Character LCD

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| **Document Name** |  |
| **Version** | 2.0 |
| **Author** | Norhan Osama |
| **Status** |  |
| **Date** | 4/8/2016 |

Document History

| Version | Date | Author | Changes |
| --- | --- | --- | --- |
| 1.00 | 01/04/2016 | Norhan Osama | Initial |
| 2.0 | 4/8/16 | Norhan osama | Added macros |
|  |  |  |  |
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# Introduction

This document is created to demonstrate the character LCD component and its used APIs also to demonstrate the dependant drivers for this module.

This design document descries the software module component of the 16X2 LCD ,that has the following characteristics:

* 16 character/ line
* 2 lines.
* 8 data lines (D0 – D8)

## Goals and Objectives

To provide demonstration of the used APIs and components to write any string on the LCD, controlling where to display the character on the LCD.

Display any kind of characters by creating custom characters on the LCD internal CGRAM, so basically we can write any alphabetical characters in any language.

## Component APIs and variables

|  |  |
| --- | --- |
| **Interface** | **Description** |
| *LCD driver* | *The driver is to write characters on the LCD and interface with the DIO driver.* |
| *DIO Driver* | *It is required to interface with microcontroller through DIO peripheral.* |

Table 1: Interfaces description

|  |  |  |  |
| --- | --- | --- | --- |
| ***API*** | ***Description*** | ***Input arguments*** | ***Return Value*** |
| **LCD\_voidInit** | This function is used to initialize the LCD.  it sets the functionality of LCD to be 8 bit mode or 4 bit mode .  It also sets the LCD initial state of the LCD. | None | None |
| **LCD\_voidWriteCommand** | This function used to send a command to the LCD internal controller. | A variable that holds the 8 bit command to be sent | None |
| **LCD\_voidWriteChar** | This function used to send data to be displayed on LCD.  These data usually is the ASCII code of the character to be displayed, as the ASCII code is considered the physical address of this character inside the CGROM of the LCD controller | A variable that holds the 8 bit data to be displayed | None |
| **LCD\_voidWriteString** | This function used to send string to be displayed on LCD by sending displaying character by character.  So this function calls the **LCD\_voidWriteChar()** function as many times as the number of characters inside the string ( character array). | a pointer to string (char array). | None |
| **LCD\_voidWriteCustomChar** | this function is used to write a custom character to the CGRAM of the LCD to be displayed later on. | A pointer to array that holds the character, each element consider the value of a Row in a custom character and a 8-bit variable that holds the location of the created character in CGRAM | None |
| **LCD\_voidClearLine** | This function is used to clear a specific line in LCD. | A 8-bit variable that holds the number of line to be cleared the first or second line. | None |

Table 2: API description

|  |  |  |
| --- | --- | --- |
| **Variable** | **Type** | **Description** |
| **LCD\_u8dataPins[ ]** | Global u8 | This array holds the data pins of the LCD that refers to a digital output pins on the microcontroller |

Table 3: global variables

## Interfacing macros:

|  |  |  |
| --- | --- | --- |
| **Macro** | **Description** | **Comment** |
| DISPOFF\_CURSOFF | LCD command clear display without clearing DDRAM | Used as an argument for function LCD\_voidWriteCommand() |
| DISPON\_CURSON | LCD command display on ,cursor on | Used as an argument for function LCD\_voidWriteCommand() |
| DISPON\_CURSOFF | LCD command display on ,cursor off | Used as an argument for function LCD\_voidWriteCommand() |
| DISPON\_CURSBLINK | LCD command display on , cursor blinking | Used as an argument for function LCD\_voidWriteCommand() |
| SHIFT\_DISP\_RIGHT | LCD command shift entire display right | Used as an argument for function LCD\_voidWriteCommand() |
| SHIFT\_DISP\_LEFT | LCD command shift entire display left | Used as an argument for function LCD\_voidWriteCommand() |
| MOV\_CURS\_LEFT | LCD command move cursor one character right | Used as an argument for function LCD\_voidWriteCommand() |
| MOV\_CURS\_RIGHT | LCD command move cursor one character left | Used as an argument for function LCD\_voidWriteCommand() |
| CLR\_DISP | LCD command Clear display and also clears DDRAM | Used as an argument for function LCD\_voidWriteCommand() |
| LCD\_SET\_CURS | LCD command set cursor position | Used as an argument for function LCD\_voidWriteCommand() |
| LCD\_u8LINE1 | LCD command Line 1 address | Used as an argument for function LCD\_voidWriteCommand() |
| LCD\_u8LINE2 | LCD command line 2 address | Used as an argument for function LCD\_voidWriteCommand() |
| LCD\_u8LINE1\_LOC0 | LCD command Go to line 1 location 0 | Used as an argument for function LCD\_voidWriteCommand() |
| LCD\_u8LINE2\_LOC0 | Go to line 2 location 0 | Used as an argument for function LCD\_voidWriteCommand() |

## Dependant Modules :

* DIO driver

**2 Design constraints**

## 2.1 Constraints on Initialization

* The configuration of data and control pins must be right to avoid wrong initialization and the modes of the LCD, which affect the initialization process.
* This module needs the DIO driver to be initialized first, because the DIO driver API’s are used in side this module.
* Make sure to include the shared libraries used
* Types.h.

## 2.2 Constraints on Inputs

While Writing Custom character to CGRAM make sure that the 8 bit variable that holds the location of the created custom character in CGRAM to be in range from 0 to 7.Configuration

**3 Configurations**

**3.1 configuration macros**

|  |  |  |
| --- | --- | --- |
| **Configuration Parameters** | **Description** | **Comment** |
| LCD\_u8D0  LCD\_u8D1  LCD\_u8D2  LCD\_u8D3  LCD\_u8D4  LCD\_u8D5  LCD\_u8D6  LCD\_u8D7 | DIO pins connected to LCD data pins. | 8 pins for data in range of **DIO\_u8PIN0 ~ DIO\_u8PIN31** |
| LCD\_u8RS  LCD\_u8RW  LCD\_u8ENABLE | DIO pins connected to LCD control pins. | 8 pins for data in range **DIO\_u8PIN0 ~ DIO\_u8PIN31** |
| LCD\_u8INIT\_STATE | The initial state of the LCD. | To be ON or OFF and show the  **LCD\_u8ON ~ LCD\_u8OFF** |
| LCD\_u8Mode | The LCD data mode. | To be 4-bit or 8-bit mode.  **LCD\_u8\_4bit ~ LCD\_u8\_8bit** |

Table 4: Configuration Parameters

## 3.2 File Description

|  |  |
| --- | --- |
| **File Name** | **Description** |
| LCD\_interface.h | It contains the prototypes of the APIs. |
| LCD\_config.h | It contains the configuration parameters of the component. |
| LCD\_private.h | It contains private configuration parameters. |
| LCD\_prog.c | It contains the written code of the APIs. |

Table 5: Files Description

{END\_VAL\_SPECIFICATION\_DOC}