

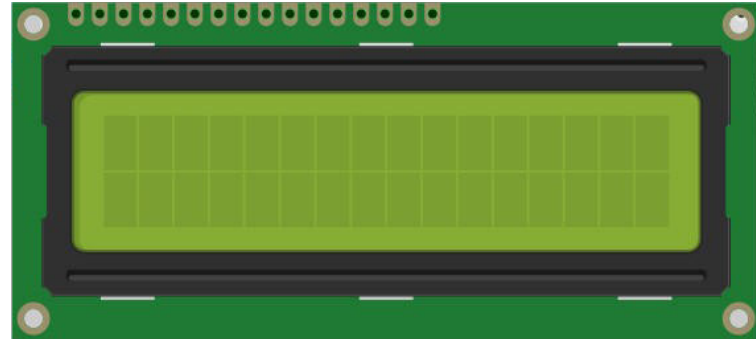


# **PV198 – One-chip Controllers**

## **LCD Display**

# Content

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2. LCD 1602A
3. Driver
4. Application





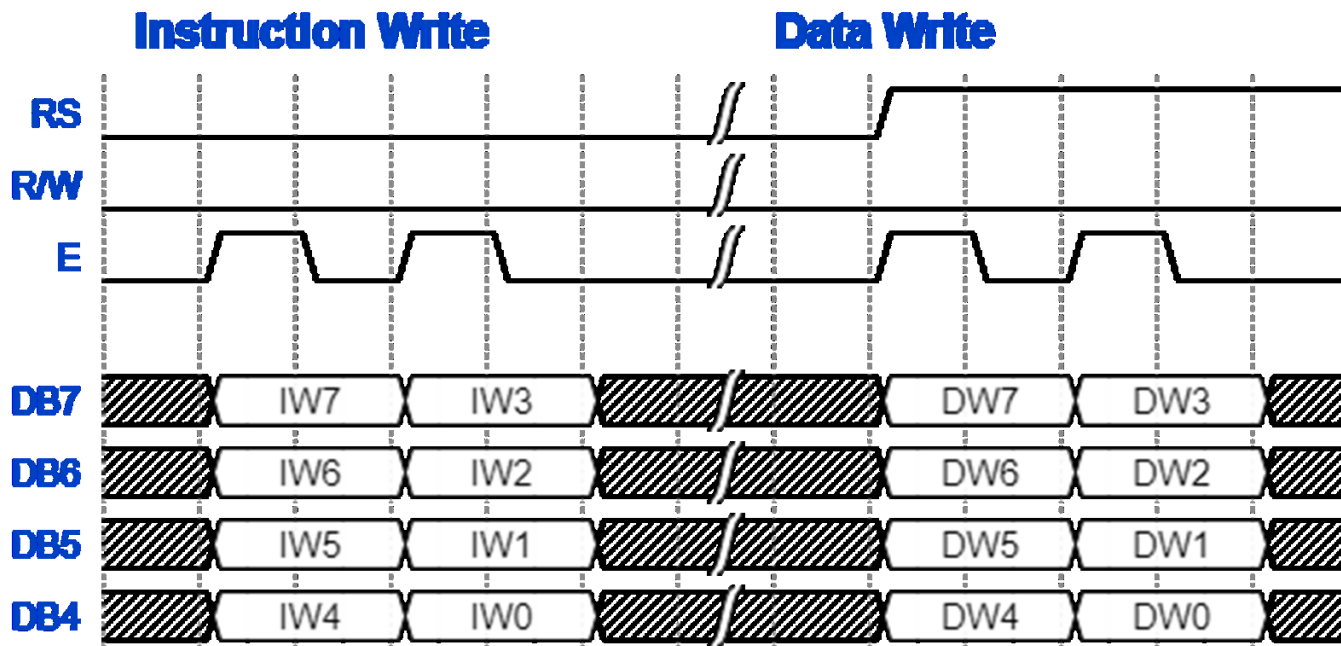
## LCD Display usage

- Printers
- Routers
- Industrial equipment
- ...

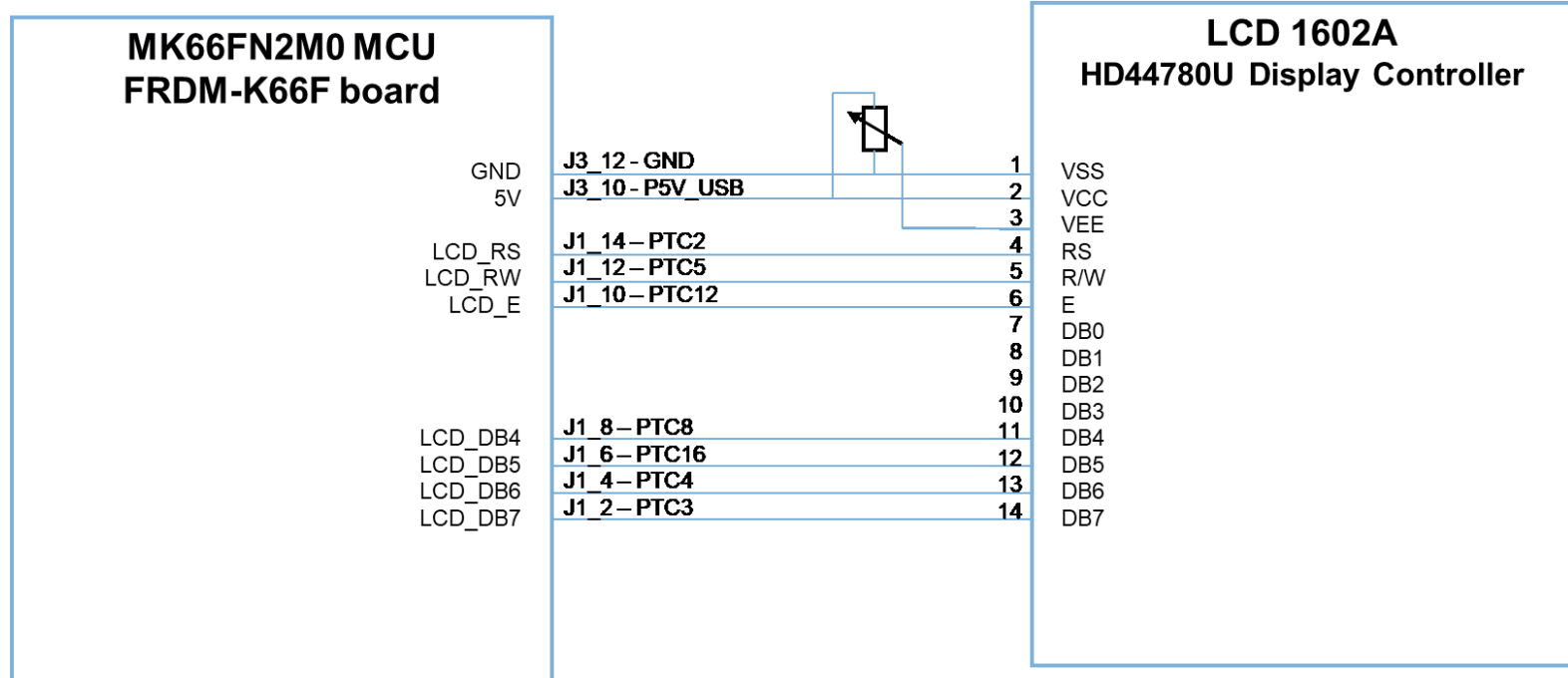
## LCD 1602A – Overview

- LCD 1602A display driver
  - HD44780U Display Controller – [Datasheet](#)
  - 4 bits connection
  - Connection via GPIO pins (7 outputs)

# LCD 1602A – Message

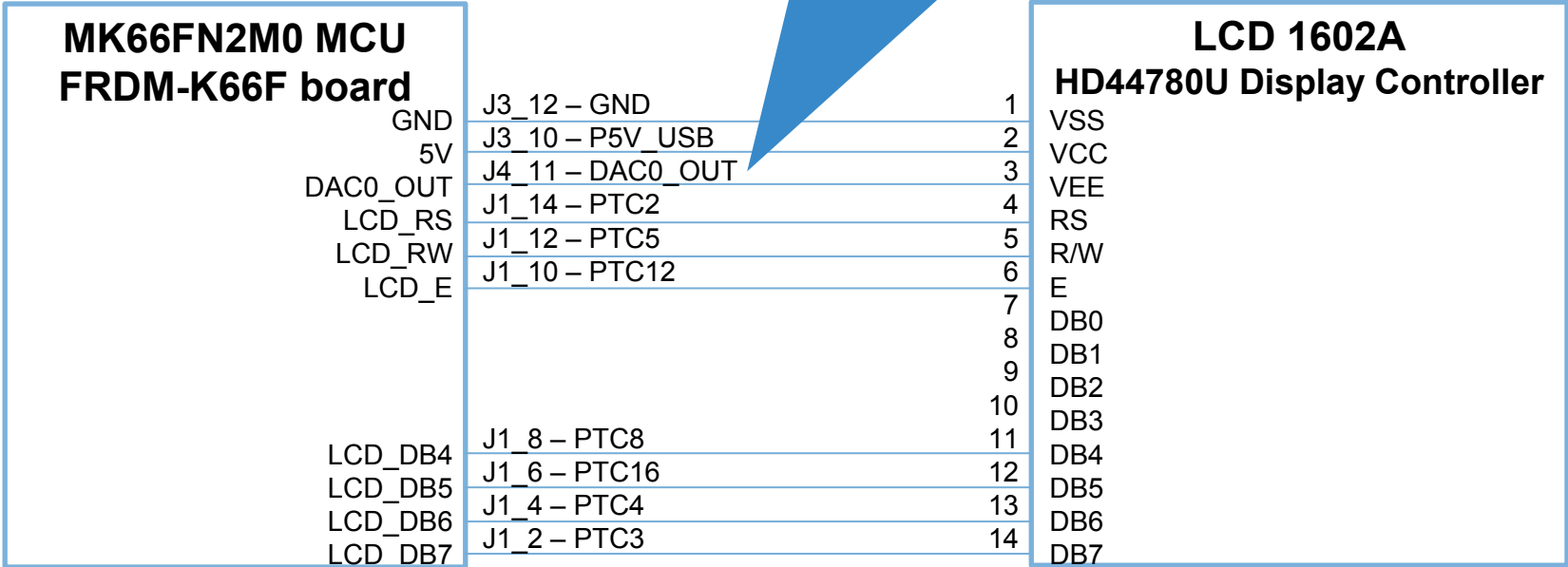


# LCD 1602A – Scheme



# LCD 1602A – Scheme

We will use DAC output instead of potentiometer



## LCD 1602A – Driver

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




# LCD 1602A – Driver Interface

- 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

#	Peripheral	Signal	Route to	Label	Identifier	Direction	GPIO initial state	GPIO interrupt	Slew rate	Open drain	Drive strength	Pull select	Pull enable	Passive
A12	GPIOC	GPIO, 2	PTC2	J1[14]/FTM0_CH1/CMP1_IN0/FB_AD12	LCD_RS	Output	Logical 0	n/a	Fast	Disabled	Low	Pulldown	Disabled	Disable
D8	GPIOC	GPIO, 5	PTC5	J1[12]/I2S0_RXD0/FB_AD10/FTM0_CH2	LCD_RW	Output	Logical 0	n/a	Fast	Disabled	Low	Pulldown	Disabled	Disable
A7	GPIOC	GPIO, 12	PTC12	J1[10]/FB_AD27	LCD_E	Output	Logical 0	n/a	Fast	Disabled	Low	Pulldown	Disabled	Disable
A8	GPIOC	GPIO, 8	PTC8	J1[8]/FTM3_CH4/ADC1_SE4b	LCD_DB4	Output	Logical 0	n/a	Fast	Disabled	Low	Pulldown	Disabled	Disable
A6	GPIOC	GPIO, 16	PTC16	J1[6]/ENET0_1588_TMR0	LCD_DB5	Output	Logical 0	n/a	Fast	Disabled	Low	Pulldown	Disabled	Disable
A9	GPIOC	GPIO, 4	PTC4	J1[4]/UART1_TX/FTM0_CH3/FB_AD11	LCD_DB6	Output	Logical 0	n/a	Fast	Disabled	Low	Pulldown	Disabled	Disable
A11	GPIOC	GPIO, 3	PTC3	J1[2]/UART1_RX/FTM0_CH2/CLKOUT	LCD_DB7	Output	Logical 0	n/a	Fast	Disabled	Low	Pulldown	Disabled	Disable

## LCD 1602A – Driver Interface

- The following LCD driver functions are provided:
  - 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)**
- SysTick timer is used for implementation of delay



Our task is to  
implement this function

## Application

- LCD driver initialization
- RTC peripheral initialization
- Real date and time display demo



## Application

- Initialization sequence of the LCD driver

```
BOARD_InitPins();
```

Initialization of GPIO pins (wired interface) with the generated code from the Pins tools

Initialization of the LCD driver (using core clock frequency and without cursor)

```
LCD_4BitsInit(BOARD_BOOTCLOCKRUN_CORE_CLOCK, false, false);
```

- Runtime usage of the driver (example):

```
LCD_SetPosition(0, 0);  
LCD_Print("a string");
```

Displaying "a string" on the LCD screen at position 0,0 (the first column and first line)

## Application

- Implement function according to message format picture:
  - void LCD\_SendData(uint8\_t data, MessageType\_t messageType)

Bonus:

- Display floating text on the display



## Homework

- Use LCD display with any project created before (accelerometer, temperature sensor, ...)