

INCL CONTROLLER SSD1311 FOR SPI AND I<sup>2</sup>C



Dimension 61x26x3.3mm

## FEATURES

- 4x20 CHARACTER / ALTERNATIVELY 3x20 OR 2x20 WITH DOUBLE HEIGHT FONT
- CONTRASTY OLED DISPLAY (TYP. 170° VIEWING ANGLE)
- INTEGRATED CONTROLLER SSD1311
- LOGIC SUPPLY 3.3V OR 5V
- VCC= 12V
- SPI-INTERFACE (3-WIRE): MOSI, CLK, CS
- I<sup>2</sup>C INTERFACE: SDA, SCL
- EXTREME WIDE TEMPERATURE RANGE (T<sub>OP</sub> -40°C - +80°C)
- NO SPECIAL ASSEMBLY NECESSARY: SIMPLY SOLDER INTO PCB
- 3 VERSIONS AVAILABLE: WITH / WITHOUT POLARISER AND COVER GLASS
- FAST RESPONSE TIME (10μS), NO AFTERGLOW EFFECT

## ORDERING CODE

- |   |                        |
|---|------------------------|
| • OLED TEXT 4x20, yellow, black background, incl. cover glass | <b>EA OLEDM204-GGA</b> |
| • OLED TEXT 4x20, yellow, black background, no cover glass    | <b>EA OLEDM204-LGA</b> |
| • OLED TEXT 4x20, white, black background, no cover glass     | <b>EA OLEDM204-LWA</b> |

FROM A MINIMUM QUANTITY OF 10,000 PCS.

- |  |                        |
|--|------------------------|
| • SPECIAL COLORS OLED TEXT 4x20, with polariser (no cover glass) | <b>EA OLEDM204-LxA</b> |
| X: G = Green   |                        |
| B = Blue   |                        |

## ACCESSORIES

- |   |                     |
|---|---------------------|
| • TEST BOARD WITH USB INTERFACE             | <b>EA 9781-1USB</b> |
| • SOCKET 4.8mm HEIGHT (2 PCS. ARE REQUIRED) | <b>EA FL-10P</b>    |

## EA OLED SERIES

With its EA OLED series ELECTRONIC ASSEMBLY launches worldwide the first display family with OLED-technology for direct mounting and soldering. In comparison to standard displays there's no FFC/FPC cable/connector that may loose contact, this OLED series will be soldered directly or put into a standard 2.54 mm precision socket.

It is designed for compact handheld equipment and provides a lot real advantages:

- Extreme compact (68x51mm) with a large viewing area (64x37mm)
- Super flat with 2.4 mm (without frontal protection glass)
- SPI and I<sup>2</sup>C interface
- Simple mounting with direct soldering
- Ex stock available from 1 pc. off
- Long life time (>50,000h for yellow)
- Extreme wide temperature range (-40..+80°C)
- Fast response time (10µs), no afterglow

## VERSIONS

The EA OLEDM204 is available in 3 different versions:

### EA OLEDM204-GGA / Allround

This module is perfect for rough environment. An additional frontal glass protects the display against scratch, shock and UV light. Thanks to its integrated polariser there's no need for an additionally smoked glass.

### EA OLEDM204-LGA / Flat

This module is the standard module and does fit for the most applications. The flat design (2.4 mm) makes the display perfect for smallest equipment. The background is always deep black for best contrast.

### EA OLEDM204-LWA / White and Flat

This module is the standard module and does fit for the most applications. The white colored text and the flat design (2.4 mm) makes the display perfect for smallest equipment. The background is always deep black for best contrast.

## COLORS (CUSTOM MADE)

The standard colors are yellow and white.

The flat version EA OLEDM204-LGA is on customers request available in 3 more colors. The minimum order quantity is 10,000 pcs. and lead time is about 20 weeks. Samples are available on request.

Interface and software are 100% compatible. The yellow color provides highest brightness and longest life time.

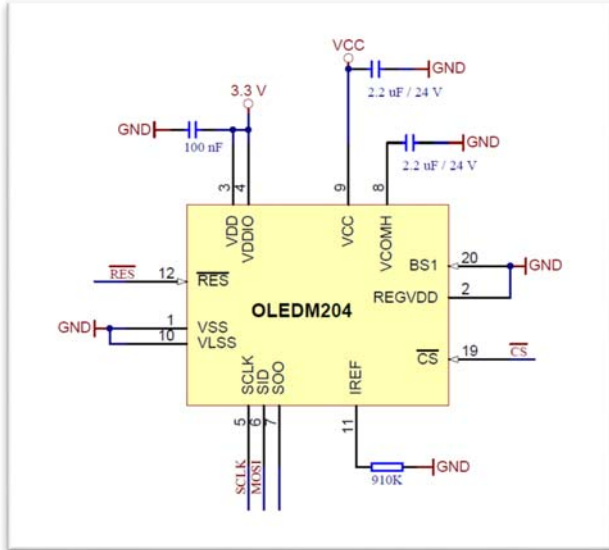


EA OLEDM204-LEA

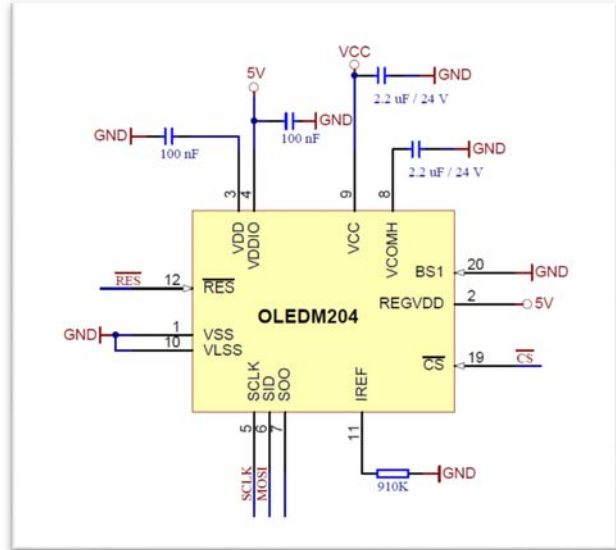


EA OLEDM204-LBA

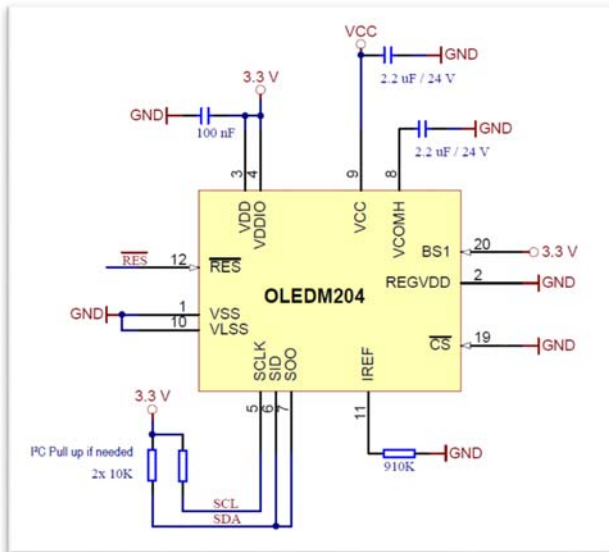
## APPLICATION EXAMPLES



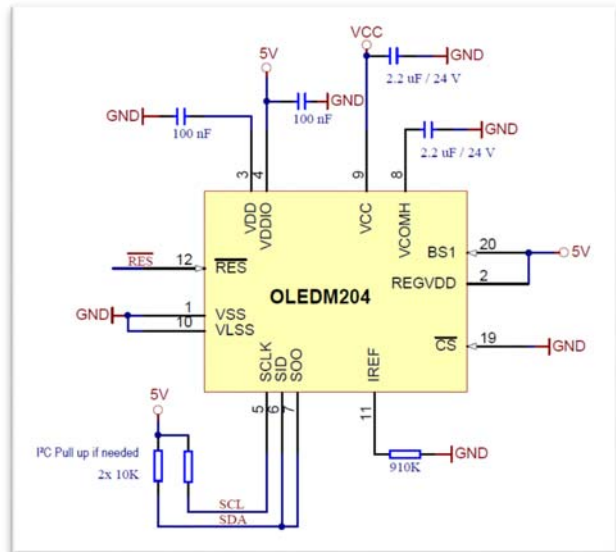
SPI – 3.3V / VCC – 12V



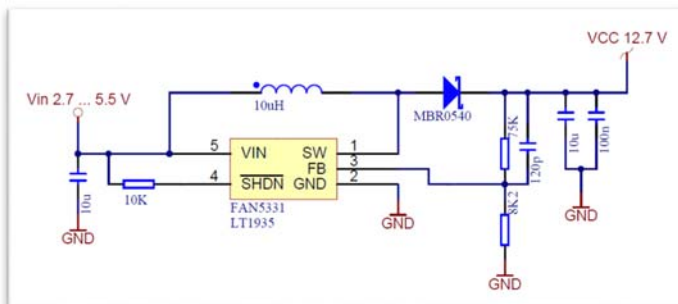
SPI – 5V / VCC – 12V



I<sup>2</sup>C – 3.3V - Address 0x78 (0x3C) / VCC – 12V



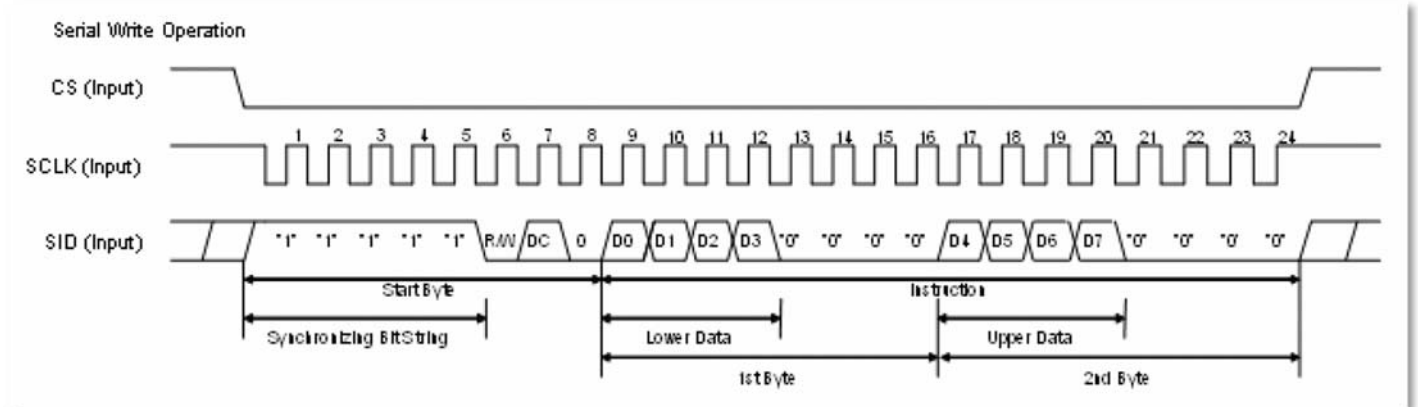
I<sup>2</sup>C – 5V - Address 0x78 (0x3C) / VCC – 12V



Power supply for VCC – 12V

## DATA TRANSFER 3-WIRE SPI (8 BIT)

Data transmission for SPI is unidirectional, that means that data can only be written, there's no data read option. Selection for writing data or command is done with the DC bit.

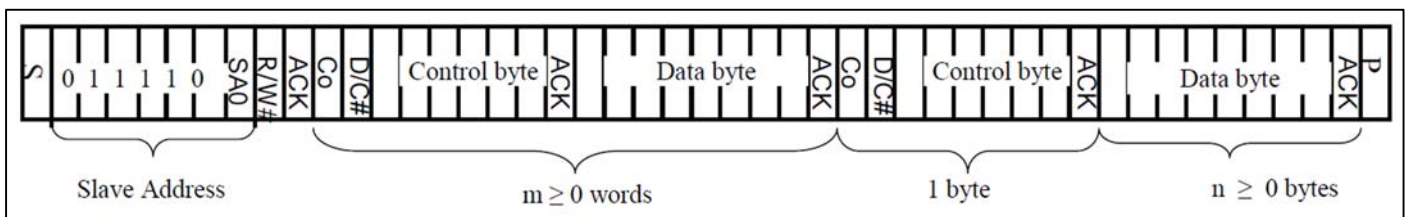


A busy check is not necessary at all. Clock rate may be up to 1 MHz. Data transmission is based on SPI mode 3, LSB first. For more details please refer to the controllers data sheet SSD1311.

## DATA TRANSFER I<sup>2</sup>C

The I<sup>2</sup>C mode provides a bi-directional data transmission: That means that data can be written and read. Because SA0 is internally set to GND, the I<sup>2</sup>C address is 0x78 (0x3C). The clock rate may be up to 400 KHz.

**Attention:** When reading data, after the command for page- or column address there need to be a dummy read (discard the first byte).



Control byte: C<sub>0</sub> (Continuation bit) = 0 → Display data do follow; 1 → refer D/C bit.

## COMMAND TABLE (ABSTRACT)

This is a collection of the most important commands. The data sheet SSD1311 provides the full list plus a detailed description.

1. Fundamental Command Set														
Command	IS	RE	SD	Instruction Code										Description
				D/C#	R/W# (WR#)	D7	D6	D5	D4	D3	D2	D1	D0	
Clear Display	X	X	0	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM and set DDRAM address to "00H" from AC.
Return Home	X	0	0	0	0	0	0	0	0	0	0	1	*	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.
Entry Mode Set														Assign cursor / blink moving direction with DDRAM address.  I/D = "1": cursor/ blink moves to right and DDRAM address is increased by 1 (POR)  I/D = "0": cursor/ blink moves to left and DDRAM address is decreased by 1
	X	0	0	0	0	0	0	0	0	0	1	I/D	S	Assign display shift with DDRAM address.  S = "1": make display shift of the enabled lines by the DS4 to DS1 bits in the shift enable instruction. Left/ right direction depends on I/D bit selection.  S = "0": display shift disable (POR)
	X	1	0	0	0	0	0	0	0	0	1	BDC	BDS	Common bi-direction function. BDC = "0": COM31 -> COM0 BDC = "1": COM0 -> COM31  Segment bi-direction function. BDS = "0": SEG99 -> SEG0, BDS = "1": SEG0 -> SEG99
Display ON / OFF Control	X	0	0	0	0	0	0	0	0	1	D	C	B	Set display/cursor/blink ON/OFF  D = "1": display ON, D = "0": display OFF (POR),  C = "1": cursor ON, C = "0": cursor OFF (POR),  B = "1": blink ON, B = "0": blink OFF (POR).  <b>Note:</b> It is recommended to turn off the cursor and blinking effects when updating internal RAM contents for better visual performance; refer to Section 9.1.4 for details



1. Fundamental Command Set														
Command	IS	RE	SD	Instruction Code										Description
				D/C#	R/W# (WR#)	D7	D6	D5	D4	D3	D2	D1	D0	
Extended Function Set	X	1	0	0	0	0	0	0	0	1	FW	B/W	NW	Assign font width, black/white inverting of cursor, and 4-line display mode control bit.  FW = "1": 6-dot font width, FW = "0": 5-dot font width (POR),  B/W = "1": black/white inverting of cursor enable, B/W = "0": black/white inverting of cursor disable (POR)  NW = "1": 3-line or 4-line display mode (POR) NW = "0": 1-line or 2-line display mode
Cursor or Display Shift	0	0	0	0	0	0	0	0	1	S/C	R/L	*	*	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.  S/C = "1": display shift, S/C = "0": cursor shift,  R/L = "1": shift to right, R/L = "0": shift to left
Double Height (4-line) / Display-dot shift	0	1	0	0	0	0	0	0	1	UD2	UD1	*	DH'	UD2~1: Assign different doubt height format (POR=11b) Refer to Table 9-2 for details  DH' = "1": display shift enable DH' = "0": dot scroll enable (POR)
Shift Enable	1	1	0	0	0	0	0	0	1	DS4	DS3	DS2	DS1	DS[4:1]=1111b (POR) when DH' = 1b  Determine the line for display shift.  DS1 = "1/0": 1 <sup>st</sup> line display shift enable/disable DS2 = "1/0": 2 <sup>nd</sup> line display shift enable/disable DS3 = "1/0": 3 <sup>rd</sup> line display shift enable/disable DS4 = "1/0": 4 <sup>th</sup> line display shift enable/disable.
Scroll Enable	1	1	0	0	0	0	0	0	1	HS4	HS3	HS2	HS1	HS[4:1]=1111b (POR) when DH' = 0b  Determine the line for horizontal smooth scroll.  HS1 = "1/0": 1 <sup>st</sup> line dot scroll enable/disable HS2 = "1/0": 2 <sup>nd</sup> line dot scroll enable/disable HS3 = "1/0": 3 <sup>rd</sup> line dot scroll enable/disable HS4 = "1/0": 4 <sup>th</sup> line dot scroll enable/disable.

1. Fundamental Command Set														
Command	IS	RE	SD	Instruction Code										Description
				D/C#	R/W# (WR#)	D7	D6	D5	D4	D3	D2	D1	D0	
Function Set														Numbers of display line, N when N = "1" (POR): 2-line (NW=0b) / 4-line (NW=1b), when N = "0": 1-line (NW=0b) / 3-line (NW=1b)
	X	0	0	0	0	0	0	1	*	N	DH	RE (0)	IS	DH = "1/0": Double height font control for 2-line mode enable/ disable (POR=0)  Extension register, RE ("0")  Extension register, IS
	X	1	0	0	0	0	0	1	*	N	BE	RE (1)	REV	CGRAM blink enable BE = 1b: CGRAM blink enable BE = 0b: CGRAM blink disable (POR)  Extension register, RE ("1")  Reverse bit REV = "1": reverse display, REV = "0": normal display (POR)
Set CGRAM address	0	0	0	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter. (POR=00 0000)
Set DDRAM Address	X	0	0	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter. (POR=000 0000)
Set Scroll Quantity	X	1	0	0	0	1	*	SQ5	SQ4	SQ3	SQ2	SQ1	SQ0	Set the quantity of horizontal dot scroll. (POR=00 0000) Valid up to SQ[5:0] = 110000b
Read Busy Flag and Address/ Part ID	X	X	0	0	1	BF	AC6 / ID6	AC5 / ID5	AC4 / ID4	AC3 / ID3	AC2 / ID2	AC1 / ID1	AC0 / ID0	Can be known whether during internal operation or not by reading BF. The contents of address counter or the part ID can also be read. When it is read the first time, the address counter can be read. When it is read the second time, the part ID can be read.  BF = "1": busy state BF = "0": ready state
Write data	X	X	0	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM / CGRAM ).
Read data	X	X	0	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM / CGRAM ).

**Notes**

(1) POR stands for Power On Reset Values.

(2) "\*" and "X" stand for "Don't care".

The complete data sheet for the controller SSD1311 is available at our website under  
<http://www.lcd-module.de/fileadmin/eng/pdf/zubehoer/ssd1311.pdf>.

## 3 CHARACTER SETS BUILT-IN

ROM A	ROM B	ROM C
0000	0000	0000
0001	0001	0001
0010	0010	0010
0011	0011	0011
0100	0100	0100
0101	0101	0101
0110	0110	0110
0111	0111	0111
1000	1000	1000
1001	1001	1001
1010	1010	1010
1011	1011	1011
1100	1100	1100
1101	1101	1101
1110	1110	1110
1111	1111	1111

## INITIALISATION EXAMPLE

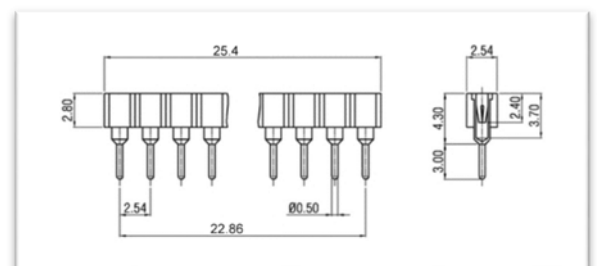
```

void init_OLEDM204(void)
{
    command(0x3A);           //FunctionSet: N=1 BE=0 RE=1 IS=0
    command(0x09);           //4-line mode
    command(0x05);           //View 0°
    command(0x38);           //FunctionSet: N=1 DH=0 RE=0 IS=0
    command(0x3A);           //FunctionSet: N=1 BE=0 RE=1 IS=0
    command(0x72);           //ROM Selection (RE muss 1 sein)
    data(0x00);              //ROM_A = 0x00, ROM_B = 0x04, ROM_C = 0x0C
    command(0x38);           //FunctionSet: N=1 DH=0 RE=0 IS=0
    command(0x0D);           //Display blink cursor on
    command(0x01);           //Clear display
}

```

## ACCESSORY: SOCKET EA FL-10P

Using a 10-pin socket makes the display replaceable and adapts the height. Those socket may also be soldered automatically by wave soldering or reflow process. Each display requires 2 pcs.





## ELECTRICAL SPECIFICATION

Unless otherwise specified, VSS = 0V , VDD = 1.8 - 3.3V ( Ta = 25°C)

Value	Condition	min	typ	max	Unit
Operating Temperature		-40		+80	°C
Storage Temperature		-40		+80	°C
Storage Humidity	<40°C			90	%RH
Operating Voltage VDD logic supply	3.3V Design	2.4	3.3	3.6	V
	5V Design	4.4	5.0	5.5	V
Operating Voltage VCC OLED supply			12.0	13.0	V
High Logic input level		0.8 x VDDIO			V
Low Logic input level				0.2 x VDDIO	V
High Logic output level		0.9 x VDDIO			V
Low Logic output level				0.1 x VDDIO	
Power Supply VCC <sup>1)</sup>	Empty		0,4		mA
	Demo content <sup>2)</sup>		3		mA
	Block Character		12		mA

<sup>1)</sup> VCC=12V, externally generated. Initialization 0x81,0xFF / 0xDB,0x20

<sup>2)</sup> Demo content:

```
* EA OLEDM204-LGA *
* 4x20 / SPI / I2C *
* -40..+80°C *
* 3 fonts+European *
```

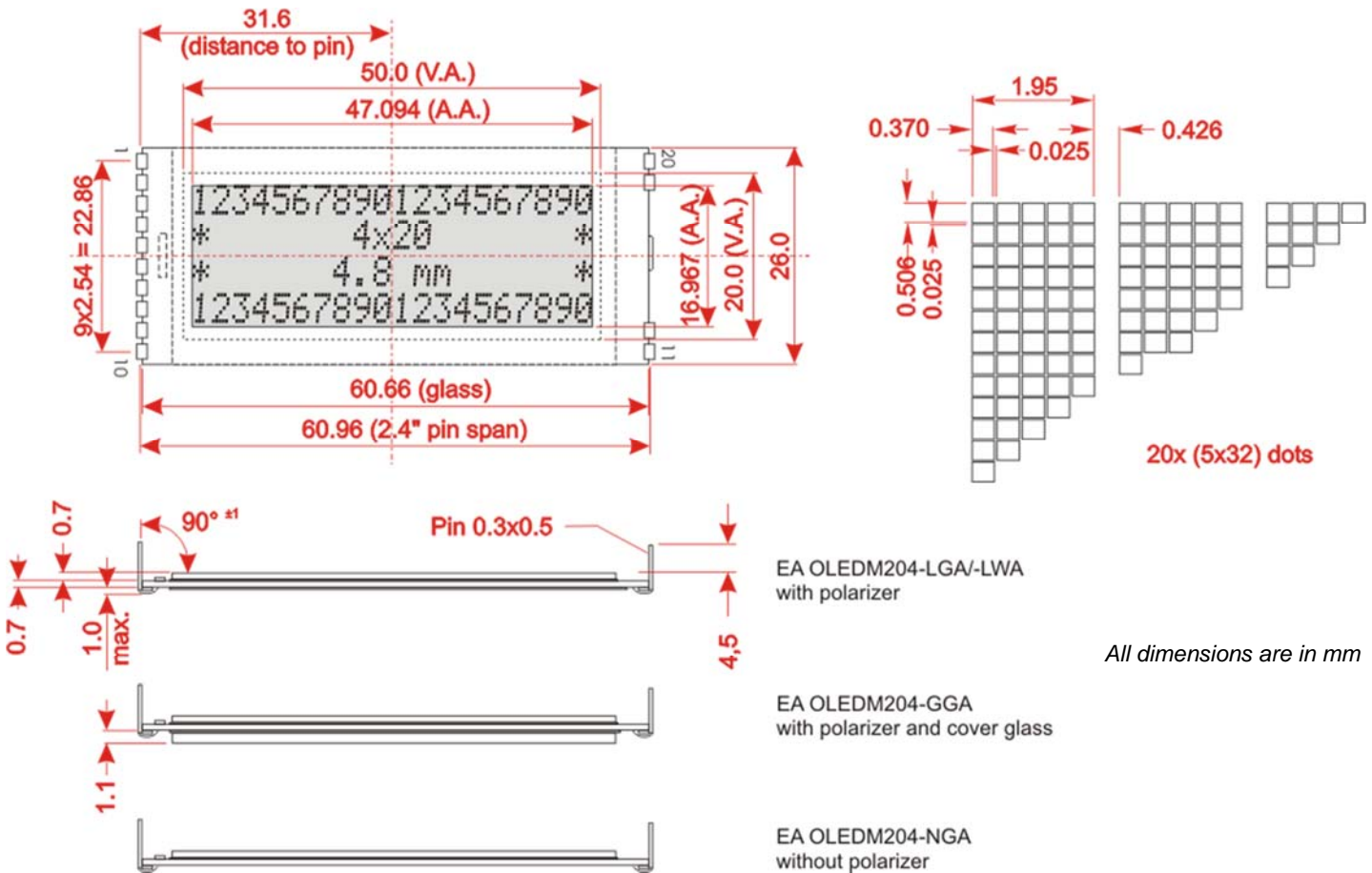
## OPTICAL DATA

Item	Symbol	Condition	min	typ	max	Unit
View Angle	(V)θ	CR≥2000	160	170		deg
	(H)φ	CR≥2000	160	170		deg
Contrast Ratio	CR	Dark Room	2000:1			
Response Time	T rise			10		µs
	T fall			10		µs
Luminance <sup>1)</sup>	L	-LGA		140		cd/m²
		-GGA		130		
		-LWA		90		
CIE 1931 x(Yellow)		Dark Room	0.45	0.47	0.49	
CIE 1931 y(Yellow)		Dark Room	0.48	0.50	0.52	
Operating Life Time <sup>2)</sup>	yellow	50% chess board	50,000			hrs
	white		20,000			

<sup>1)</sup> VDD= 3.3V, incl. booster FAN5331 with VCC= 12.3V

<sup>2)</sup> Ta=25°C, operating life time is defined the amount of time until the luminance has decayed to 50% of the initial value.  
Screen saving mode is recommended to extend life time

## DIMENSION EA OLEDM204



## PINOUT

Pin	Symbol	Description	Pin	Symbol	Description
1	VSS	Ground	11	IREF	Segment current reference
2	REGVDD	Internal 3.3V regulator	12	RES	Reset (active low)
3	VDD	3.3 V power supply			
4	VDDIO	Logic power supply			
5	CLK/SCL	Serial Clock			
6	MOSI/SDAin	Data in			
7	MISO/SDAout	Data out			
8	VCOMH	COM signal			
9	VCC	OLED driving voltage	19	CS	Chip Select (active low)
10	VLSS	Analog ground	20	BS1	L = 4-Wire SPI H = I <sup>2</sup> C Interface

**Note:**

- OLED displays are generally not suited for wave or reflow soldering. Temperatures of over 80°C can cause lasting damage.
- The surfaces of the displays are protected from scratching by self-adhesive protective foil. Please remove before mounting
- OLED are generally designed for indoor application. When be used outside they need to be protected against sunlight (UV radiation) and humidity, water and dust.