# **DOG SERIES 3.3V**

## INCL. CONTROLLER ST7036 FOR 4-/8-BIT, SPI (4-WIRE)



- \* HIGH-CONTRAST LCD SUPERTWIST DISPLAY
- \* OPTIONAL LED BACKLIGHT UNITS IN DIFFERENT COLORS
- \* 1x8, 2x16 AND 3x16 WITH 12.0 mm / 5.6 mm AND 3.6 mm CHARACTER HEIGHT
- \* ST 7036 CONTROLLER FOR 4-BIT, 8-BIT AND SPI (4-WIRE) INTERFACE
- \* POWER SUPPLY +3.3V OR +5V SINGLE SUPPLY (typically 250µA)
- \* NO ADDITIONAL VOLTAGES REQUIRED
- \* OPERATING TEMPERATURE RANGE -20 THROUGH +70°C
- \* LED BACKLIGHT 3 through 80mA@3.3V or 2 through 40mA@5V
- \* NO MOUNTING REQUIRED, SIMPLY SOLDER INTO PCB

#### **ORDERING CODE**

LCD MODULE 1x8 - 11.97mm	EA DOGM081x-A
LCD MODULE 2x16 - 5.57 mm	EA DOGM162x-A
LCD MODULE 3x16 - 3.65mm	EA DOGM163x-A

x: B = blue background

E = yellow/green background

 $L = yellow/green\ background\ (cannot\ be\ backlit)$ 

 $S = black\ background$ 

W = white background

LED BACKLIGHT, WHITE	EA LED55X31-W
LED BACKLIGHT, YELLOW/GREEN	EA LED55X31-G
LED BACKLIGHT, BLUE	EA LED55X31-B
LED BACKLIGHT, RED	EA LED55X31-R
LED BACKLIGHT, AMBER	EA LED55X31-A
LED BACKLIGHT, FULL COLOR RGB	EA LED55X31-RGB

USB TEST BOARD FOR PC (WINDOWS)

SOCKET CONNECTOR 4.8 mm HIGH (1x20-PIN, 2.54mm PITCH) EA FL-20P



**EA 9780-2USB** 

#### **EA DOG SERIES**

With its EA DOG series, ELECTRONIC ASSEMBLY presents the world's first display series which will run on 3.3 V systems without auxiliary power. They can, of course be used on traditional 5 V systems.

Unlike normal LCD modules, you order the display and the corresponding backlight separately. This gives you a wealth of possible combinations.

Designed for compact hand-held devices, this modern LCD range provides a number of real benefits with or without backlight:

- \* extremely compact at 55 x 31 mm at the standard font size of 5.57 mm (2 x 16)
- \* ultra-flat at 2.0 mm without backlight or 5.8 mm including LED backlight
- \* 4-bit, 8-bit and SPI interface (4-wire)
- \* typical power consumption of only 250µA in full operation (LED white backlight as of 3mA)
- \* easy installation by simply soldering into the board
- \* A whole range of design variants (63) can be supplied as of single units
- Changing background color

#### **SETTING THE CONTRAST**

The contrast on all displays of the EA DOG series can be set with a command. This is done using bits C0 through C5 in the commands "Contrast Set" and "Power/Icon Control/Contrast Set". Generally, the contrast is set once and kept constant across the entire operating temperature range (-20 through +70°C) thanks to the integrated temperature compensation function.

Even when run at 3.3 V, the displays do not require any additional negative voltage!

#### **LED BACKLIGHTS**

6 different variants are available for individual backlighting: white, yellow/green, blue, red, amber and full color.

For monochrome backlights, 2 separate LED paths are available, which can be switched in parallel or in series to ideally match the system voltage. This means that all the backlights can be run either at 5 V or at 3.3 V.

Operation of the backlight requires an external series resistor for current limiting. This can be calculated from R=U/I; you will find the values in the table. To improve life time it is recommanded to use a current source only.

The operating life of the yellow/green, red and amber backlights is 100,000 hours and that of the white and blue backlights much shorter.

Important: Never operate the backlight directly on a 5 V/ 3.3V supply, as this can immediately destroy the LEDs!

### **INSTALLATION**

First, the display and the corresponding backlight are clipped together. The complete unit is then inserted into a PCB and soldered. Note that the 4 pins for the backlight must also be soldered from the top.

<u>Important:</u> There are one or two protective films on the display (top and/or rear side) and one on each backlight. Those have to be removed during or after production.

yellow/green	Forwar	Current	Limiting resistor		
EA LED55x31-G	voltage	max.	@ 3,3 V	@ 5 V	
Connected in parallel	2,2 V	80 mA	14 ohm	35 ohm	
Connected in series	4,4 V	40 mA	-	15 ohm	

white	Forwar	Current	Limiting resistor		
EA LED55x31-W	voltage	max.	@ 3,3 V	@ 5 V	
Connected in parallel	3,2 V	60 mA	1,6 ohm	30 ohm	
Connected in series	6,4 V	30 mA	-	-	

blue	Forwar	Current	Limiting resistor		
EA LED55x31-B	voltage	max.	@ 3,3 V	@ 5 V	
Connected in parallel	3,2 V	60 mA	1,6 ohm	30 ohm	
Connected in series	6,4 V	30 mA	-	-	

amber	Forwar	Current	Limiting resistor		
EA LED55x31-A	voltage	max.	@ 3,3 V	@ 5 V	
Connected in parallel	2,4 V	80 mA	11 ohm	32 ohm	
Connected in series	4,8 V	40 mA	-	5 ohm	

red	Forwar	Current	Limiting resistor		
EA LED55x31-R	voltage	max.	@ 3,3 V	@ 5 V	
Connected in parallel	2,1 V	80 mA	15 ohm	36 ohm	
Connected in series	4,2 V	40 mA	-	20 ohm	

Full color	Forwar	Current	Limiting resistor			
EA LED55x31-RGB	voltage	max.	@3,3 V	@ 5 V		
Connected in parallel	4 V	125 mA	-	3x24 ohm		



#### **5 DIFFERENT TECHNOLOGIES**

As a standard we provide 5 different technologies as STN and FSTN:

display type	technology	optional backlight	readability	display color non backlighted	display color with backlighted	recommended backlight color
EA DOGMxxxW-A	FSTN pos. transflective	it's fine with and without backlight	readable even without backlight	black on white	black on backlight color	white, blue, RGB
EA DOGMXXXE-A	STN pos. yellow/green transmissive	backlight unit required	readable even without backlight dark green on yellow/green		black on yellow/green or amber	yellow/green, amber
EA DOGMxxxB-A	STN neg. blue transmissive	usage only with backlight			backlight color on blue background	white, yellow/green
EA DOGMxxxS-A	FSTN neg. transmissive	usage only with backlight			backlight color on black background	white, RGB
EA DOGMxxxL-A	STN pos. yellow/green reflective	no backlight possible	finest readable without backlight	dark green on yellow/green		

#### **3 DIFFERENT DISPLAYS**

These displays are available for mentioned technologies:

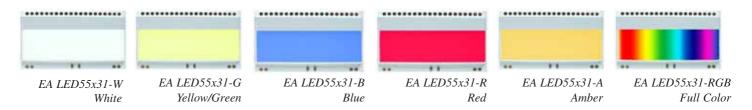






#### **6 DIFFERENT BACKLIGHTS**

6 different backlight colors are available to match equipments design as much as possible. The most effective and brightest one is the white one EA LED55x31-W.



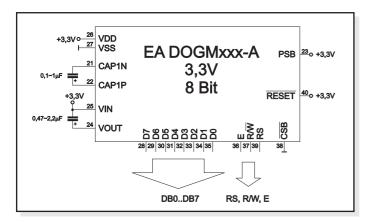
When you can see black and white pictures only here on this page then you're able to download a coloured version from our website <a href="http://www.lcd-module.de/eng/pdf/doma/dogme.pdf">http://www.lcd-module.de/eng/pdf/doma/dogme.pdf</a>

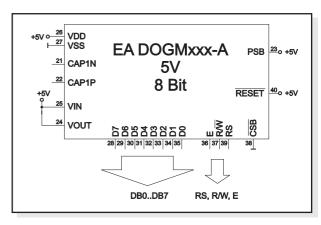


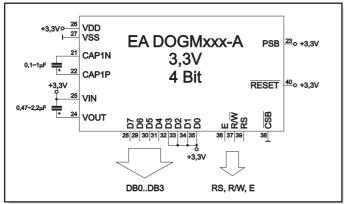
#### **APPLICATION EXAMPLES**

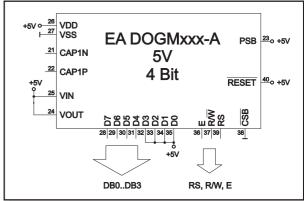
Different wiring must be used depending on the interface and the power supply. 2 additional capacitors are required for 3.3 V operation.

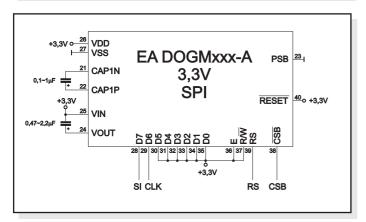
Note that the COG technology means that the current capacity of the outputs is limited. Therefore, a large load on the bus may cause signal loops and unclean levels. If in doubt, additional pull-down resistors (8051) are required or additional waits/NOPs must be incorporated.

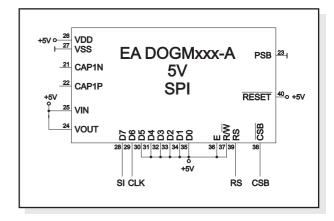












#### **USB-TEST BOARD EA 9780-2USB**

For easy startup, a USB test board is available that can be connected to a PC. An USB cable and a Windows software is supplied with the product. This allows individual text and to be displayed directly on the connected display.

#### SIMULATION WITH WINDOWS

A simulator window also displays the contents of the display. The software can simulate all the displays and colors even without the hardware. You can download the software free from our website: <a href="http://www.lcd-module.de/deu/disk/startdog.zip">http://www.lcd-module.de/deu/disk/startdog.zip</a>



#### **CHARACTER SET**

The below show character set is already built-in. In addition to that you are able to define 8 characters by your own.

67-64 60-60	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000														***		
0001				*****												
0010																
0011																
0100																
0101																
0110																
0111																
1000																
1001																
1010																
1011																
1100																
1101																
1110																
1111																

A detailed description for integrated controller ST7036 you can find under <a href="http://www.lcd-module.de/eng/pdf/zubehoer/st7036.pdf">http://www.lcd-module.de/eng/pdf/zubehoer/st7036.pdf</a>



## **TABLE OF COMMAND**

Instruction			Ir	nstr	ucti	on	Coc	le			Description	Execution
motraction	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description	Exec
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC	1.08 ms
Return Home	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.	1.08 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.	26.3 µs
Display ON/OFF	0	0	0	0	0	0	1	D	С	В	D=1:entire display on C=1:cursor on B=1:cursor position on	26.3 µs
Function Set	0	0	0	0	1	DL	N	DH	IS2	IS1	DL: interface data is 8/4 bits N: number of line is 2/1 DH: double height font IS[2:1]: instruction table select	26.3 µs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter	26.3 µs
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM/ICONRAM)	26.3 μs
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM/ICONRAM)	26.3 µs

	Instruction table 0(IS[2:1]=[0,0])												
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	X	x	S/C and R/L: Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	26.3 µs	
Set CGRAM	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter	26.3 µs	

						Ins	truc	tior	ı ta	ble	1(IS[2:1]=[0,1])	
Bias Set	0	0	0	0	0	1	BS	1	0	FX	BS=1:1/4 bias BS=0:1/5 bias FX: fixed on high in 3-line application and fixed on low in other applications.	26.3 µs
Set ICON Address	0	0	0	1	0	0	AC3	AC2	AC1	AC0	Set ICON address in address counter.	26.3 µs
Power/ICON Control/ Contrast Set	0	0	0	1	0	1	Ion	Bon	C5	C4	Ion: ICON display on/off Bon: set booster circuit on/off C5,C4: Contrast set for internal follower mode.	26.3 µs
Follower Control	0	0	0	1	1	0	Fon	Rab 2	Rab 1	Rab 0	Fon: set follower circuit on/off Rab2~0: select follower amplified ratio.	26.3 µs
Contrast Set	0	0	0	1	1	1	С3	C2	C1	CO	Contrast set for internal follower mode.	26.3 µs

						Ins	truc	tior	ı tal	ble	2(IS[2:1]=[1,0])	
Double Height Position Select	0	0	0	0	0	1	UD	X	х	х	UD: Double height position select	26.3 µs
Reserved	0	0	0	1	X	X	X	X	X	Х	Do not use (reserved for test)	26.3 µs





## **EXAMPLES FOR INITIALISATION**

## EA DOGM081

				E	xam	ple		itiali			bit /	3.3V
Command	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Hex	Note
Function Set	0	0	0	0	1	1	0	0	0	1	\$31	8 bit data length, 1 line, instruction table 1
Bias Set	0	0	0	0	0	1	0	1	0	0	\$14	BS: 1/5, 1 line LCD
Power Control	0	0	0	1	0	1	0	1	0	1	\$55	booster on, contrast C5, set C4
Follower Control	0	0	0	1	1	0	1	1	0	1	\$6D	set voltage follower and gain
Contrast Set	0	0	0	1	1	1	1	1	0	0	\$7C	set contrast C3, C2, C1
Function Set	0	0	0	0	1	1	0	0	0	0	\$30	switch back to instruction table 0
Display ON/OFF	0	0	0	0	0	0	1	1	1	1	\$0F	display on, cursor on, cursor blink
Clear Display	0	0	0	0	0	0	0	0	0	1	\$01	delete display, cursor at home
Entry Mode Set	0	0	0	0	0	0	0	1	1	0	\$06	cursor auto-increment

Initialisation for 3.3V

	Example of initialisation: 8 bit / 5V  EA DOGM081														
Command	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Hex	Note			
Function Set	0	0	0	0	1	1	0	0	0	1	\$31	8 bit data length, 1 line, instruction table 1			
Bias Set	0	0	0	0	0	1	1	1	0	0	\$1C	BS: 1/4, 1 line LCD			
Power Control	0	0	0	1	0	1	0	0	0	1	\$51	booster off, contrast C5, set C4			
Follower Control	0	0	0	1	1	0	1	0	1	0	\$6A	set voltage follower and gain			
Contrast Set	0	0	0	1	1	1	0	1	0	0	\$74	set contrast C3, C2, C1			
Function Set	0	0	0	0	1	1	0	0	0	0	\$30	switch back to instruction table 0			
Display ON/OFF	0	0	0	0	0	0	1	1	1	1	\$0F	display on, cursor on, cursor blink			
Clear Display	0	0	0	0	0	0	0	0	0	1	\$01	delete display, cursor at home			
Entry Mode Set	0	0	0	0	0	0	0	1	1	0	\$06	cursor auto-increment			

 $Initialisation \ for \ 5V$ 

## EA DOGM162

				E	xam	ple	of in	itiali	satio	n: 8	Bit /	3.3V
							E	A DO	3M16	2		
Command	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Hex	Note
Function Set	0	0	0	0	1	1	1	0	0	1	\$39	8 bit data length, 2 lines, instruction table
Bias Set	0	0	0	0	0	1	0	1	0	0	\$14	BS: 1/5, 2 line LCD
Power Control	0	0	0	1	0	1	0	1	0	1	\$55	booster on, contrast C5, set C4
Follower Control	0	0	0	1	1	0	1	1	0	1	\$6D	set voltage follower and gain
Contrast Set	0	0	0	1	1	1	1	0	0	0	\$78	set contrast C3, C2, C1
Function Set	0	0	0	0	1	1	1	0	0	0	\$38	switch back to instruction table 0
Display ON/OFF	0	0	0	0	0	0	1	1	1	1	\$0F	display on, cursor on, cursor blink
Clear Display	0	0	0	0	0	0	0	0	0	1	\$01	delete display, cursor at home
Entry Mode Set	0	0	0	0	0	0	0	1	1	0	\$06	cursor auto-increment

Initialisation for 3.3V

	Example of initialisation: 8 bit / 5V  EA DOGM162														
Command	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Hex	Note			
Function Set	0	0	0	0	1	1	1	0	0	1	\$39	8 bit data length, 2 lines, instruction table			
Bias Set	0	0	0	0	0	1	1	1	0	0	\$1C	BS: 1/4, 2 line LCD			
Power Control	0	0	0	1	0	1	0	0	1	0	\$52	booster off, contrast C5, set C4			
Follower Control	0	0	0	1	1	0	1	0	0	1	\$69	set voltage follower and gain			
Contrast Set	0	0	0	1	1	1	0	1	0	0	\$74	set contrast C3, C2, C1			
Function Set	0	0	0	0	1	1	1	0	0	0	\$38	switch back to instruction table 0			
Display ON/OFF	0	0	0	0	0	0	1	1	1	1	\$0F	display on, cursor on, cursor blink			
Clear Display	0	0	0	0	0	0	0	0	0	1	\$01	delete display, cursor at home			
Entry Mode Set	0	0	0	0	0	0	0	1	1	0	\$06	cursor auto-increment			

 $Initialisation \ for \ 5V$ 

## EA DOGM163

				Е	xam	ple					bit /	3.3V
							E	A DO	GM16	3		
Befehl	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Hex	Bemerkung
Function Set	0	0	0	0	1	1	1	0	0	1	\$39	8 bit data length, 2 lines, instruction table
Bias Set	0	0	0	0	0	1	0	1	0	1	\$15	BS: 1/5, 3 line LCD
Power Control	0	0	0	1	0	1	0	1	0	1	\$55	booster on, contrast C5, set C4
Follower Control	0	0	0	1	1	0	1	1	1	0	\$6E	set voltage follower and gain
Contrast Set	0	0	0	1	1	1	0	0	1	0	\$72	set contrast C3, C2, C1
Function Set	0	0	0	0	1	1	1	0	0	0	\$38	switch back to instruction table 0
Display ON/OFF	0	0	0	0	0	0	1	1	1	1	\$0F	display on, cursor on, cursor blink
Clear Display	0	0	0	0	0	0	0	0	0	1	\$01	delete display, cursor at home
Entry Mode Set	0	0	0	0	0	0	0	1	1	0	\$06	cursor auto-increment

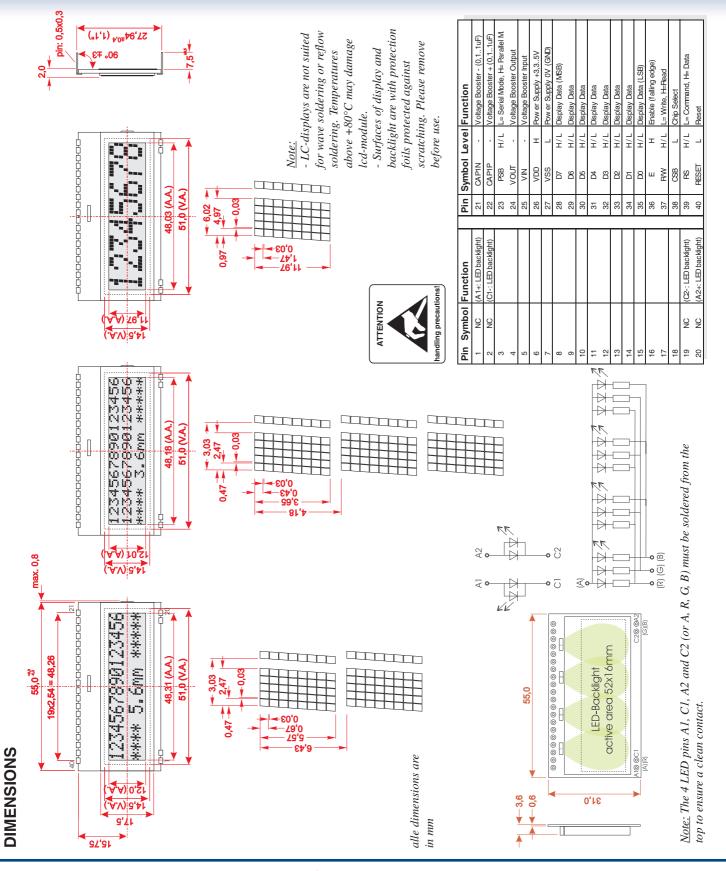
Initialisation for 3.3V

	Example of initialisation: 8 bit / 5V EA DOGM163														
Command	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Hex	Note			
Function Set	0	0	0	0	1	1	1	0	0	1	\$39	8 bit data length, 2 lines, instruction table			
Bias Set	0	0	0	0	0	1	1	1	0	1	\$1D	BS: 1/4, 3 line LCD			
Power Control	0	0	0	1	0	1	0	0	0	0	\$50	booster off, contrast C5, set C4			
Follower Control	0	0	0	1	1	0	1	1	0	0	\$6C	set voltage follower and gain			
Contrast Set	0	0	0	1	1	1	1	1	0	0	\$7C	set contrast C3, C2, C1			
Function Set	0	0	0	0	1	1	1	0	0	0	\$38	switch back to instruction table 0			
Display ON/OFF	0	0	0	0	0	0	1	1	1	1	\$0F	display on, cursor on, cursor blink			
Clear Display	0	0	0	0	0	0	0	0	0	1	\$01	delete display, cursor at home			
Entry Mode Set	0	0	0	0	0	0	0	1	1	0	\$06	cursor auto-increment			

Initialisation for 5V



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## ELECTRONIC ASSEMBLY making things easy