Display Datasheet

4.0", 115 ppi,
400 x 240 pixels

Part-No. 700557

Type S040_T1.1

Revision 2

15-February-2018

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Revision Status	Date	Author	Reason of Modification
1	29-May-2015	MT	Initial Version
2	15-Feb-2018	MT	Format update and general review

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1. Introduction

1.1 Purpose of this document

This document describes the technical specification of the 4.0" Plastic Logic display module, part number 700557. 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
- Build in EPD controller
- 400 x 240 pixels @ 115 ppi
- 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.

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).

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

The area of the driver chips must not be bent.

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1.4 General parameters

Parameter	Value	Unit	Comments
Module dimensions folded	106.6 (min) x 59.8	mm	In folded state
Module thickness	0.65±0.1	mm	active area
Active screen dimensions	88.0 x 52.8	mm	equivalent to 4.0" diagonal
Active screen resolution	400 x 240	pixels	
Pixel pitch	220 x 220	µm	equivalent to 115ppi.
Top Surface finish hard coat	2	H	Antiglare, UV-protection
Driver Chip Source	1	piece	Epson S1D13541 with build in EPD controller
Driver Chip Gate	1	piece	MXEI2240

Table 1: general specification

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2. Mechanical specification

2.1 Outline dimensions

Please request technical drawing document for full details.

Plastic Logic is providing a display module consisting of

- the actual flexible display,
- COF that contains the Epson S1D13541 EPD controller/source driver and an IXYS MXEI2240 gate driver
- a FPC, doing the rewiring between the two chips on the COF and containing a few components required by the controller and temp sensor and a SPI flash to store wavefrom data.

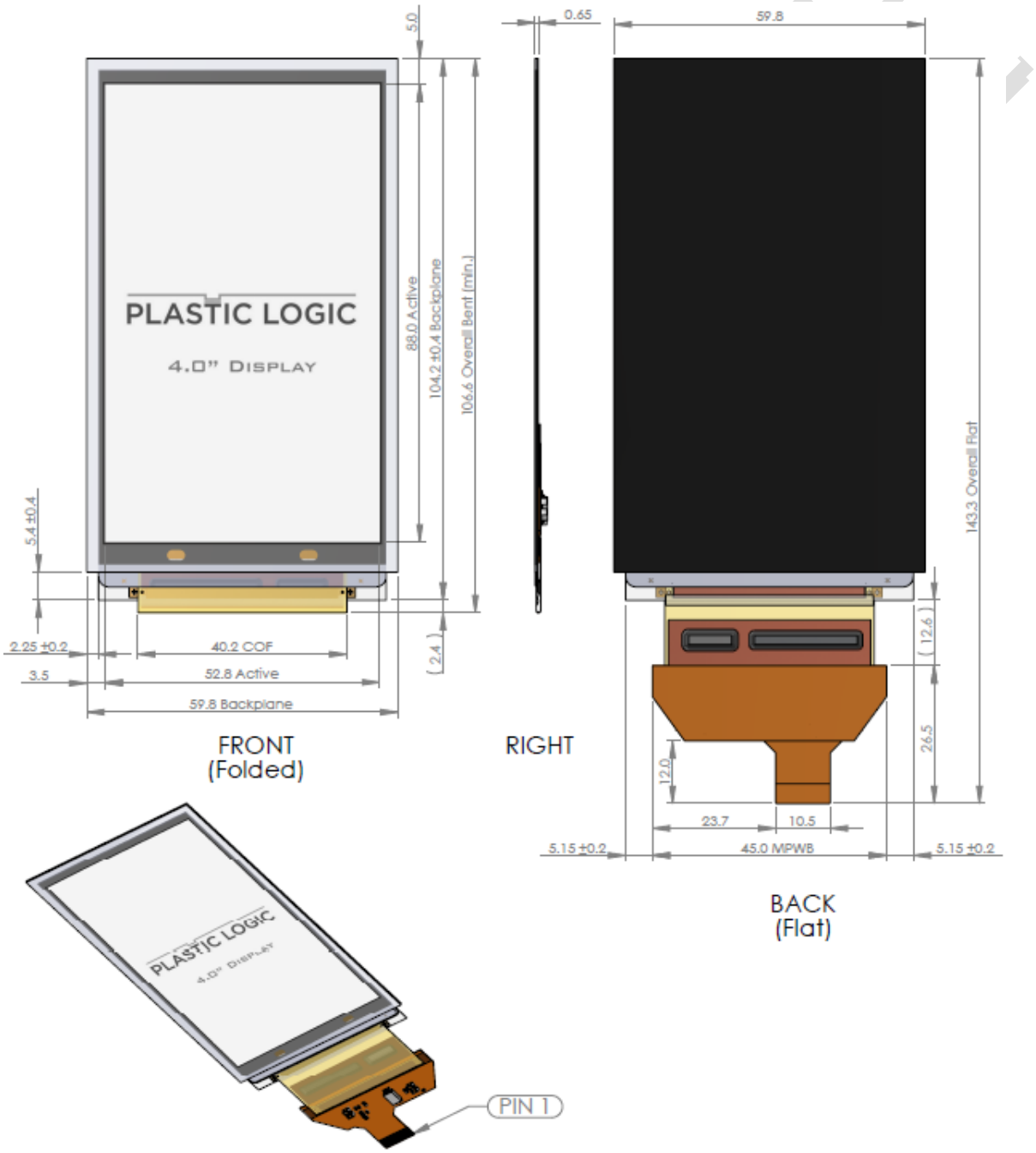

Figure 1: Outline dimension

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3. Optical specification

3.1 Optical requirements

The display supports 16 grey levels. Specific display grey levels are defined using the terminology GLx, 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 Plastic Logic (waveform, VCOM, ...).

- Viewing Angle : α=±45°
- Viewing Distance : 30cm±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*
Pixel Yield		>99.99%		

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.

This display does not have a flash for waveform storage. If not available please request the waveform from Plastic Logic.

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 → b/w	High	Medium
A2	Fast monochrome updates	b/w → b/w	High	Fast

Notes: Additional customer specific waveforms are possible on request.

Table 3: Waveform types

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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

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5. Electrical specification

5.1 Connectors

5.1.1 Mechanical

Recommended type of connector:

20ways, Omron XF2M2015-1A, back flip FFC conn, dual contact

5.1.2 Electrical pin-out

The table lists the pin out and description of all signals of the display module.

Pin number	Symbol	Function
1	MP_VCC_3V3	3V3 power pin
2	MP_VCC_3V3	3V3 power pin
3	MP_I2C_SCL	I2C clock
4	MP_I2C_SDA	I2C data
5	MP_POR_RESET	EPDC power-on reset pin
6	MP_HD/C	Reserved, not used currently
7	MP_SPICS	SPI chip select for EPDC host interface
8	MP_SPIDI	SPI data input for EPDC host interface
9	MP_SPIDO	SPI data output for EPDC host interface
10	MP_SPICLK	SPI clock for EPDC host interface
11	MP_HIRQ	Interrupt line from EPDC
12	MP_CLKI	EPDC clock
13	MP_GND	Ground
14	MP_VGNEG	Negative HV supply for gate driver (-32V typ)
15	MP_VSNEG	Negative HV supply for source driver (-15V typ)
16	MP_GND	Ground
17	MP_VGPOS	Positive HV supply for gate driver (+25V typ)
18	MP_VSPOS	Positive HV supply for source driver (+15V typ)
19	MP_GND	Ground
20	MP_FPCOM_SW	Switched VCOM supply (tuned for each panel, +9V typ)

Table 5: Electrical pin-out

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5.2 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	23	25	27	V
VGL	HV power supply for gate negative	-34	-32	-30	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 6: DC characteristics

5.3 Controller

These displays use an EPSON S1D13541 EPD (Electrical Paper Display) source driver and controller. This chip integrates the source driver, EPD display engine, Display Memory, Waveform Memory, Command Memory, Multi Time PROM and temperature sensing system.

In these displays the controller is combined with a IXYS MXEI2240 gate driver. Both chips are bonded to the display substrate (COP).

Key features:

- Serial Interface (SPI) as Host interface
- Transparency write
- Supported Data Formats: 1bpp, 2bpp, 4bpp, 1 Byte-per-pixel
- 202K Bytes Image Buffer
- Mirror and Rotate mode (Vertical/Horizontal Mirror, 0°/90°/180°/270° Rotate)
- 16K Bytes embedded memory for Waveform storage
- 16 or 32MHz clock input
- Built-in thermistor sensing system (external thermistor)
- I2C serial master
- External Gate driver control, Type 1
- External Power Management IC control

Please refer to EPSON S1D13541 datasheet for full controller specification.

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5.4 Display Power Supply System

The display module itself does not contain the power management subsystem required to generate the high voltages driving the display. Reference circuitry can be provided by Plastic Logic recommending either a Maxim MAX17135 or a TI TPS65185.

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 Kit.

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