

Display Datasheet

**4.7", 196 ppi,
800 x 450 pixels**

Part-No. 700408

Type S047_T2.1

Revision 2

15-February-2018

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1. Introduction

1.1 Purpose of this document

This document describes the technical specification of the e-Paper Innovation display module, part number 700408. It defines general characteristics of the display module and the technical information required to integrate the display module into a product.

1.2 Key features of display module

- ☐ Organic TFT active matrix
- ☐ 800 x 450 pixels @ 196ppi
- ☐ 16 grey levels
- ☐ Incorporates industry-leading bi-stable electrophoretic display technology
- ☐ Ultra-wide viewing angle
- ☐ Enables robust product design
- ☐ Glass free

1.3 Handling requirements

The display module is an electrostatic discharge (ESD) sensitive device. Ensure proper ESD precautions are in place to avoid damage to the display module.

The display module must be shipped in its unfolded flat state. All loose tails must be constrained during shipping.

Take appropriate care to protect the rear side of the display module from indents and punctures as this may damage the display. Take appropriate care to ensure the minimum bend radii of the flex tails are not violated (see Table 1). Areas with driver chips on COF or plastic substrate must not be bent.

In the application the gate and source driver chips must be protected from light to avoid unwanted drift effects.

1.4 General parameters

Parameter	Value	Unit	Comments
Module dimensions folded	117.26 x 62.1	mm	folded state, min. dimension
Module thickness	0.65±0.1	mm	active area
Module mass	6	g	
Active screen dimensions	103.68 x 58.32	mm	equivalent to 15.4" diagonal
Active screen resolution	800 x 450	pixels	
Pixel pitch	129.6	µm	equivalent to 196ppi.
FPC tail minimum internal bend radius	0.7	mm	with E-Z fold design
COF minimum internal bend radius	0.4	mm	bend not permitted at IC location.
Top Surface finish hard coat	2	H	Antiglare, UV-protection
Driver Chip Source	1	piece	UC8124
Driver Chip Gate	1	piece	UC8434

Table 1: general specification

2. Mechanical specification

2.1 Outline dimensions

Please request technical drawing document for full details. The module outline dimensions from top view are shown in Figure 1.

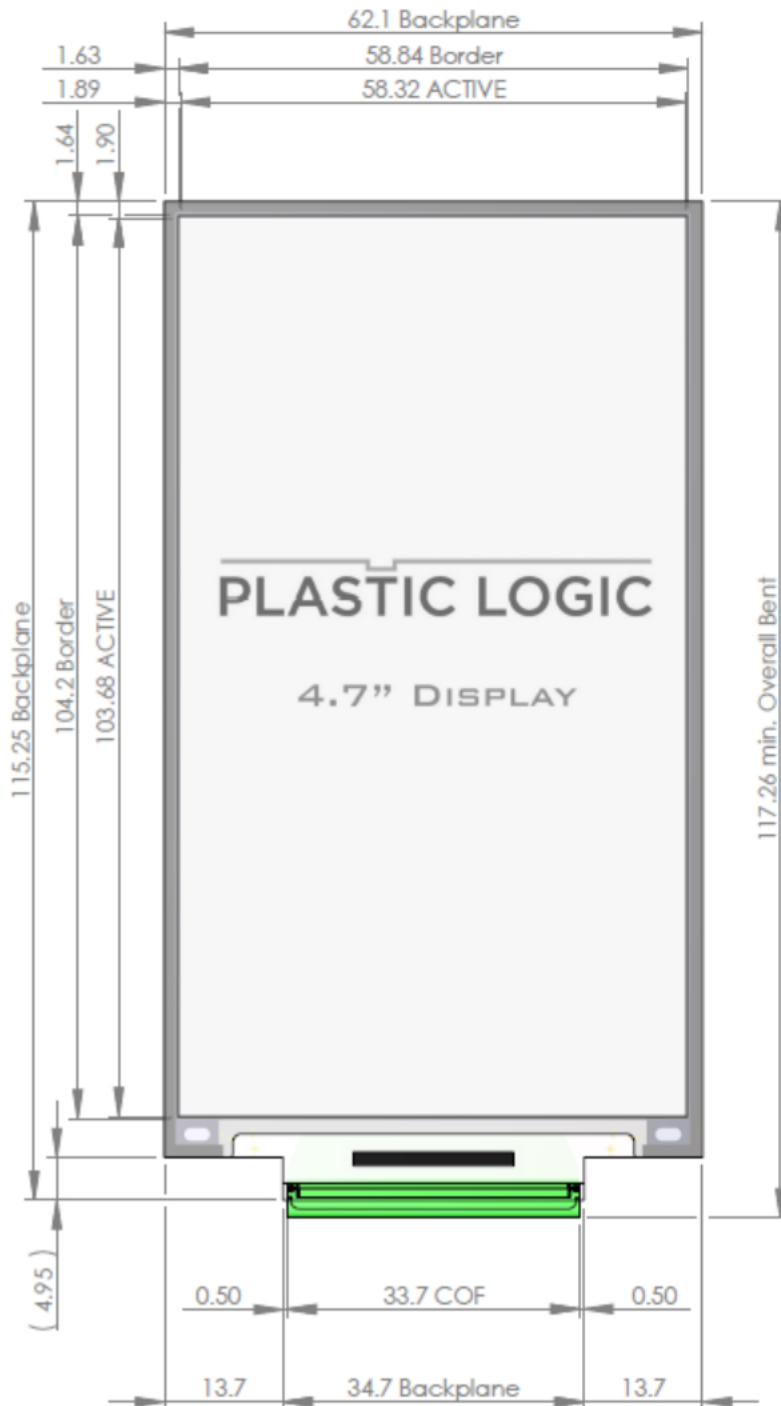


Figure 1: Outline dimension, front side view folded state

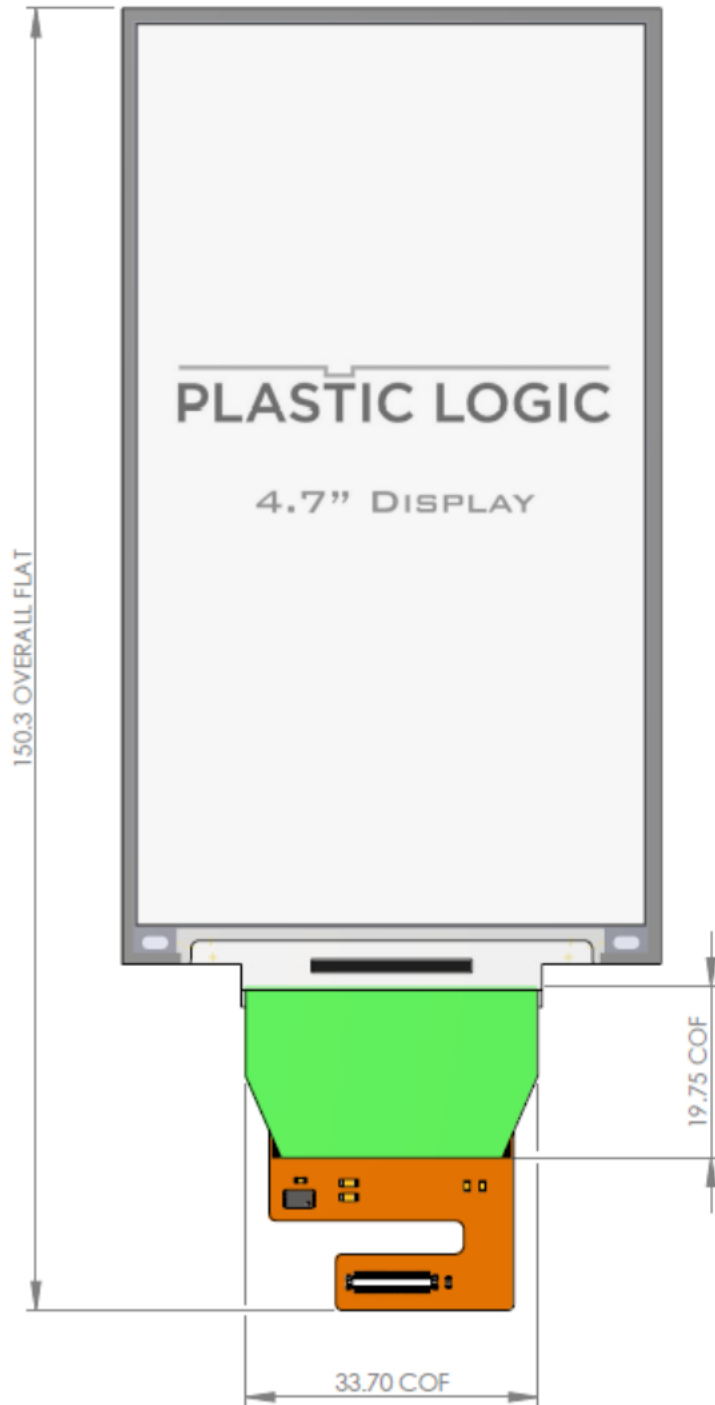


Figure 2: Outline dimensions, frontside view unfolded state

3. Optical specification

3.1 Optical requirements

The display supports 16 grey levels. Specific display grey levels are defined using the terminology GL_x, where x = 0-15. GL0 corresponds to "black" and GL15 corresponds to "white".

Grey levels are measured using the L* scale, which is the lightness component of the CIE 1976 CIELUV and CIELAB [2] colour spaces. Measurements in L* can be related to reflectivity using the formula $L^* = 116(L/L_w)^{1/3} - 16$, where L and L_w are measured in % reflectance and L_w is defined as 100%. This formula is valid for L* > 16.

The following table lists the criteria for the optical inspection of the display module. Inspection shall be done after an image updates with a GC16 waveform using the display specific settings as provided by e-Paper Innovation (waveform, VCOM, ...).

- Viewing Angle : $\alpha = \pm 45^\circ$
- Viewing Distance : 30cm $\pm$ 10cm
- Ambient Luminance : 700~1000 Lux
- Ambient Temperature : 20°C~25°C
- Ambient Humidity : 40~70%rH

Parameter	Description	Min	Max	Unit
White state	Median white	65	-	L*
Black to White difference	(Median white) – (Median black)	38	-	L*

Table 2: Optical requirements (16GL waveforms)

3.2 Update modes and waveforms

The display module will be supplied with a library of waveforms that are tuned to optimise display performance. Each waveform has an optimum temperature range over which it is valid – it is the responsibility of the display controller and software to ensure that the correct waveform out of the library is selected for the current display module temperature.

Waveforms can be stored in the SPI Flash on the FPC. As default SPI Flash is empty but waveform can be pre-programmed on customer request. Waveform format is specific to used EPDC.

The following types of waveform are provided:

Mode Name	Usage	Grey Levels	Ghosting	Update speed
INIT	Recover from unknown state/ start up	White only	Low	Slow
GC16	Full refresh	16 GL	Low	Slow
DU	Delta Update; 16GL to Monochrome	16 GL $\square$ b/w	High	Medium
A2	Fast monochrome updates	b/w $\square$ b/w	High	Fast

Notes: Additional customer specific waveforms are possible on request.

Table 3: Waveform types

4. Temperature Range and Humidity

Parameter	Value	Unit	Comments
Operating Temperature Range	0 to 50	°C	15%rH to 85%rH*
Storage Temperature Range	-25 to 50	°C	15%rH to 85%rH*
*Longterm exposure of stress close to limits might reduce overall lifetime			

Table 4: Temperature range

5. Electrical specification

5.1 Connectors

5.1.1 Mechanical

The connector used on this display module is a Panasonic AXE644224 male header. It is recommended to use the Panasonic AXE544124 connector socket on the main board of application. Note: Pin1 of the flex header connector is pin2 of PCB socket and pin2 of flex header connector is pin1 of PCB socket.

5.1.2 Electrical pin-out

The table lists the pin out and description of all signals of the display module. Not connected signals can be left open or be connected to any signal level.

Pin number	Symbol	Function
1	VSNEG	Negative power supply source driver
2	VSPOS	Positive power supply source driver
3	GND	Ground
4	GND	Ground
5	NC	Not connected
6	GND	Ground
7	VDD	Digital power supply drivers
8	GND	Ground
9	GND	Ground

10	SDCLK	Clock source driver
11	SD_LE	Latch enable source driver
12	SD_OE	Output enable source driver
13	SD_CE	Start pulse source driver
14	SD_D0	Data signal source driver
15	SD_D1	Data signal source driver
16	SD_D2	Data signal source driver
17	SD_D3	Data signal source driver
18	SD_D4	Data signal source driver
19	SD_D5	Data signal source driver
20	SD_D6	Data signal source driver
21	SD_D7	Data signal source driver
22	TS1	Thermistor Sensor 1
23	NC	Not connected
24	VCOM	EPD panel top plane COM
25	VGPOS	Positive power supply gate driver
26	VCOM	EPD panel top plane COM
27	VGPOS	Positive power supply gate driver
28	GND	Ground
29	GND	Ground
30	VBORDER	Border electrode connection
31	VGNEG	Negative power supply gate driver
32	VBORDER	Border electrode connection
33	VGNEG	Negative power supply gate driver
34	GND	Ground
35	GND	Ground
36	GD_CLK	Clock gate driver
37	GD_SP	Start pulse gate driver
38	GD_OE	Output mode selection gate driver
39	NC	Not connected
40	THERM_GND	Thermistor Analog Ground
41	SPI_CLK	Serial Data Clock for Flash memory
42	SPI_CE	Chip Enable for Flash memory

43	SPI_MOSI	Serial Data Input for Flash memory (SPI_SDI)
44	SPI_MISO	Serial Data Output for Flash memory (SPI_SDO)

Table 5: Electrical pin-out for gate FPC

5.2 Absolute maximum ratings

The following table lists the absolute maximum ratings. Exceeding these ratings as well as longer term operation outside the recommended ratings may result in permanent damage of the display module.

Signal	Parameter	Rating	Unit
VDD	Logic power supply	-0.3~+4.0	V
VGH	HV power supply for gate positive	-0.3~+40	V
VGL	HV power supply for gate negative	-50V~+0.3	V
VGH-VGL	Maximum gate voltage range	80V	V
VPOS	HV power supply for source positive	-0.3~+18V	V
VNEG	HV power supply for source negative	-18~+0.3	V
VPOS-VNEG	Maximum source voltage range	36	V

Table 6: Absolute maximum ratings

5.3 DC characteristics

Signal	Parameter	Min	typ	Max	Unit
GND	Signal ground	-	0	-	V
VDD	Logic power supply	3.0	3.3	3.6	V
VGH	HV power supply for gate positive	26	28	30	V
VGL	HV power supply for gate negative	-44	-42	-40	V
VPOS	HV power supply for source positive	14.6	15	15.4	V
VNEG	HV power supply for source negative	-15.4	-15	-14.6	V
VASYM	Asymmetry source (VPOS+VNEG)	-150	0	150	mV
VCOM*	Common voltage	1	5.0	9	V

*VCOM will need to be tuned for each display module. The correct value will be supplied as part of the waveform data.

Table 7: DC characteristics

5.4 Power On/Off Sequence

Power Supply start up sequence

- ☐ Initial state: all supplies off (disabled).
- ☐ Enable VDD, the source and gate driver logic supplies and allow to stabilize.
- ☐ Set SD_OE=0 to set all source outputs to 0V (GND).
- ☐ Set GD_OE=0 to set all gate outputs to VGH.
- ☐ Open VCOM switch to isolate the display VCOM electrode from the VCOM supply.
- ☐ Enable HV supplies in sequence VGH, VCOM, VGL, VNEG, VPOS (see drawing below)
- ☐ Allow supplies to stabilize.
- ☐ Enable source and gate driver outputs by SD_OE=GD_OE=1.
- ☐ Write one null frame to the display.
- ☐ Close the VCOM switch.

Display image update

- ☐ Write image update data to the display system.
- ☐ A final null frame is required as part of the image update (this will be supplied as part of the waveform data).

Power down sequence

- ☐ Open the VCOM switch.
- ☐ Disable source and gate outputs by SD_OE=GD_OE=0.
- ☐ Shut down the HV power supplies in the reverse order of Power up sequence and allow to go to 0V (GND) (Active discharge recommended).
- ☐ Disable VDD.

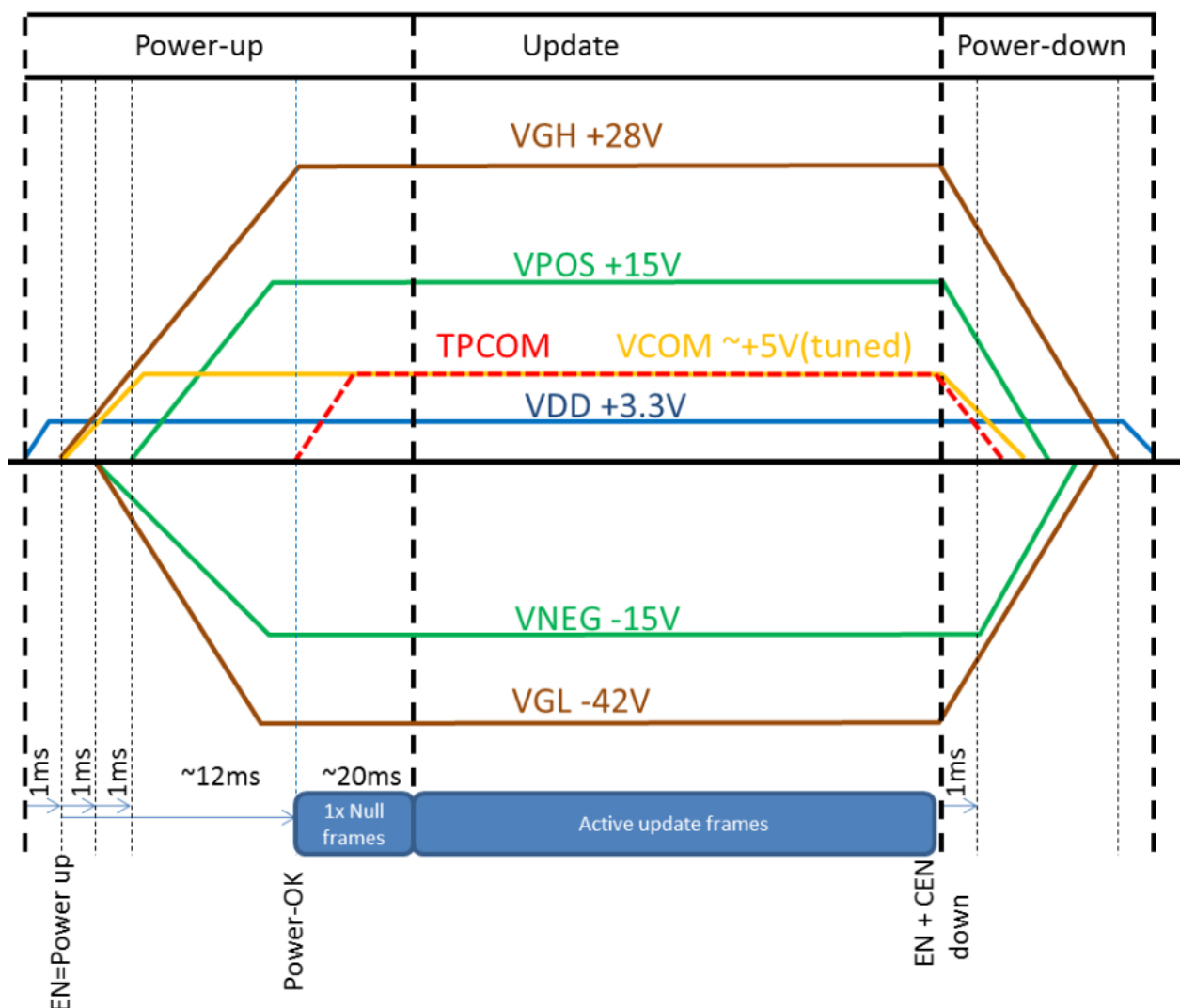


Figure 3: Power up/down sequence

5.5 AC Characteristics

For details of AC timing please also check driver chip datasheets.

6. Safety and Flammability requirements

The integrator of this display module into a final product is responsible for ensuring that the relevant safety and flammability requirements are met.

7. Compatible Evaluation Kits

Do not use any other than the recommended evaluation kits.

8. Literature