ZKit-51-V664, 8051 Development Kit

User Manual

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ZILOGIC
S Y S T E M S

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Chapter 1. Introduction

ZKit-51-V664 is a 8051 micro-controller development kit from Zilogic Systems. ZKit-51-V664 is designed for a easy usage, rapid prototyping and extensive product design. ZKit-51-V664 is a single board computer which can be used as it is in the end product design.

1. Features

The ZKit-51-V664 comes with

- Graphics display and on-board keys
- Well defined IO connector interface for I²C, SPI, PWM, GPIO, SIO and ADC
- USB and External power supply
- Programmable through USB
- Free and open source compiler and programmer
- Zilogic's open source software library
- Ready to go with Zilogic's Relay, Motor, Display boards etc., add-on boards.

2. Applications

- CPU for embedded product
- Embedded application prototyping
- Teaching and learning embedded systems

3. Board Details

The ZKit-51-V664 offers the following features

- NXP P89V664 micro-controller with 64KB Flash and 2KB RAM
- 18.432MHz crystal
- On-board Peripherals
  - 128x64 graphics LCD, with backlight
  - 2K I²C EEPROM
  - 4 channel ADC
  - 1 DAC
  - Piezoelectric buzzer
  - USB serial interface, for communication and program download
  - Four button keypad
  - Push button with hardware de-bounce (interrupt input)
  - 2 debug LEDs
- Connectors
  - USB, type B connector
  - 2.1mm power supply connector
  - 14 pin header for Digital IO
  - 10 pin header for UART and I²C
  - 10 pin header for SPI
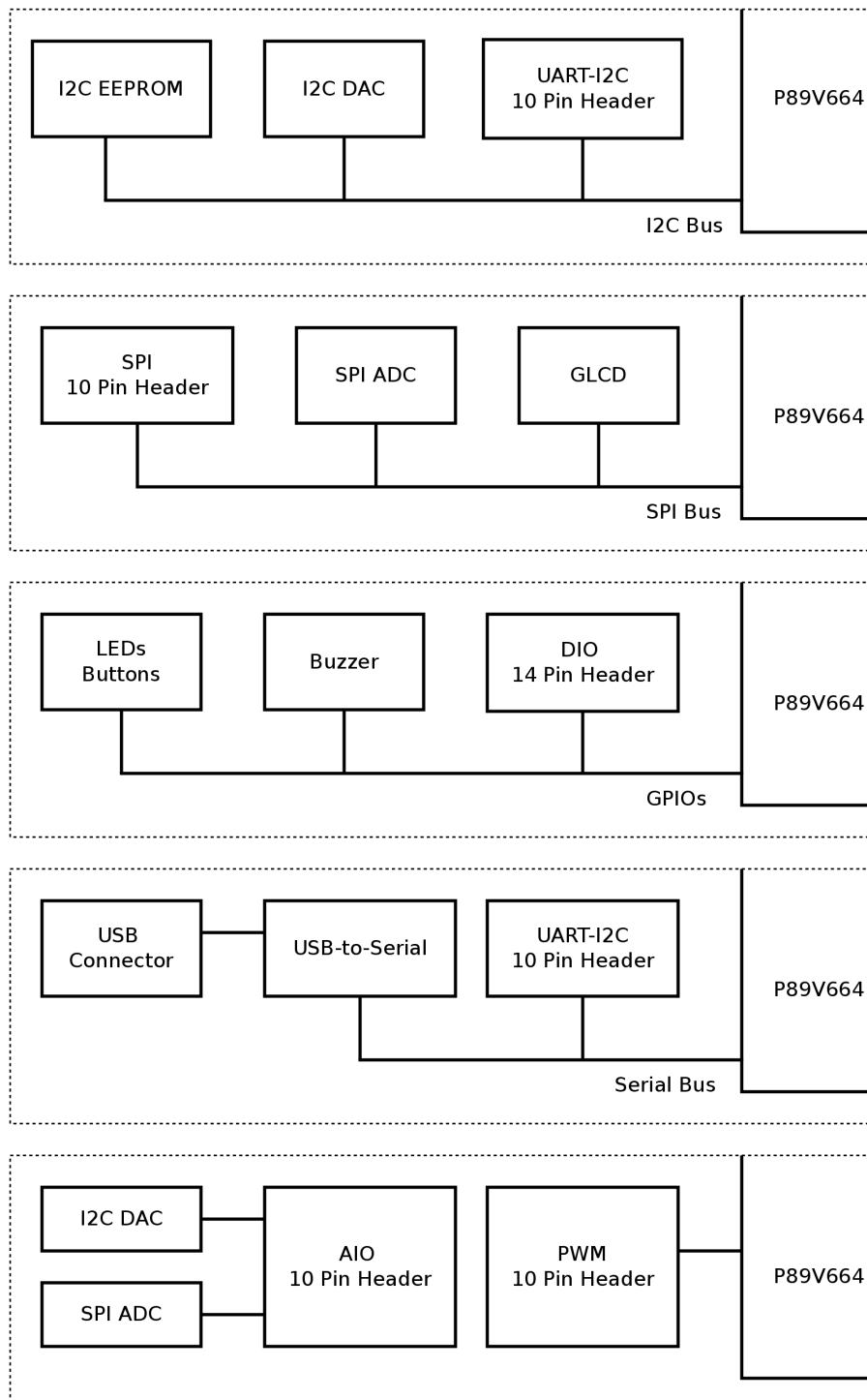 - 10 pin header for PWM

– 10 pin header for Analog IO

Chapter 2. Board Design

1. Overview

A bird's eye view of the devices available on the board, is shown in the following block diagram. Each device connectivity is described in detail in the following sections.
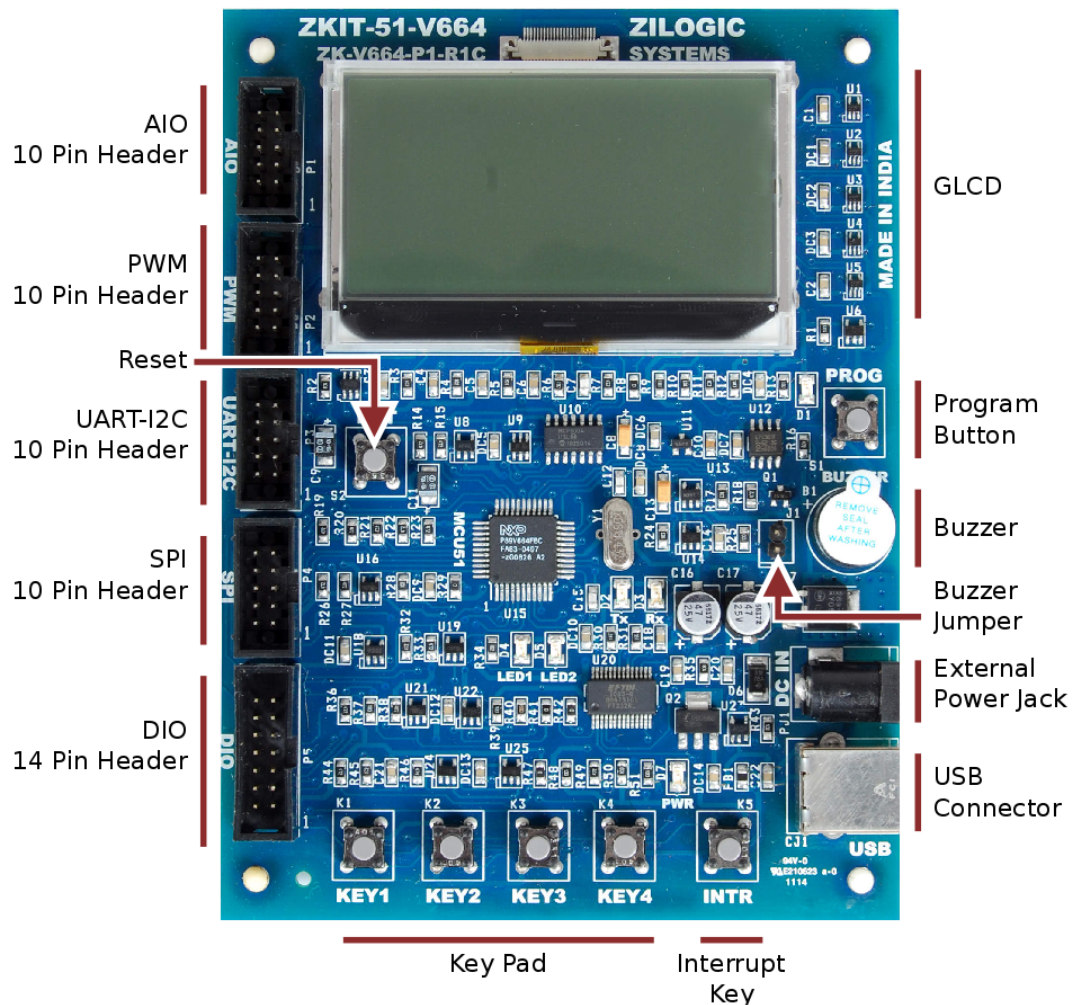
Figure 2.1. Block Diagram
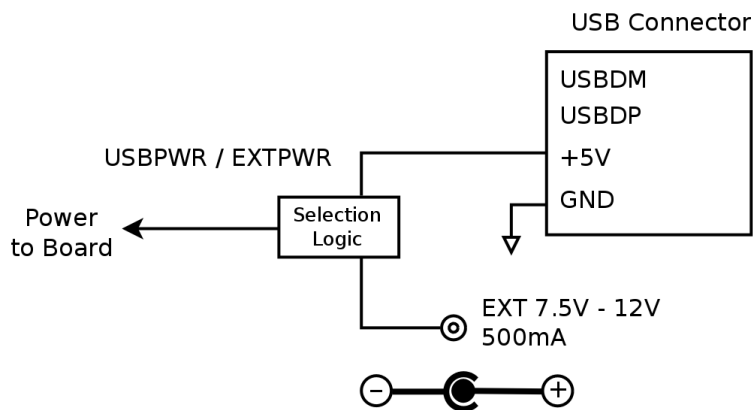
2. Locating Components

The location of the components on the board is indicated in the following diagram.

Figure 2.2. Front View

3. Power Supply

The ZKit-51-V664 can be powered through USB or an external power supply.

Figure 2.3. Power Supply Connection Diagram

The external power supply, if used, should be a regulated power supply. The regulated power supply should have the following charactersitcs.

Output Voltage	7.5V - 12V
Output Current	> 500mA
Polarity	Shown in diagram

4. CPU

The heart of the ZKit-51-V664 is a Philips P89V664 micro-controller. The P89V664 is an 8-bit 80C51 5V low power micro-controller with 64 kB Flash, 2KB of data RAM and supports In-System Programming (ISP).

The main features of the micro-controller are listed below.

- Dual 100 kHz byte-wide I²C-bus interfaces
- 0 MHz to 40 MHz operating frequency in 12x mode, 20 MHz in 6x mode
- 64 kB of on-chip flash user code memory with ISP and IAP
- 2 kB RAM
- SPI (Serial Peripheral Interface) and enhanced UART
- PCA (Programmable Counter Array) with PWM and Capture/Compare functions
- Three 16-bit timers/counters
- Four 8-bit I/O ports
- WatchDog Timer (WDT)
- Support for 12-clock (default) or 6-clock mode selection via ISP
- Low EMI mode (ALE inhibit)
- Power-down mode with external interrupt wake-up

The micro-controller crystal frequency is 18.432 MHz. 8051-based processors generate their serial port timing using a combination of external crystal and internal programmable divider chains. This crystal frequency has been selected in order to ensure the following

1. the timing requirements of the controller's serial interface are met.
2. the CPU runs at high speed in 6-clock mode.

Power to the board is sourced either from the external regulated power supply or via USB power automatically.

Figure 2.4. Micro-controller Block Diagram
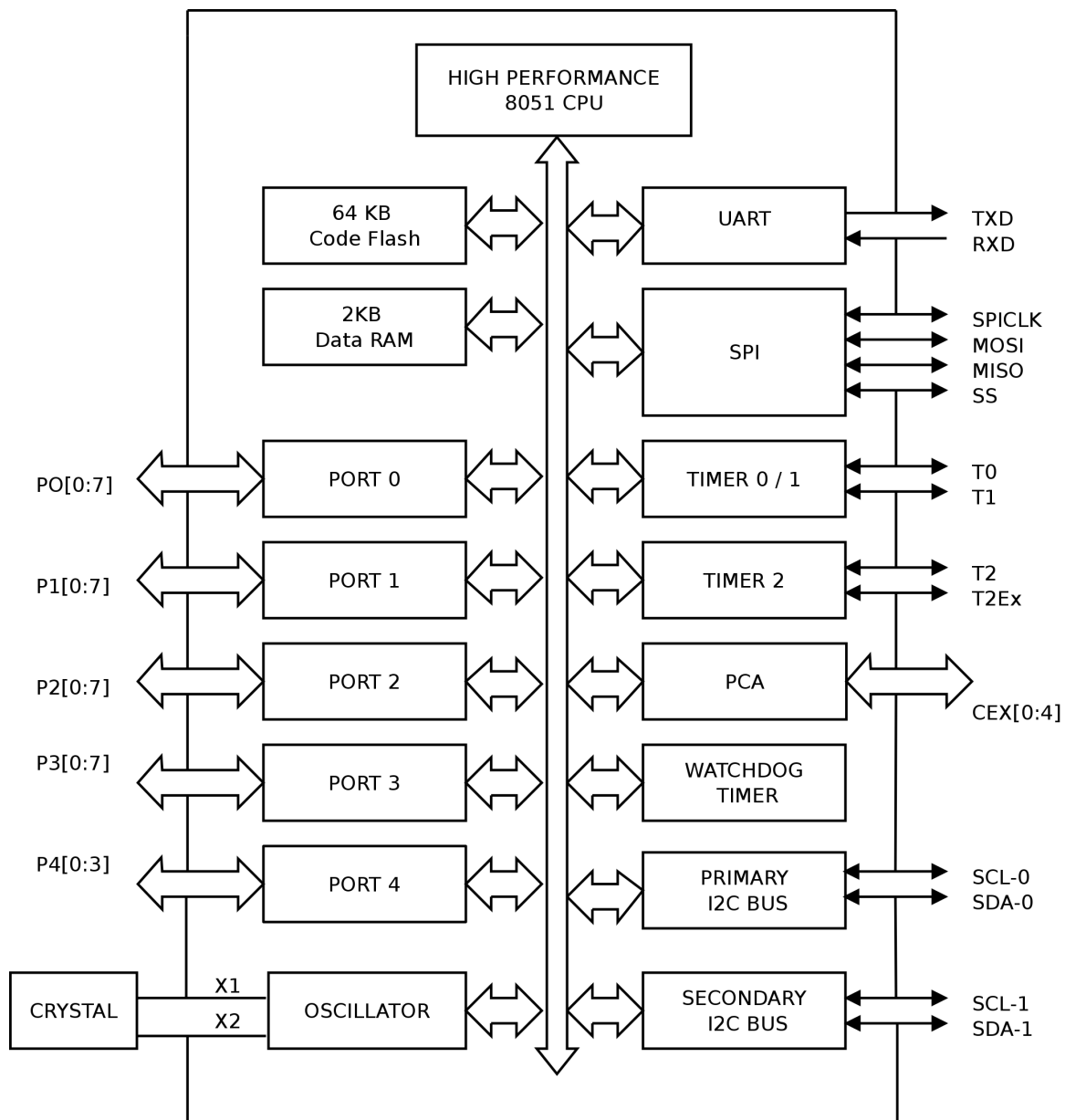
5. USB Serial

The ZKit-51-V664 has a FT232R USB to serial UART converter. The FT232R has the following advanced features:

- The FT232R is fully compliant with the USB 2.0 specification.
- Single chip USB to asynchronous serial data transfer interface.
- Entire USB protocol handled on the chip. No USB specific firmware programming required.
- Supports transmit and receive LED drive signals.

The ZKit-51-V664 uses USB Serial UART for serial communication between PC and the P89V664 MCU. This is also used to download firmware by activating the bootloader of P89V664 MCU. This is called In-System Programming (ISP).

5.1. In-System Programming

The ZKit-51-V664 has a PROG push button, which can be used to select between Programming mode and Serial Communication mode. When the board is powered on, it is in Serial Communication mode. Press the PROG button to switch into Programming mode. The current mode is indicated by the PROG LED. The LED glows in the Programming mode.

In Programming mode, the RTS is connected to the RESET of the MCU, and DTR is connected to the PSEN of the MCU. Flash programming applications like Smash and Flash Magic can utilize this feature to switch the device into ISP mode automatically, without user intervention.

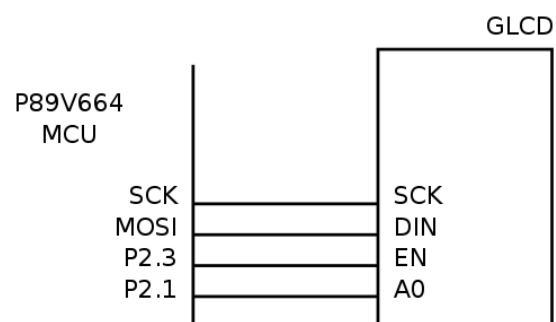The following diagram shows the FT232R connection details.

Figure 2.5. FT232R Connection Diagram
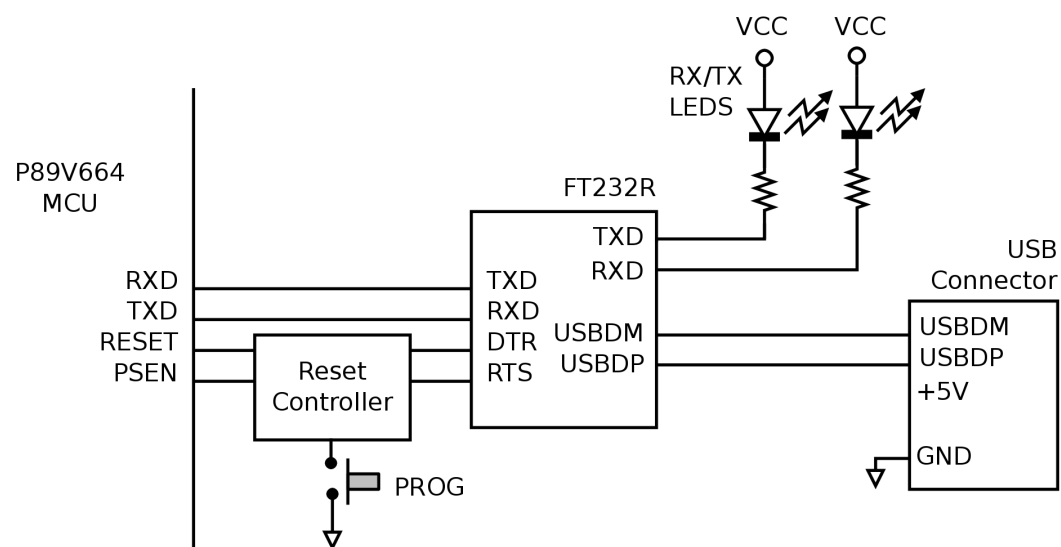
6. LCD Display

The ZKit-51-V664 has a TM12864, Sitronix chipset compatible, 128x64 pixel monochrome LCD. The LCD is connected to SPI lines of the MCU. The following diagram shows the LCD pin connection details.

### Figure 2.6. LCD Connection Diagram

7. I²C EEPROM

The ZKit-51-V664 has a CAT24AA02 EEPROM for data storage. The CAT24AA02 is a 2-Kbit Serial EEPROM. The memory is accessed via I²C bus. The maximum bus speed supported by the device is 400 kbit/s

The I²C EEPROM is connected to the on-chip I²C controller of the P89V664 MCU. The following diagram shows the EEPROM pin connection details.

Figure 2.7. I²C EEPROM Connection Diagram
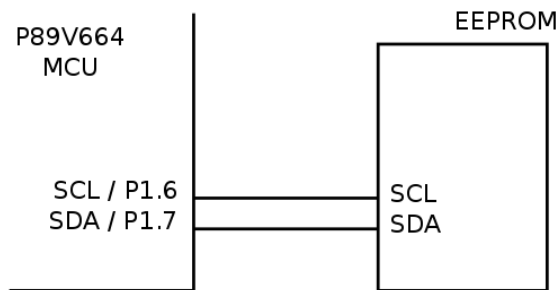
8. SPI ADC

The ZKit-51-V664 has a Microchip MCP3004 ADC for analog to digital convertion. The Microchip MCP3004 is a 4 channel SPI ADC which can sample at 200k samples/sec. The reference voltage, of 4.096V, for the ADC, is generated by MCP1541 voltage reference device.

The device is accessed via a simple Serial Peripheral Interface (SPI). The SPI ADC is connected to the on-chip SPI controller of the P89V664 MCU. The following diagram shows the ADC pin connection details.

Figure 2.8. SPI ADC Connection Diagram
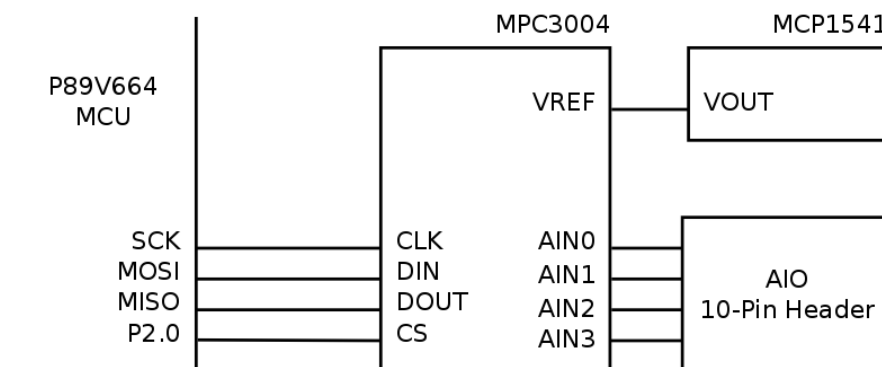
9. I²C DAC

The ZKit-51-V664 has a Microchip MCP4725 DAC for digital to analog convertion. The MCP4725 is a low-power, high accuracy, single channel, 12-bit buffered voltage output Digital-to-Analog Convertor (DAC). The DAC uses the 5V power supply as the reference voltage.

This device is accessed using the I²C interface. The following diagram shows the DAC pin configuration details.

Figure 2.9. I²C DAC Connection Diagram
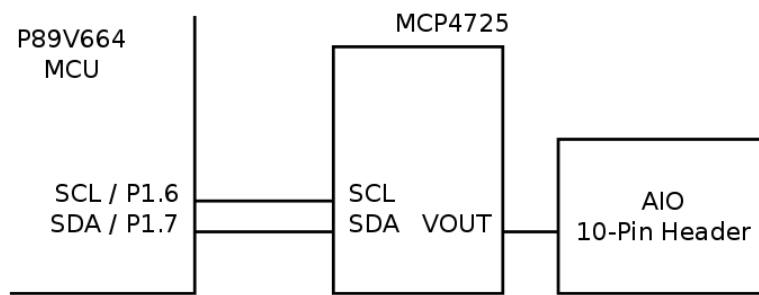
10. Piezoelectric Buzzer

The ZKit-51-V664 has a piezoeletric buzzer that can be used to provide audible indications. The buzzer is connected to `P1.3` pin. By rapidly toggling the pin, a tone can be generated on the buzzer. Alternatively, the on-chip PCA (Programmable Counter Array) can be used to generate a pulse train to the buzzer. Using PWM techniques, both volume and tone can be controlled.

The buzzer is connected to `P1.3` pin, through jumper `J1`. When the jumper is closed, `P1.3` is connected to the buzzer. The following diagram shows the buzzer connection details.

Figure 2.10. Buzzer Connection Diagram
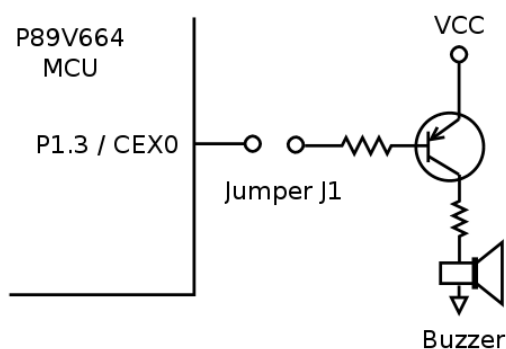
11. Debug LEDs

The ZKit-51-V664 has two debug LEDs connected to `P1.0` and `P1.3`, through a non-inverting buffer. By driving `P1.0` and `P1.3` low, the LEDs can be switched On. Alternatively, the on-chip PCA (Programmable Counter Array) can be used to generate a PWM signal to control the LED brightness.

Figure 2.11. LEDs Connection Diagram
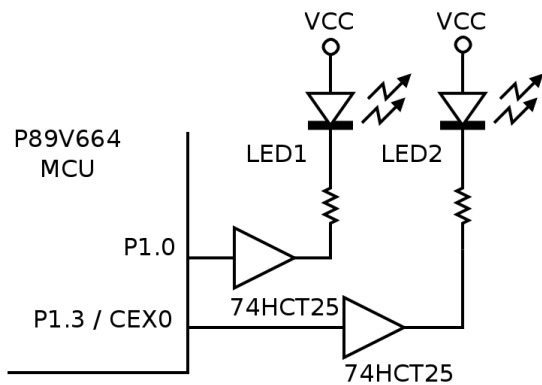
12. Keypad

The ZKit-51-V664 has 4 tactile push button switches connected to `P2.4` to `P2.7`. The keypad connection details are shown in the following diagram.

Figure 2.12. Keypad Connection Diagram
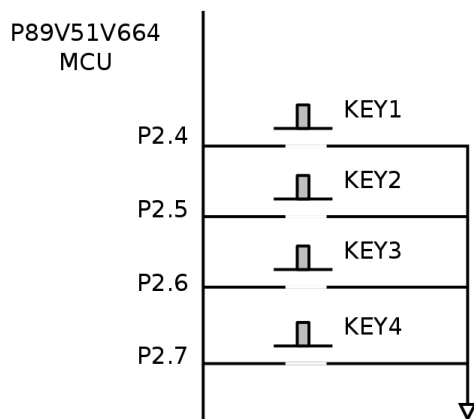
13. Interrupt Key

The ZKit-51-V664 has 1 tactile push button switch for testing interrupts. The push button is hardware debounced and connected to `INTR1`. The following diagram shows the interrupt key connection details.

Figure 2.13. Interrupt Key Connection Diagram
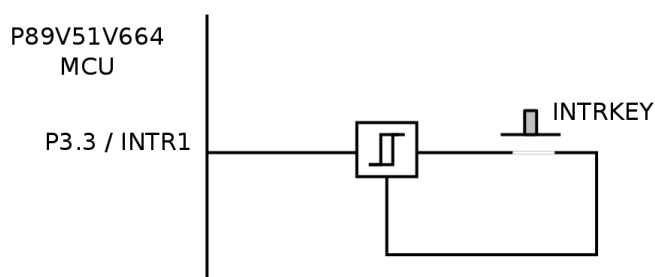
Chapter 3. Connecting to ZKit-51-V664

This chapter describes the connectors in the ZKit-51-V664.

1. `PWM` Pinmap

The `PWM` header is terminated with 5 pulse width modulation signals and power supply. Add-on boards like LED control, motor control can be connected through this header.
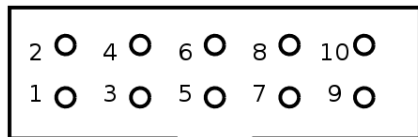
Table 3.1. `PWM` Header

Pin #	Signal Name	MCU Signal
1	`VCC`	`VCC`
2	`PWM 0`	`P1.4/CEX1`
3	`PWM 1`	`P1.5/CEX2`
4	`PWM 2`	`P3.4/CEX3`
5	`PWM 3`	`P3.5/CEX4`
6	`PWM 4`	`P1.3/CEX0`
7	`PWM 5`	`ECI/P1.2`
8	`Freq-In 0`	`T2EX/P1.1`
9	`Freq-In 1`	`T2/P1.0`
10	`GND`	`GND`

`VCC` (Pin 1)
:   This is the +5V power supply for the external add-on boards. The supply has a total current limit of 200mA when powered through USB.

`PWM` (Pin 2 - 7)
:   These are PWM output signals. The PWM signal when active produces a stream of pulses whose width can be controlled through software. An important parameter of a PWM signal is the **duty cycle**. The duty cycle is defined as the ratio between the pulse duration and pulse period of a rectangular waveform.

    The PWM signal can be used to control the power delivered to a load, by controlling the duty cycle of the PWM signal. PWM signals are generally used for Motor speed control, LED brightness control, power supplies and wave form generation.

    The PWM signal is a 5V CMOS/TTL output.

`Freq-In` (Pin 8, 9)
:   These are input signals, used for event counting and frequency measurement. These signals are 5V tolerant CMOS/TTL inputs.

2. `AIO` Pinmap

The `AIO` header is terminated with 4 ADC channels, 1 DAC and power supply. Sensors can be connected to this header.
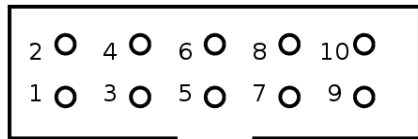
Table 3.2. `AIO` Header

Pin #	Signal Name	MCU Signal
1	`VCC`	`VCC`
2	`ADC 0`	`MCP3004 CH0`
3	`ADC 1`	`MCP3004 CH1`
4	`ADC 2`	`MCP3004 CH2`
5	`ADC 3`	`MCP3004 CH3`
6	`ADC 4`	`-`
7	`ADC 5`	`-`
8	`DAC 0`	`MCP4725 CH0`
9	`VREF-OUT`	`+4.096V`
10	`GND`	`GND`

`VCC` (Pin 1)	This is the +5V power supply for the external add-on boards. The supply has a total current limit of 200mA when powered through USB.
`ADC` (Pin 2-5)	These are analog input signals connected to the MCP3004 ADC.
`DAC` (Pin 8)	This is analog output signal connected to the MCP4725 DAC.
`VREF-OUT` (Pin 9)	This is the ADC's reference voltage.
`GND` (Pin 10)	This is the ground signal. All other signals are referenced to this signal.

3. `SPI` Pinmap

The `SPI` header is terminated with serial peripheral interface (SPI) bus, 4 general purpose IO and power supply. Add-on boards with SPI interface and general purpose IOs like MMC/SD card,EEPROM etc., can be connected through this header.

Table 3.3. `SPI` Header

Pin #	Header Signal	MCU Signal
1	`VCC`	`VCC`

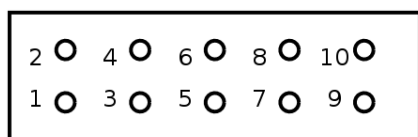| Pin #	Header Signal	MCU Signal
2	SCK	P4.0/SCK
3	MISO	P4.1/MISO
4	MOSI	P4.2/MOSI
5	SS	P4.3/SS
6	DIO0	P3.6/WRn
7	DIO1	P3.7/RDn
8	DIO2	P1.3/CEX0
9	DIO3	P3.3/INT1
10	GND	GND

VCC (Pin 1)	This is the +5V power supply for the external devices. The supply has a total current limit of 200mA when powered through USB.
SCK (Pin 2)	This is Serial Clock signal. The signal is a 5V logic signal, but the output can drive a 5V device or 3.3V device with 5V tolerance.
MISO (Pin 3)	This is the Master Input, Slave Output signal. The signal is a 5V logic signal.
MOSI (Pin 4)	This is the Master Output, Slave Input signal. The signal is a 5V logic signal, but the output can drive a 5V device or 3.3V device with 5V tolerance.
SS (Pin 5)	This is the SPI chip select signal.
DIO (Pin 6-9)	These are digital input/output signals. The signal is a 5V logic signal, but the output can drive a 5V device or 3.3V device with 5V tolerance. These lines can be used to interface any extra signals required for a SPI devices like SD Card, etc., or can be used as chip selects for four other devices.
GND (Pin 10)	This is the ground signal. All other signals are referenced to the this signal.

4. UART-I2C Pinmap

The UART-I2C header is terminated with serial communication signals, I²C signals and power supply. Add-on boards, with different functionalities, can be connected through this header.
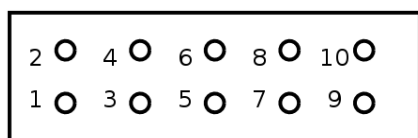

Table 3.4. UART-I2C Header

Pin #	Header Signal	MCU Signal
1	VCC	VCC
2	RXD	P3.0/RXD
3	TXD	P3.1/TXD
4	SCL	P1.6/SCL
5	SDA	P1.7/SDA

Pin #	Header Signal	MCU Signal
6	`DIO0`	`P3.6/WR`
7	`DIO1`	`P3.7/RD`
8	`DIO2`	`P1.3/CEX0`
9	`DIO3`	`P3.2/INT0`
10	`GND`	`GND`

`VCC` (Pin 1)	This is the +5V power supply for the external devices. The supply has a total current limit of 200mA when powered through USB.
`RXD` (Pin 2)	This is transmit line of serial IO. This signal is a 5V CMOS/TTL input
`TXD` (Pin 3)	This is transmit line of serial IO. This signal is a 5V CMOS/TTL output.
`SCL`, `SDA` (Pin 4, 5)	These are I²C bus signals(clock, data), and can be used to connect I²C devices. Any 5V tolerant I²C device, can be connected to the bus. The signals are pulled up to 5V, through a 4.7K resistor.
`DIO` (Pin 6-9)	These are digital input/output signals. The signal is a 5V logic signal, but the output can drive a 5V device or 3.3V device with 5V tolerance. These pins can be used for hand-shake and flow control signals like `DTR`, `RTS`, `CTS`, etc.
`GND` (Pin 10)	This is the ground signal. All other signals are referenced to this signal.

5. `DIO` Pinmap

The `DIO` header is terminated with port `P0`, and `P1` signals, along with power supply. Add-on boards, with different functionalities, can be connected through this header.
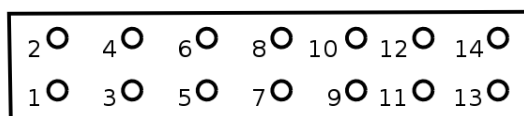
Table 3.5. `DIO` Header

Pin #	Header Signal	MCU Signal
1	`VCC`	`VCC`
2	`DO0`	`P0.0`
3	`DO1`	`P0.1`
4	`DO2`	`P0.2`
5	`DO3`	`P0.3`
6	`DO4`	`P0.4`
7	`DO5`	`P0.5`
8	`DO6`	`P0.6`
9	`DO7`	`P0.7`
10	`DIO0`	`P1.0`

Pin #	Header Signal	MCU Signal
11	`DIO1`	`P1.1`
12	`DIO2`	`P1.2`
13	`DIO3`	`P1.3`
14	`GND`	`GND`

`VCC` (Pin 1)   This is the +5V power supply for the external devices. The supply has a total current limit of 200mA when powered through USB.

`DO` (Pin 2-9)   These are digital output signals. The signal is a 5V logic signal, but the output can drive a 5V device or 3.3V device with 5V tolerance. These signals are pulled up to 5V, through a 4.7K resistor since `P0` port does not have internal pull up.

`DIO` (Pin 10-13) These are digital input/output signals. The signal is a 5V logic signal, but the output can drive a 5V device or 3.3V device with 5V tolerance. These signals can be used as control and hand-shake signals.

`GND` (Pin 14)   This is the ground signal. All other signals are referenced to this signal.

Appendix A. Legal Information

1. Copying

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2. Limited Hardware Warranty

The warranties provided by Zilogic Systems in this Limited Hardware Warranty apply only to Hardware Products you purchase for your use, and not for resale. The term "Hardware Product" means a computing device with a specific function and limited configuration ability.

2.1. LIMITED HARDWARE WARRANTY

Zilogic Systems warrants that the hardware components of its Hardware Product shall be free from material defects in design, materials, and workmanship and will function, under normal use and circumstances, in accordance with the documentation provided, for a period of one (1) year from the date of purchase of the Hardware Product.

Your sole and exclusive remedy, and Zilogic Systems' sole and exclusive liability for defective hardware components, shall be that Zilogic Systems, subject to the terms and conditions of this Section, and solely upon confirmation of a defect or failure of a hardware component to perform as warranted, shall at its sole option, either repair or replace the nonconforming hardware component. All replacement parts furnished to you under this warranty shall be refurbished and equivalent to new, and shall be warranted as new for the remainder of the original warranty period. All defective parts, which have been replaced, shall become the property of Zilogic Systems. All defective parts that have been repaired shall remain your property.

2.2. EXCLUSIONS

The foregoing warranties and remedies shall be void as to any Hardware Products damaged or rendered unserviceable by one or more of the following: (1) improper or inadequate maintenance by anyone other than Zilogic Systems or Zilogic Systems' authorized engineers, (2) interfacing supplied by anyone other than Zilogic Systems, (3) modifications, alterations or additions to the Hardware Products by personnel not certified by Zilogic Systems or Zilogic Systems' authorized engineers to perform such acts, or other unauthorized repair, installation or other causes beyond Zilogic Systems' control, (4) unreasonable refusal to agree with engineering change notice programs, (5) negligence by any person other than Zilogic Systems or Zilogic Systems' authorized engineers, (6) misuse, abuse, accident, electrical irregularity, theft, vandalism, fire, water or other peril, (7) damage caused by containment and/or operation outside the environmental specifications for the Hardware Products, (8) alteration or connection of the Hardware Products to other systems, equipment or devices (other than those specifically approved by Zilogic Systems) not in accordance to the board and on-board device specifications (9) any use that is inconsistent with the user manual supplied with the Hardware Product. The warranty period is not extended if Zilogic Systems repairs or replaces a warranted product or any parts. Zilogic Systems may change the availability of limited hardware warranties, at its discretion, but any changes will not be retroactive.

2.3. HARDWARE RETURN PROCEDURES

If a Hardware Product or one of its component parts does not function as warranted during the warranty period, and such nonconformance can be verified by Zilogic Systems, Zilogic Systems, at

its election, will provide either return and replacement service or replacement with a refurbished part/unit for the Hardware Product under the type of warranty service Zilogic Systems designates for that Hardware Product. A defective Hardware Product or one of its component parts may only be returned to Zilogic Systems upon Zilogic Systems' prior written approval. Any such approval shall reference an RMA number issued by an authorized Zilogic Systems service representative. If you do not register the Hardware Product with Zilogic Systems, you may be required to present proof of purchase as evidence of your entitlement to warranty service. The Hardware Product's serial number will be required for all RMA cases.

Transportation costs, if any, incurred in connection with the return of a defective item to Zilogic Systems shall be borne by You. Any transportation costs incurred in connection with the redelivery of a repaired or replacement item to You by Zilogic Systems shall be borne by Zilogic Systems; provided, however, that if Zilogic Systems determines, in its sole discretion, that the allegedly defective item is not covered by the terms and conditions of the warranty or that a warranty claim is made after the warranty period, the cost of the repair by Zilogic Systems, including all shipping expenses, shall be reimbursed by You.

2.4. HARDWARE REPLACEMENT PROCEDURES

Zilogic Systems will attempt to diagnose and resolve your problem over the phone or e-mail. Upon determination of the hardware issue is related to a malfunction of one of the Hardware Product components, an RMA process will be initiated by Zilogic Systems.

For Warranty Replacement service, it is required that you deliver the faulty unit to a location Zilogic Systems designates, and provide courier name and tracking number to Zilogic Systems. After the Faulty unit is returned to Zilogic Systems, Zilogic Systems will use commercially reasonable efforts to ship the replacement hardware within fourteen (14) business days. Actual delivery times may vary depending on availability of the spares and customer's location.

2.5. ADDITIONAL RESPONSIBILITIES

You agree:

- To provide Zilogic Systems or its partner with sufficient and safe access to your facilities to permit Zilogic Systems to fulfill its obligations.
- To ship back the faulty Hardware Product (or replaceable unit) suitably packaged, quoting the RMA number, to the Zilogic Systems designated location.
- You shall ship the faulty Hardware Product once Zilogic Systems approves the RMA and provide the courier name and tracking number.
- To securely erase from any Hardware Product you return to Zilogic Systems for any reason all programs and data not provided by Zilogic Systems with the Hardware Product. You acknowledge that in order to perform its responsibilities under this Limited Hardware Warranty, Zilogic Systems may ship all or part of the Hardware Product or its software to third party locations around the world, and you authorize Zilogic Systems to do so.

2.6. LIMITATION OF LIABILITY

Zilogic Systems' development kits are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, not in applications where failure or malfunction of a Zilogic Systems product can resonably be expected to result in personal injury, death or severe property or environmental damage.

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