

PV198 - LCD

One-chip Controllers

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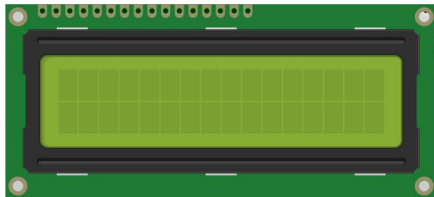
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Intro

- Switch the branch to *Week_11!*
- Discussion of HW9

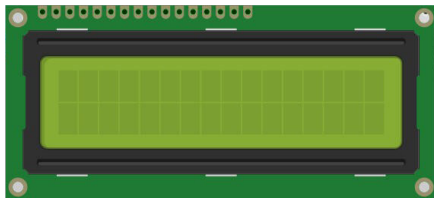
LCD

- LCD = Liquid Crystal Display
- Usage
 - Printers
 - Routers
 - Industrial equipment
 - Consumer equipment – washing machines, ...
 - ...

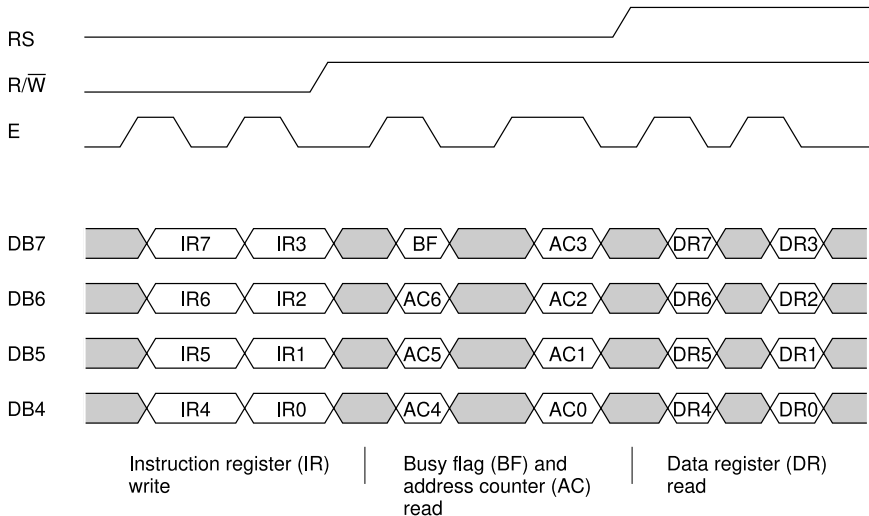


LCD 1602A

- Display for 16×2 characters
- HD44780U Display Controller – [datasheet](#)
- Basic connection:
 - DB4–DB7 (4-bit parallel transfer)
 - RS – Register Select
 - R/W – Read/Write select
 - E – Starts data read/write



Message



FRDM-K66F – LCD 1602A Connection

FRDM-K66F	LCD 1602A
GND GND	1 VSS
P5V_USB 5V	2 VDD
DAC0_OUT DAC0_OUT	3 V0
PTA27 LCD_RS	4 RS
PTA26 LCD_RW	5 R/W
PTA4 LCD_E	6 E
PTA6 LCD_DB4	11 DB4
PTA7 LCD_DB5	12 DB5
PTA8 LCD_DB6	13 DB6
PTA9 LCD_DB7	14 DB7

Digital-to-Analog-Converter (DAC) is used to control LCD contrast. Use pins A (anode – connect to 3V3) & K (cathode – connect to GND) to drive backlight.

Driver

- Support for 4bit communication initialization
- SysTick timer used for delays
- Basic command and data transfer functions
- Does not read busy flag – uses delays instead

Driver Pins

The LCD driver requires to define the following identifiers in the Pins tool for GPIO output pins: LCD_RS, LCD_RW, LCD_E, LCD_DB4, LCD_DB5, LCD_DB6, LCD_DB7.

Routing Details for LCD...

#	Peripheral	Signal	Arrow	Routed pin/signal	Label	Identifier	Direction	GPIO initial state	GPIO interrupt
J10	GPIOA	GPIO, 27	→	[J10] PTA27	J3[1]/FB_A26	LCD_RS	Output	Logical 0	n/a
J11	GPIOA	GPIO, 26	→	[J11] PTA26	J3[3]/FB_A27	LCD_RW	Output	Logical 0	n/a
L7	GPIOA	GPIO, 4	→	[L7] PTA4	J3[5]/LLWU_P3/FTM0_CH1/NMI	LCD_E	Output	Logical 0	n/a
J7	GPIOA	GPIO, 6	→	[J7] PTA6	J3[7]/CLKOUT	LCD_DB4	Output	Logical 0	n/a
J8	GPIOA	GPIO, 7	→	[J8] PTA7	J3[9]/FTM0_CH4/TRACE_D3	LCD_DB5	Output	Logical 0	n/a
K8	GPIOA	GPIO, 8	→	[K8] PTA8	J3[11]/FTM1_CH0/TRACE_D2	LCD_DB6	Output	Logical 0	n/a
L8	GPIOA	GPIO, 9	→	[L8] PTA9	J3[13]/FTM1_CH1/TRACE_D1	LCD_DB7	Output	Logical 0	n/a
L3	DAC0	OUT	→	[L3] DAC0_OUT	J4[11]/DAC_OUT	DAC0_OUT	Output	n/a	n/a
H5	DAC0	REF_2	←	[H5] VDDA	P3V3_K66F	n/a	Input	n/a	n/a

Driver Interface

```
void LCD_4BitsInit(uint32_t systick_clk_freq,  
    bool cursor_on, bool cursor_blinking)  
void LCD_Clear()  
void LCD_Home()  
void LCD_SetPosition(uint8_t x, uint8_t y)  
void LCD_PutChar(uint8_t character)  
void LCD_Print(char s[])  
void LCD_SendCommand(uint8_t command)  
void LCD_SendData(uint8_t data, MessageType_t messageType)
```

Template

- Real date and time display demo
- Download from study materials
- Content:
 - LCD driver initialization
 - RTC peripheral initialization
 - while loop: obtain current date & time, print on display

Seminar task

- Implement a function `LCD_SendData` according to the message format picture.
- `void LCD_SendData(uint8_t data, MessageType_t messageType)`
- Bonus: display floating text on the display.

Homework

- Generate something else on the LCD string (be creative).
- Tests check for initialization and if there is something on the screen.
- Avoid adding drivers, they will break the project.

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