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| SOVY |
| Digital Calculator PO1\_DGC\_HSI |

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# Document Status

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# Document History

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| Version | Author | Date | Change |
| 1.0 | NK, NM | 13/2/2021 | Initial Creation |
| 1.1 | NK, NM | 14/2/2021 | Updating the system context diagram |
| 1.2 | HM | 19/2/2021 | Updating the requirements ID’s and making them atomic.  Added: - Lcd Features section  Deleted :  - Remove the Lcd From requirement sections |
| 1.3 | NM | 22/2/2021 | Updating the requirements ID’s and making them atomic.  Added: - Lcd datasheet in the reference document  - Req\_1ST123\_HSI\_overall\_006-V1.0  - Req\_1ST123\_HSI\_overall\_007-V1.0  - ­ Req\_1ST123\_HSI\_overall\_008-V1.0  - Req\_1ST123\_HSI\_overall\_009-V1.0  ­ - Req\_1ST123\_HSI\_overall\_010-V1.0  Edited:  - Project’s description  - Req\_1ST123\_HSI\_overall\_001-V1.0  - Req\_1ST123\_HSI\_overall\_002-V1.0  - Req\_1ST123\_HSI\_overall\_003-V1.0  - Req\_1ST123\_HSI\_overall\_004-V1.0  - Req\_1ST123\_HSI\_overall\_005-V1.0 |
| 1.4 | NM | 07/3/2021 | Edited:  - Project’s description  - Req\_1ST123\_HSI\_overall\_006-V1.0  - Req\_1ST123\_HSI\_overall\_009-V1.0 |

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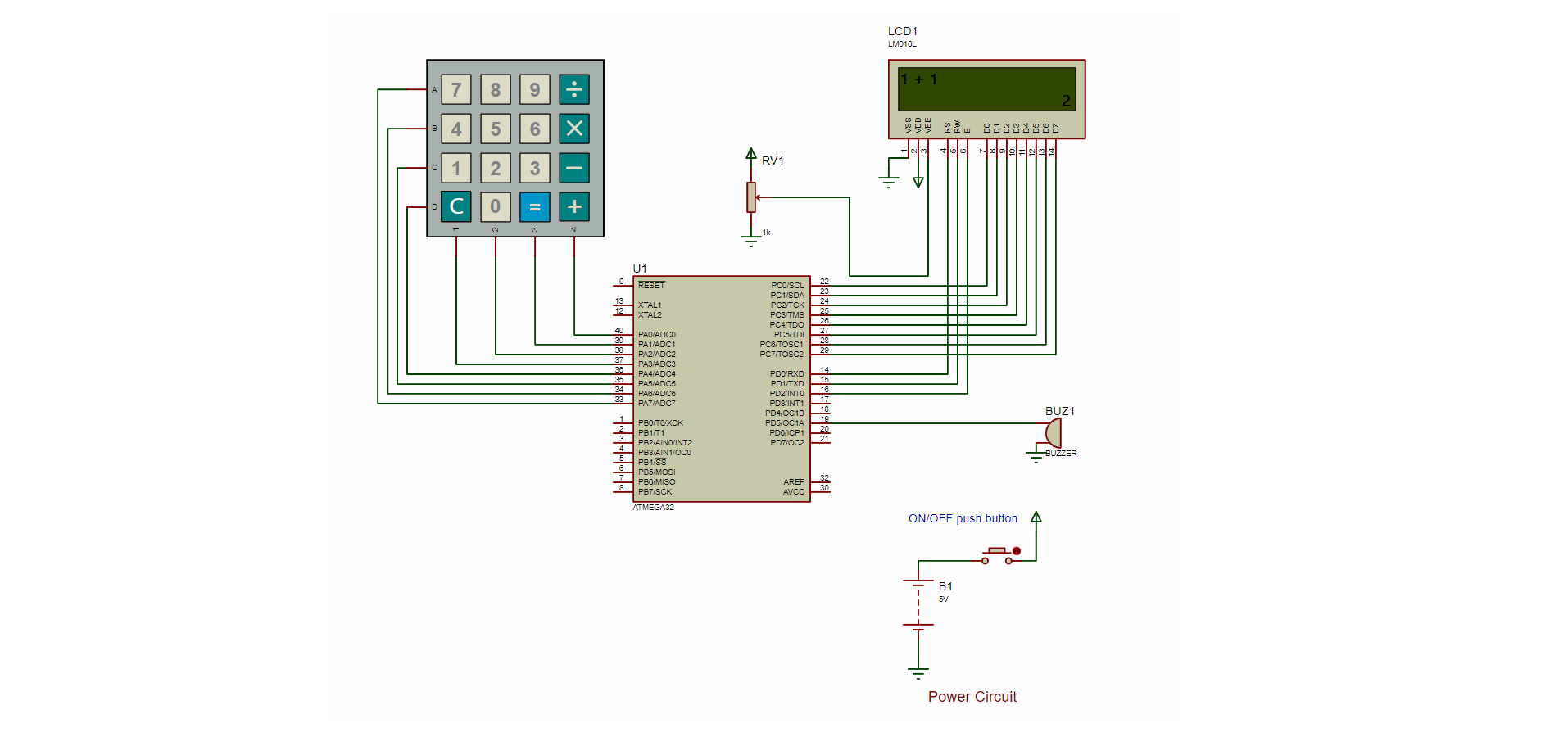
# Reference Documents

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| --- | --- | --- | --- |
| **Ref. No.** | **Doc. Name** | **Version** | **Status** |
| 1 | PO1\_DGC\_CR\_DigitalCalculator | 1.0 | Released |
| 2 | LCD\_DataSheet |  |  |

# Project Description

“Sovy” is a simple digital calculator in which the system consists of a keypad that holds all the buttons required to perform any basic mathematical operation and an LCD screen to display the operations performed. A beeping sound is generated from a buzzer whenever a key is pressed by the user.

# System Context Diagram



# System Requirements

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| Req\_ID | Req\_1ST123\_HSI\_overall\_001-V1.1 | Covers | Covers\_1ST123\_CR \_01-V1.0 |
| Description: | * The Keypad(4x4) in total contains 16 keys, each of one is used to send a particular input to the microcontroller as required by the user:  1. 10 keys are used to represent the numbers from 0 to 9. 2. 4 keys are used to represent the 4 basic mathematical operations; addition, subtraction, multiplication & division. 3. 1 key is used to represent the equal button.  * Each row and column in the keypad has a separate pin which is connected to separate pin on the Atmega32 microcontroller. | | |

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| Req\_ID | Req\_1ST123\_HSI\_overall\_002-V1.1 | Covers | Covers\_1ST123\_CR\_01-V1.0 |
| Description: | In addition to a power button is used to switch on/off the calculator, which controls the power circuit that is responsible for powering up the whole system, and hence switching the calculator on & off. | | |

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| Req\_ID | Req\_1ST123\_HSI\_overall\_003-V1.1 | Covers | Covers\_1ST123\_CR \_02-V1.0 |
| Description: | * PINs 33, 34, 35, 36 of the MCU which are connected to the rows of the keypad are configured as output in which they are initially set high (5V) * PINs 37, 38, 39 ,40 of the MCU which are connected to the columns of the keypad are configured as input pull up. | | |

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| Req\_ID | Req\_1ST123\_HSI\_overall\_004-V1.1 | Covers | Covers\_1ST123\_CR\_02-V1.0 |
| Description: | If a key got pressed, the column in which this key exists will send a signal of 0V to the microcontroller which indicates that a button (key) has been pressed. | | |

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| Req\_ID | Req\_1ST123\_HSI\_overall\_005-V1.1 | Covers | Covers\_1ST123\_CR \_04-V1.0 |
| Description: | When any key in the keypad is released, an output of 5v (logic high) shall be generated by the MCU at PIN 19 where the buzzer is connected resulting in a beeping sound for 300ms. | | |

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| Req\_ID | Req\_1ST123\_HSI\_overall\_006-V1.1 | Covers | Covers\_1ST123\_CR \_03-V1.0 |
| Description: | The LCD will be initialized, according to the initialization sequence mentioned in the LCD\_DataSheet. For 8-bit initialization refer to page 13 and for 4-bit initialization refer to page 14. | | |

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| --- | --- | --- | --- |
| Req\_ID | Req\_1ST123\_HSI\_overall\_007-V1.0 | Covers | Covers\_1ST123\_CR\_03-1.0 |
| 1.Vdd | The supply voltage of the LCD. 5V DC is supplied from the Microcontroller to this pin to turn on the LCD. | | |
| 2. Vss | The Ground Connection of the LCD. It is connected to the ground. | | |
| 3. Vo | The Contrast Control Pin. It is connected to a potentiometer in order to control the contrast for the display. | | |

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| Req\_ID | Req\_1ST123\_HSI\_overall\_008-V1.0 | Covers | Covers\_1ST123\_CR \_03-V1.0 |
| 1. R/W pin | This pin is used to select between the Read and Write Option of the LCD. When this pin is made logic low, a write operation is performed and data is sent from the microcontroller to the LCD using the D0-D7 pins. When this pin is set high, a read operation is performed and data is sent from the LCD to the microcontroller using the D0-D7 pins on the LCD. | | |
| 2. Register Select pin | This pin is used to select whether to send data to display or perform some command on the LCD. When this pin is set high, a write operation will send data onto the data register for displaying on the LCD. When this pin is set low, a write operation will send some LCD specific command to be performed on the LCD. | | |
| 3. Enable Pin | This pin is used to enable the LCD. It is operated on the rising edge of a pulse. When data is fed onto the data lines and the R/W pin set, application of a short pulse will result in data being sent to the LCD. | | |

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| Req\_ID | Req\_1ST123\_HSI\_overall\_009-V1.1 | Covers | Covers\_1ST123\_CR \_03-V1.0 |
| 1. Data pins | The 8 data pins (D0-D7) are used as a bus to send or receive data between the microcontroller and the LCD. | | |

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| Req\_ID | Req\_1ST123\_HSI\_overall\_010-V1.0 | Covers | Covers\_1ST123\_CR \_03-V1.0 |
| 1. A(Led positive) pin | Connected to 5v. | | |
| 2.K(Led negative) pin | Connected to ground. | | |

# Hardware Features

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| Hardware Component | Features |
| 1. Keypad | A **4x4 keypad** will have **eight terminals**. in them four are **rows of matrix** and four are **columns of matrix**. these 8 pins are driven out from 16 buttons present in the module. those 16 alphanumeric digits on the module surface are the 16 buttons arranged in matrix formation.   * Maximum voltage across each segment or button: 24v. * Maximum current through each segment or button: 30mA. * Maximum operating temperature: 0°c to + 50°c |
| 1. Microcontroller | ATmega32, low-power Microchip 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 54/69 general purpose I/O lines, 32 general purpose working registers, a JTAG interface for boundary-scan and on-chip debugging/programming, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a universal serial interface (USI) with start condition detector, an 8-channel 10-bit A/D converter, programmable watchdog timer with internal oscillator, SPI serial port, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. |
| 1. Buzzer | * Rated Voltage: 6V DC * Operating Voltage: 4-8V DC * Rated current: <30mA * Sound Type: Continuous Beep * Resonant Frequency: ~2300 Hz |