Rdot ECD Display

ECD0430
Datasheet

Rev. 2020-05-18

Version history

Version	Date	Description	Changed by
V1.0	2019-05-08	First issue	Philip Holgersson
V1.1	2019-09-24	Error correction	Robert Samefors
V1.2	2019-12-16	Added circuit suggestions	Philip Holgersson
V1.3	2020-02-05	Error correction	Sigrid Smedberg
V1.4	2020-02-17	Added ACF	Philip Holgersson
V1.5	2020-02-19	Added ACF Footprint	Philip Holgersson
V1.6	2020-05-18	Driving scheme update	Philip Holgersson

Contents

1. Introduction

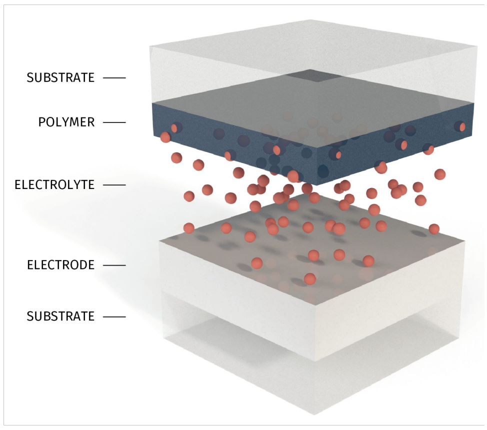
1.1 Features

A. Ultra-Low Power (<1 µW/cm²)
B. Reflective
C. Zero viewing angle dependency
D. Semi-bistable
E. Flexible
F. Long lifetime (>100000 switches)
G. Environmentally friendly

1.2 Technology Overview

The Rdot Display is an electrochromic display. It is categorized as a reflective display - meaning that it reflects ambient light instead of using a backlight. All layers are screen printed on a plastic substrate.

The display stack consists of organic layers including a plastic substrate, an electrochromic material, an electrolyte, and an electrode for each segment. Additional layers such as graphical overlays, circuits, and barrier layers may be added if required.



1.3 Glossary and Definitions

Word	Meaning
Electrochromism	The phenomenon of a material changing color when a voltage is applied.
Coloring	The process of switching the display from bright to dark state.
Bleaching	The process of switching the display from dark to bright state.
Semi-bistablility	The phenomenon that the Rdot display will maintain the segment state without power for a certain time.
Reflective Display	When the display uses ambient light and has no internal light source (required for low energy displays).

1.4 Modifications

The parameters of the Rdot display are customizable. Parameters such as reflection, contrast ratio, colors, thickness, etc., can be modified. If you have questions regarding this, please email support@rdotdisplays.com.

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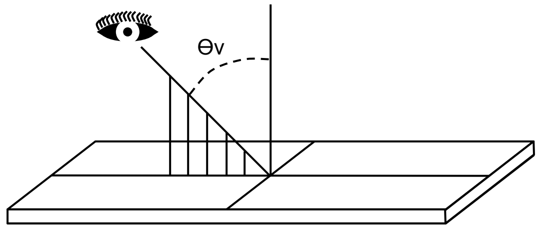
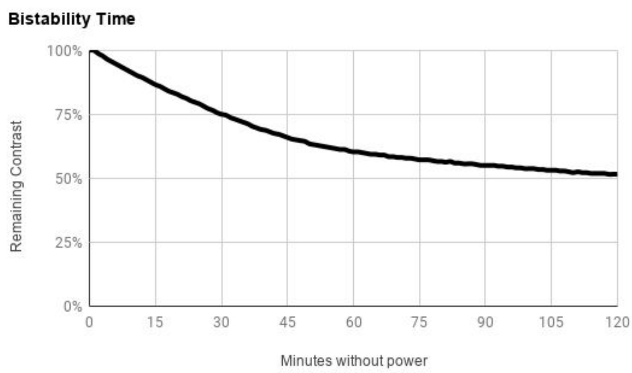


2. Optical Characteristics

Parameter	Test condition	Min	Typ.	Max	Unit
Contrast	25°C	27	30	32	ΔE
Reflectance	Bright state	38%	40%	45%	Y-value
Reflectance	Dark state	8%	12%	14%	Y-value
Viewing Angle (Θv)			90 (Lambertian)		°
Bistability	25°C, >80% contrast	15	23		min



3. Mechanical Characteristics

Parameter	Min	Typ.	Max	Unit
Thickness	30	120		µm
Weight		0,02		g/cm²
Bend radius		10		mm

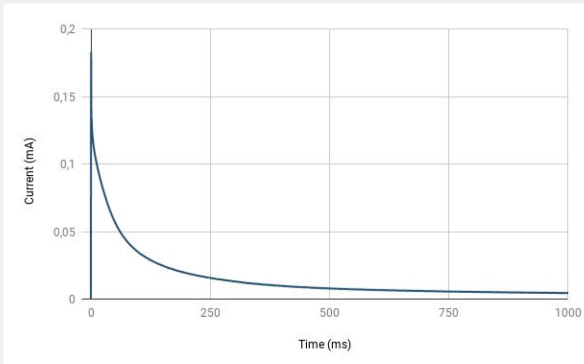
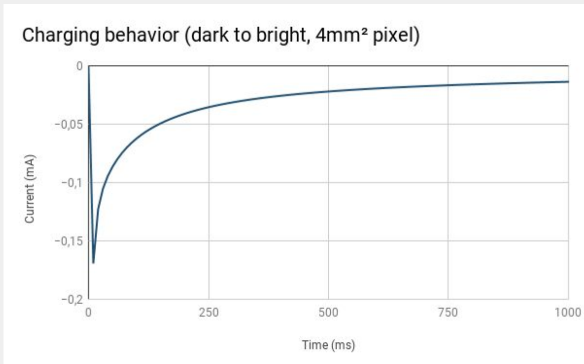
4. Timing characteristics

Parameter	Test Condition	Min	Typ.	Max	Unit
Coloring	3 V, 4 mm², 25°C	150	200	250	ms
Bleaching	3 V, 4 mm², 25°C	120	160	200	ms

5. Electrical characteristics

Parameter	Test Condition	Min	Typ.	Max	Unit
Power consumption	3 V, 25°C, static drive 4 mm² pixel size		0,21	0,3	µW/cm²
Energy consumption (switch)	3 V, 25°C 4 mm² pixel size			1	mJ/switch/cm²
Supply current (average)	3 V, 25°C, static drive 4 mm² pixel size		0,07	0,1	µA/cm²
Rec. driving voltage		±1,8	±3	±3,3	V
Peak current*	3 V, 4 mm², 25°C	120	160	200	µA
Pixel voltage	Coloring	1,8	3	3,3	V
Pixel voltage	Bleaching	-1,2	-3	-3,3	V
Open circuit potential	3 V charge for 3 sek	1,2	1,5	1,6	V

6. Charge characteristics

Parameter	Test Condition	Min
Charge characteristics	Coloring 3 V, 25°C, 4 mm² pixel size	
Charge characteristics	Bleaching -3 V, 25°C, 4 mm² pixel size	

* Easily modified by putting a resistor in series with the display.

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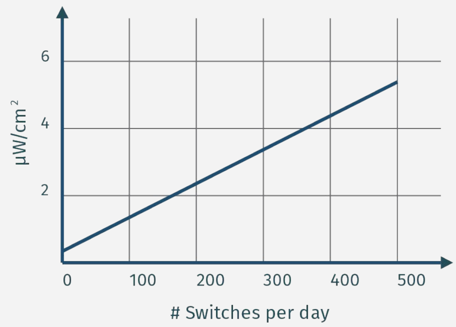
7. Power consumption

Parameter	Test Condition	Min	Typ.	Max	Unit
Average power consumption 0 switches per day	Static usage 1 cm^2 pixel size		0,28	0,32	$\mu W/cm^2$
Average power consumption 10 switches per day	Dynamic usage 1 cm^2 pixel size		0,38		$\mu W/cm^2$
Average power consumption 100 switches per day	Dynamic usage 1 cm^2 pixel size		1,28		$\mu W/cm^2$
Average power consumption 1000 switches per day	Dynamic usage 1 cm^2 pixel size		10,28		$\mu W/cm^2$

Average power calculation

$P_{avg} = 0{,}28 + 0{,}01 \times n$ **μW/cm²**

n is the number of full display updates per day.



8. Operating conditions (Encapsulated version)

Parameter	Min	Typ.	Max	Unit	Method
Operating Temperature	-20		80	°C	
Operating Humidity	5		95	% RH	
Storage temperature	0		40	°C	
UV exposure					

9. Lifetime

Parameter	Test condition	Min	Typ.	Max	Unit	Method
Number of switches	25°C, ±3 V	100 000	200 000			

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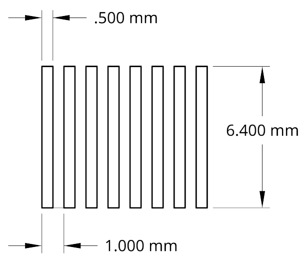
10. Recommended connectors

Connector Name	Connector pitch	Type
3M Electrically Conductive Adhesive Transfer Tape 9703 - ACF	-	ACF
Molex 52852-XX70	1000 µm	Connector
TE Connectivity 84953-8	1000 µm	Connector
TE Connectivity 1734248-8	1000 µm	Connector
Amphenol FCI HLW8S-2C7LF	1000 µm	Connector
Amphenol FCI SFW8R-2STE1LF	1000 µm	Connector

10.1 Example Board Layout for 3M 9703 - ACF



Please not that the number of pads should correspond to number of electrodes on the display version.

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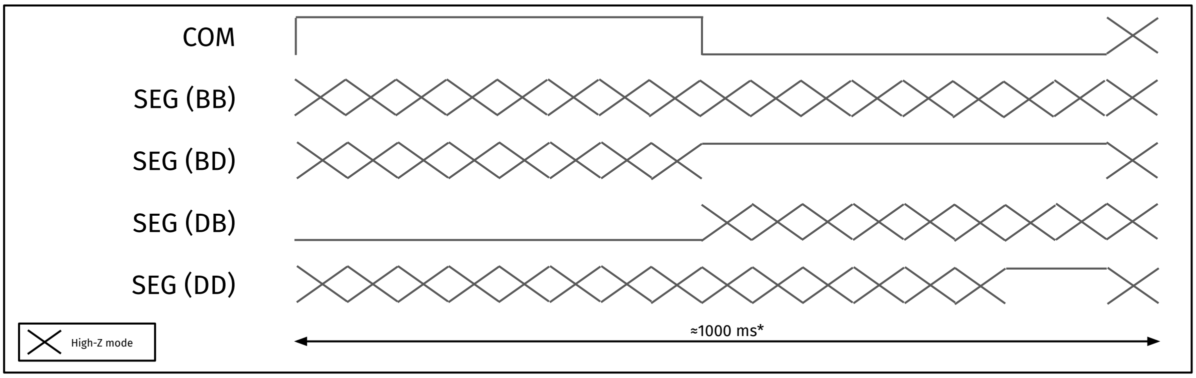
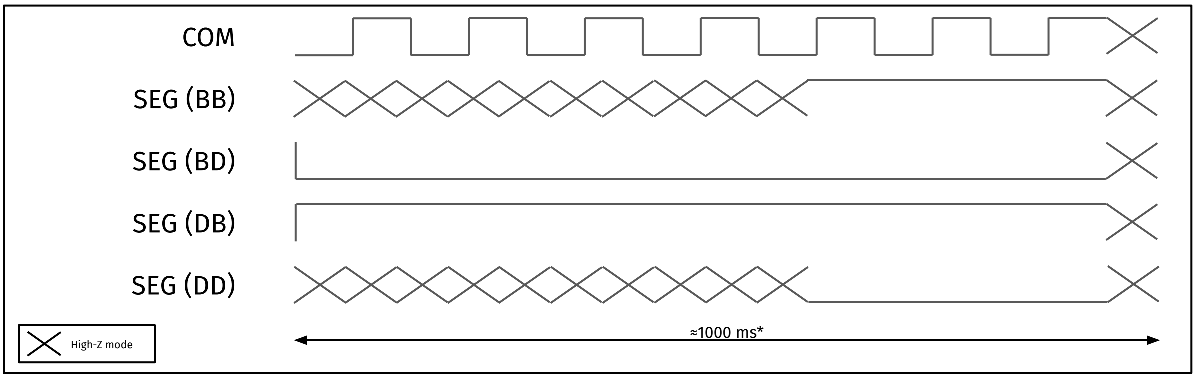
11. Driving scheme (for more information, please see implementation guide)

Symbol	Definition
COM	Common electrode (marked with black color on the display)
SEG (BB)	Segment that should go from bright state to bright state
SEG (BD)	Segment that should go from bright state to dark state
SEG (DB)	Segment that should go from dark state to bright state
SEG (DD)	Segment that should go from dark state to dark state

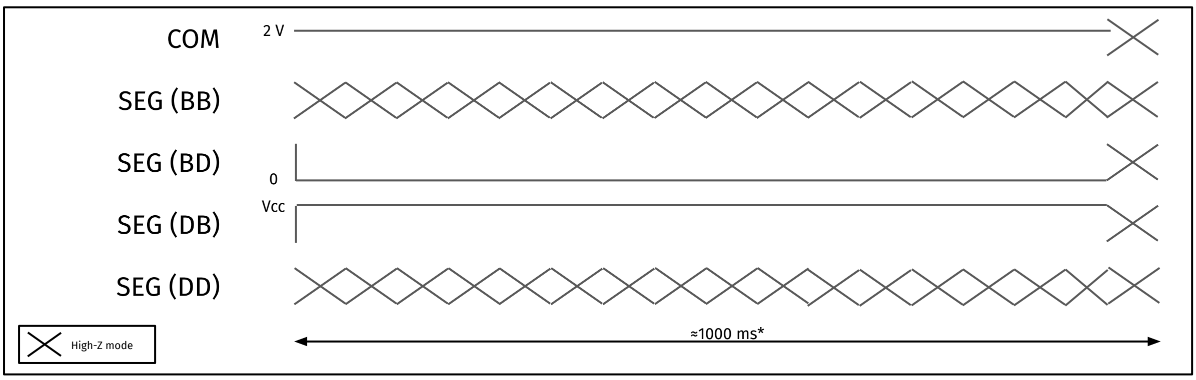
Driving scheme A (1,8-3,3 Vcc For maximum energy efficiency)



Driving scheme B (1,8-3,3 Vcc For smooth switching)



Driving scheme C (3,7-5 Vcc With adjusted input level on COM**)



* For 4mm² pixels.
** The com port doesn't have to be analog as long as it can achieve a voltage of Vss-1.5 V. This could be achieved with a low pass filtered PWM signal or a voltage divider circuit for example. Please see circuit implementation suggestions (Section 12).

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12. Circuit implementation suggestions

A positive voltage across the pixel activates dark mode while a negative voltage activates bright mode. In high impedance mode (High-Z) the pixel will maintain its state (see bistability time graph in Section 2).

1,8-3,3 V System

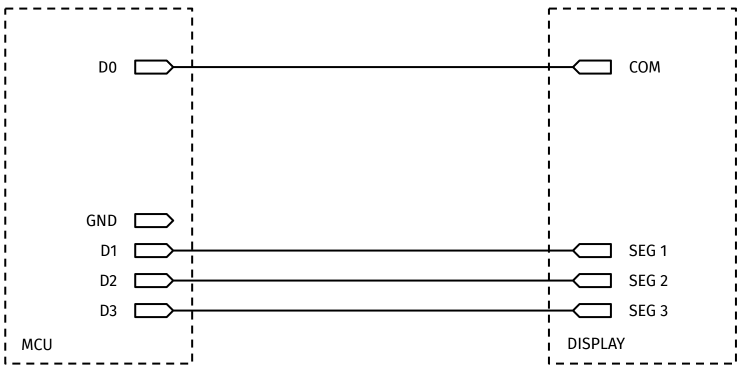
When running on 1.8-3.3 V it is possible to connect the display directly to the MCU (Circuit example A). Proposed waveforms of this approach demonstrated in driving scheme A or B in the datasheet. For long lifetime (especially when using higher voltages) a current limiting resistor may be connected in series with the counter electrode (Circuit example B). There is a trade-off between switching speed and lifetime, if fast switching speed is required the resistor value should be kept at a low value.

3,3-5 V System

The display should not be driven with voltages above 3,3 V for long lifetime applications. If the system uses more than 3,3 V it is recommended to adjust the voltage of the common electrode. This could be done cost effectively with a voltage divider (Circuit example C) or low pass filtered PWM signal amplified with an operation amplifier (Circuit example D).

12.1. Circuit examples

Circuit example A, 1.8-3.3V supply



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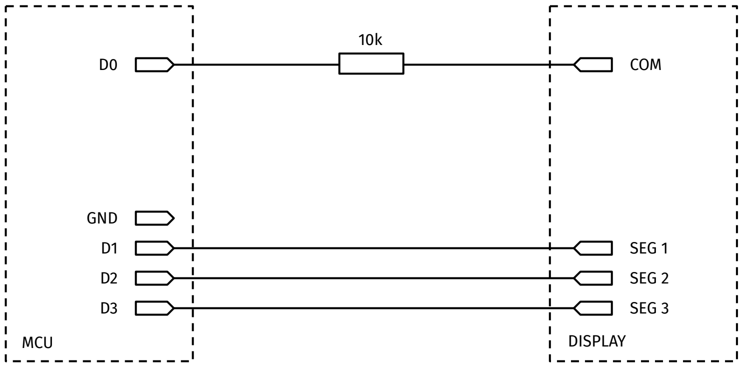
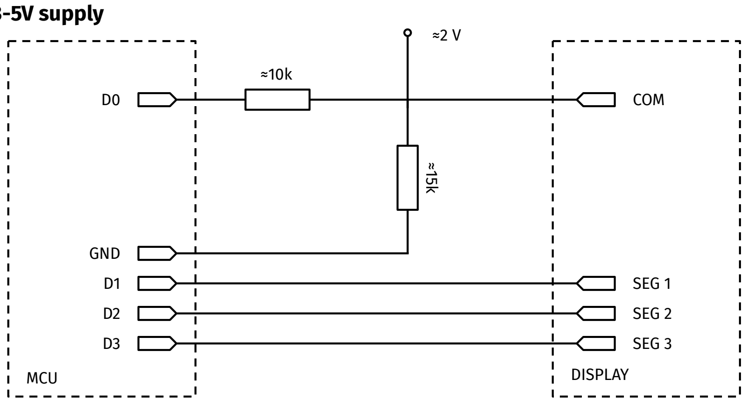
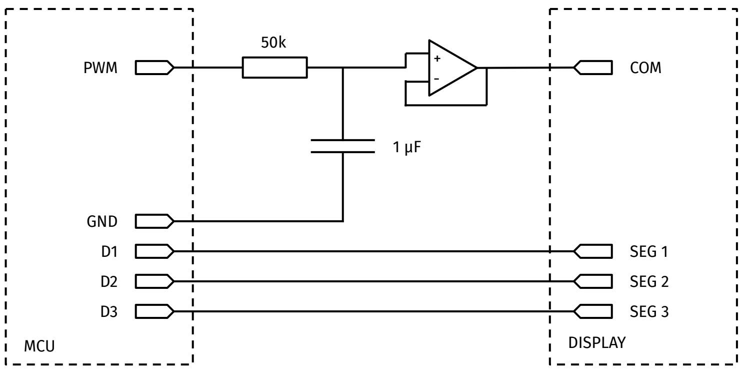
Circuit example B, 1.8-3.3V supply



Example circuit C, 3.3-5V supply



Example circuit D, 3.3-5V supply



Component	Example	Size	Unit	Comment
Resistor	Panasonic ERJ-U02D5362X	50	kΩ	It is possible to use a lower resistance to reduce the rise time of the circuit. The drawback is higher energy consumption of the circuit and more ripple on the COM electrode.
Capacitor	MuRata GRM21BC81C106KE15L	1	µF	It is possible to use a lower capacitance to reduce the rise time of the circuit. The drawback is more ripple on the COM electrode.
Operational Amplifier	Texas Instruments TLV9001IDCKR			Used to maintain a stable COM potential at different loads.

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