = 2.4 to 3.7V Temp = 0 to +50°C

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

2 Power on COG driver

This flowchart describes power sequence for driver chip.



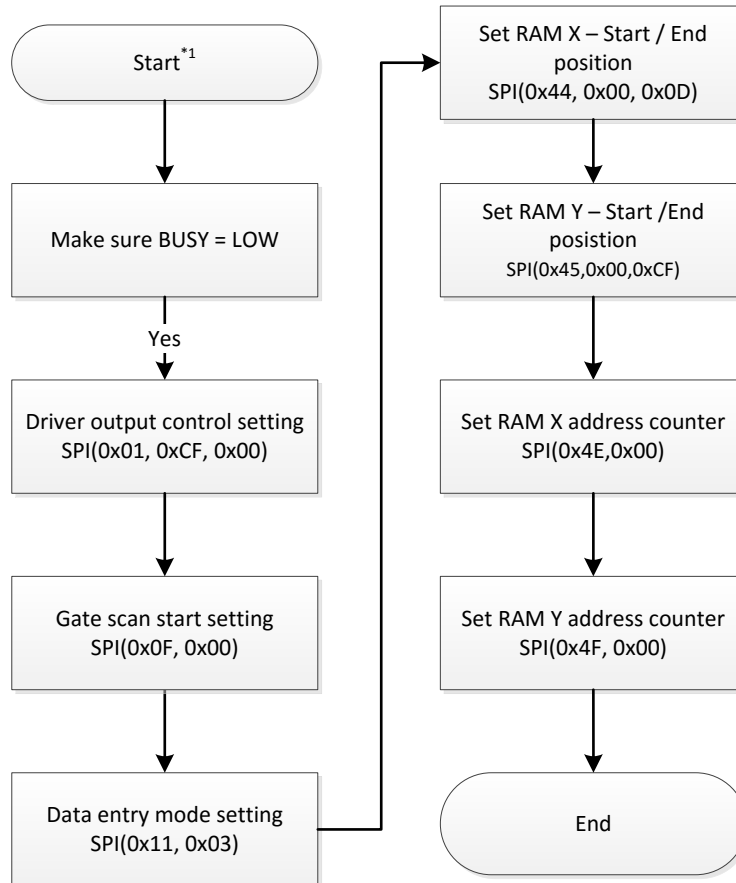
Note:

1. Start

Initial State:

VCC/VDD, RES#, CS#, SDIN, SCLK = 0

3 Initialize COG Driver

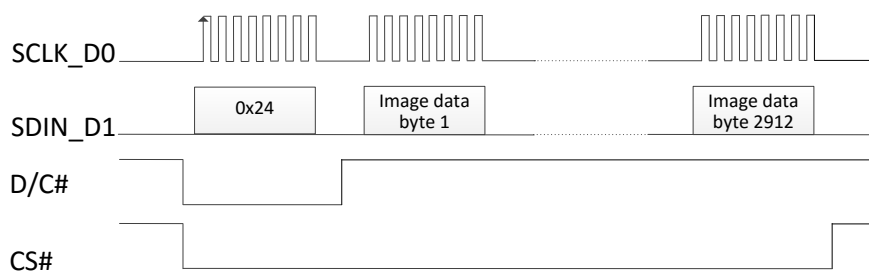


Note:

1. Start
Follow the end of the power on sequence

4 Input image to the EPD

This section describes how data should be sent to the COG driver which will update the display. The COG driver uses a buffer to store a line of data and then writes to the displays.



The resolution of 2.15" EPD is 112x208, one image have 2912 bytes.

One bit represents on pixel on EPD. If the pixel is black, the data bit is "1". If the pixel is white, the data bit is "0".

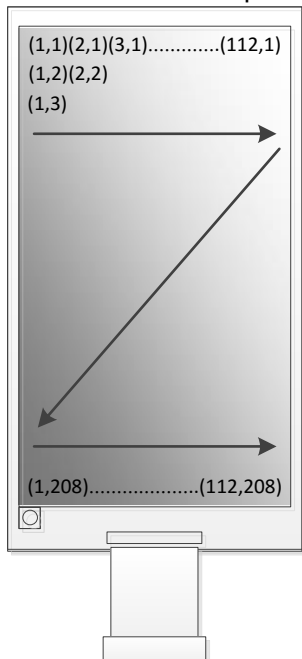
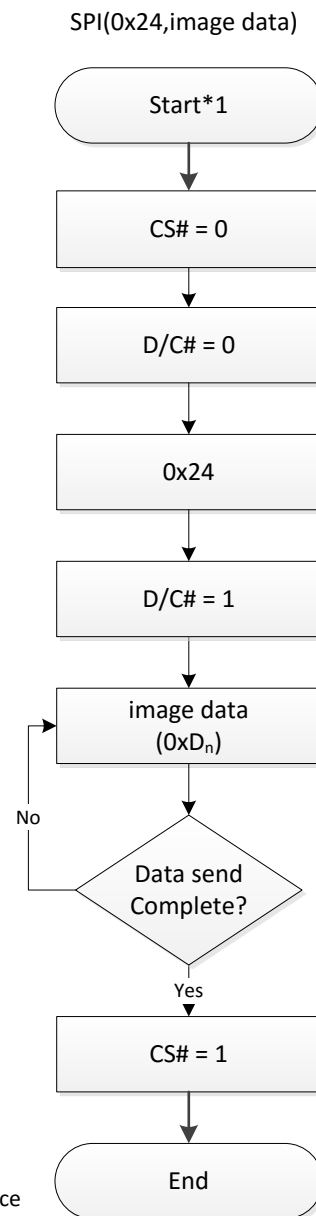
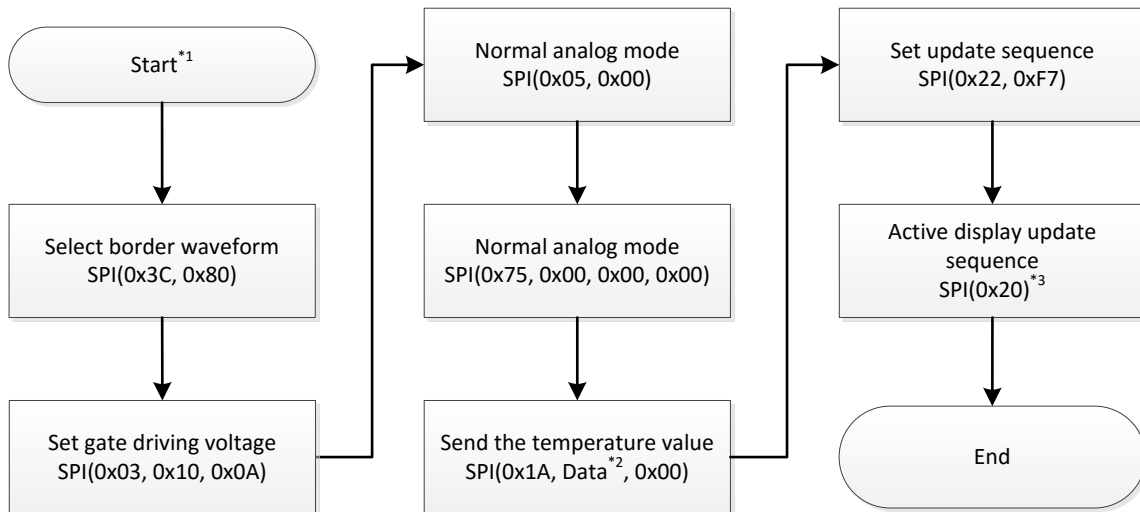


Image data input sequence :
 Line1:(1,1)>(2,1)>...>(112,1)>
 Line2:(1,2)>(2,2)>...>(112,2)>
 ...
 Line208:>(112,208)
 Total : 112 x 208 = 23296 bits
 = 2912 Bytes

Note:
 1. Start
 Follow the end of the driver initial sequence



5 Update command sequence



Note:

1. Start

Follow the end of the input image sequence

2. The data is the temperature value and unit is degree of Celsius.

The highest bit of the data represents positive/negative in temperature.

if it's positive, the data = (temperature value)

if it's negative, the data = (2's complement of temperature value)

example:

temperature value	data
25°C	0x19
5°C	0x05
-5°C	0xFB

3. This register does not have data, just need to send the index

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Revision History

Version	Date	Page (New)	Section	Description
01	2016/3/27			First release
02	2016/8/5	12	4	Swap the representation of the black and white pixel

Glossary of Acronyms

EPD	Electrophoretic Display (e-Paper Display)
EPD Panel	EPD
TCon	Timing Controller
FPL	Front Plane Laminate (e-Paper Film)
SPI	Serial Peripheral Interface
COG	Chip on Glass
PDI, PDi	Pervasive Displays Incorporated