

ZKit-51-V664, 8051 Development Kit

User Manual

1.1, Sept 2011



This work is licensed under the Creative Commons Attribution-Share Alike 2.5 India License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-sa/2.5/in/> or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.

Table of Contents

1. Introduction	1
1. Features	1
2. Applications	1
3. Board Details	1
2. Board Design	2
1. Overview	2
2. Locating Components	3
3. Power Supply	3
4. CPU	4
5. USB Serial	5
6. LCD Display	6
7. I ² C EEPROM	6
8. SPI ADC	7
9. I ² C DAC	7
10. Piezoelectric Buzzer	8
11. Debug LEDs	8
12. Keypad	9
13. Interrupt Key	9
3. Connecting to ZKit-51-V664	10
1. PWM Pinmap	10
2. AIO Pinmap	10
3. SPI Pinmap	11
4. UART-I ² C Pinmap	12
5. DIO Pinmap	13
A. Legal Information	14
1. Copying	14
2. Disclaimers	14

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

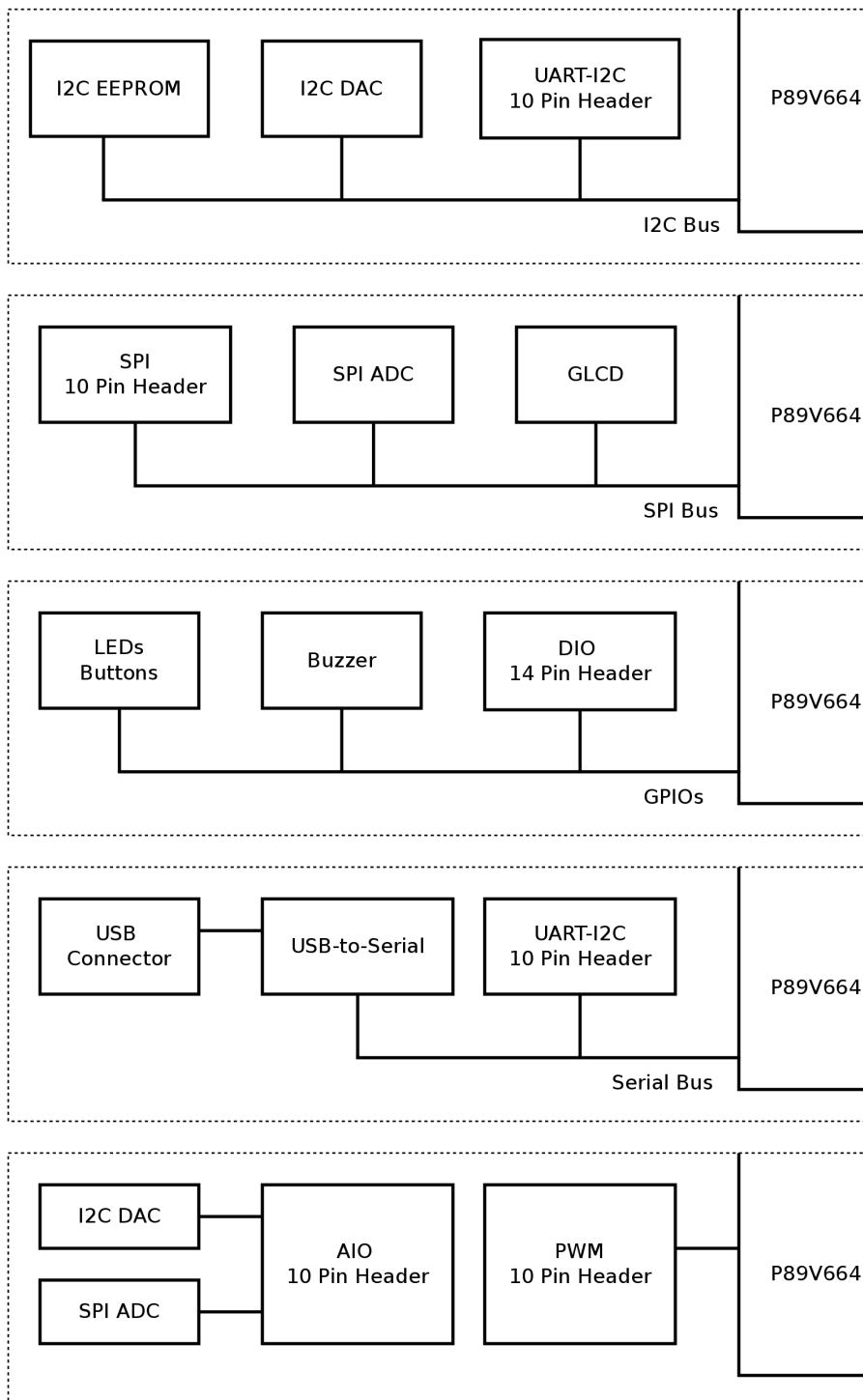
- NXP P89V664 micro-controller with 64KB Flash and 2KB RAM
- 18.432MHz crystal
- On-board Peripherals
 - 128x64 graphics LCD, with backlight
 - 2K I²C EEPROM
 - 4 channel ADC
 - 1 DAC
 - Piezoelectric buzzer
 - USB serial interface, for communication and program download
 - Four button keypad
 - Push 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.

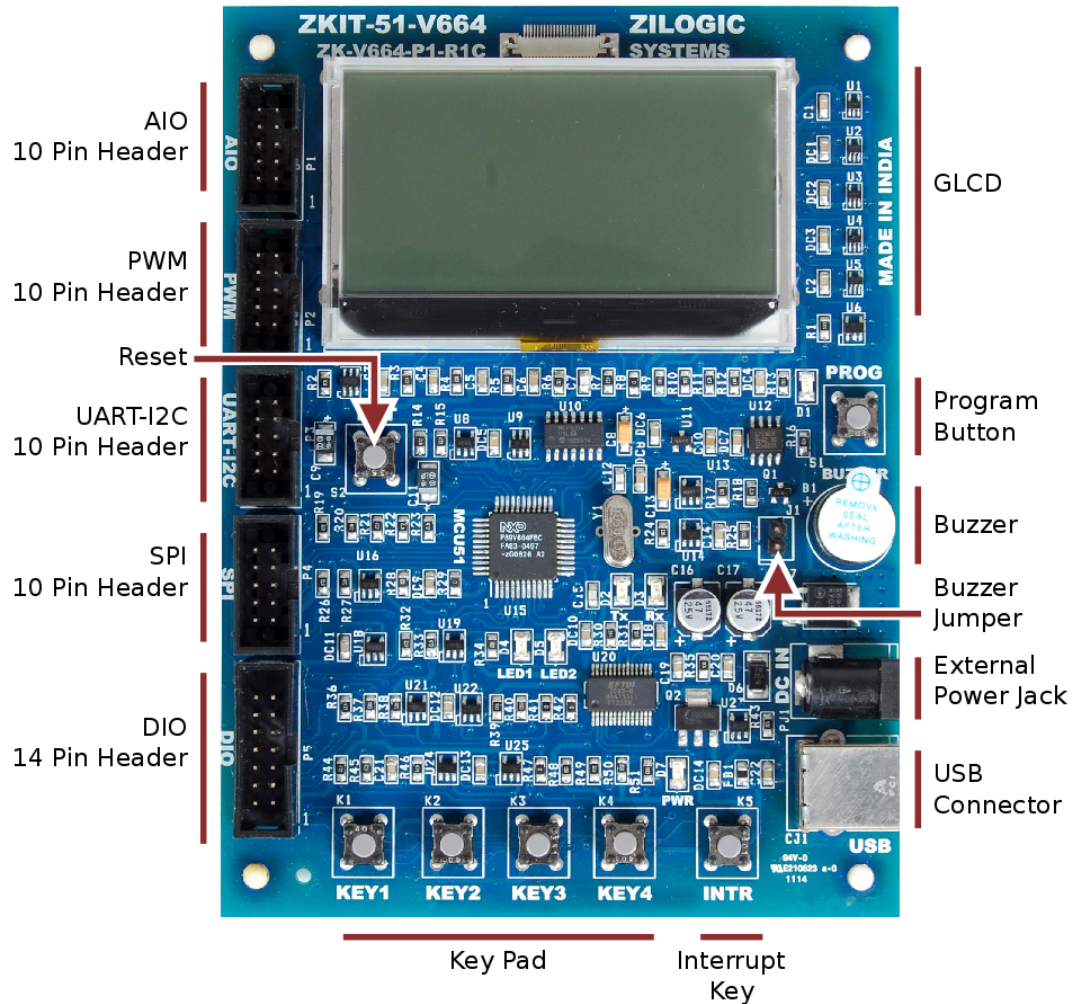
Figure 2.1. Block Diagram



2. Locating Components

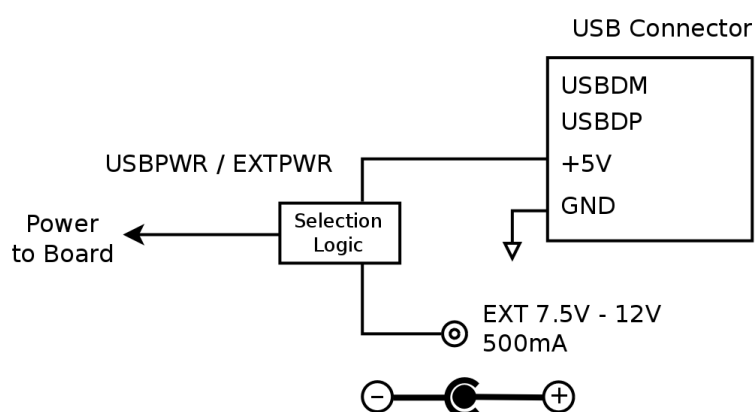
The location of the components on the board is indicated in the following diagram.

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 characteristics.

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).

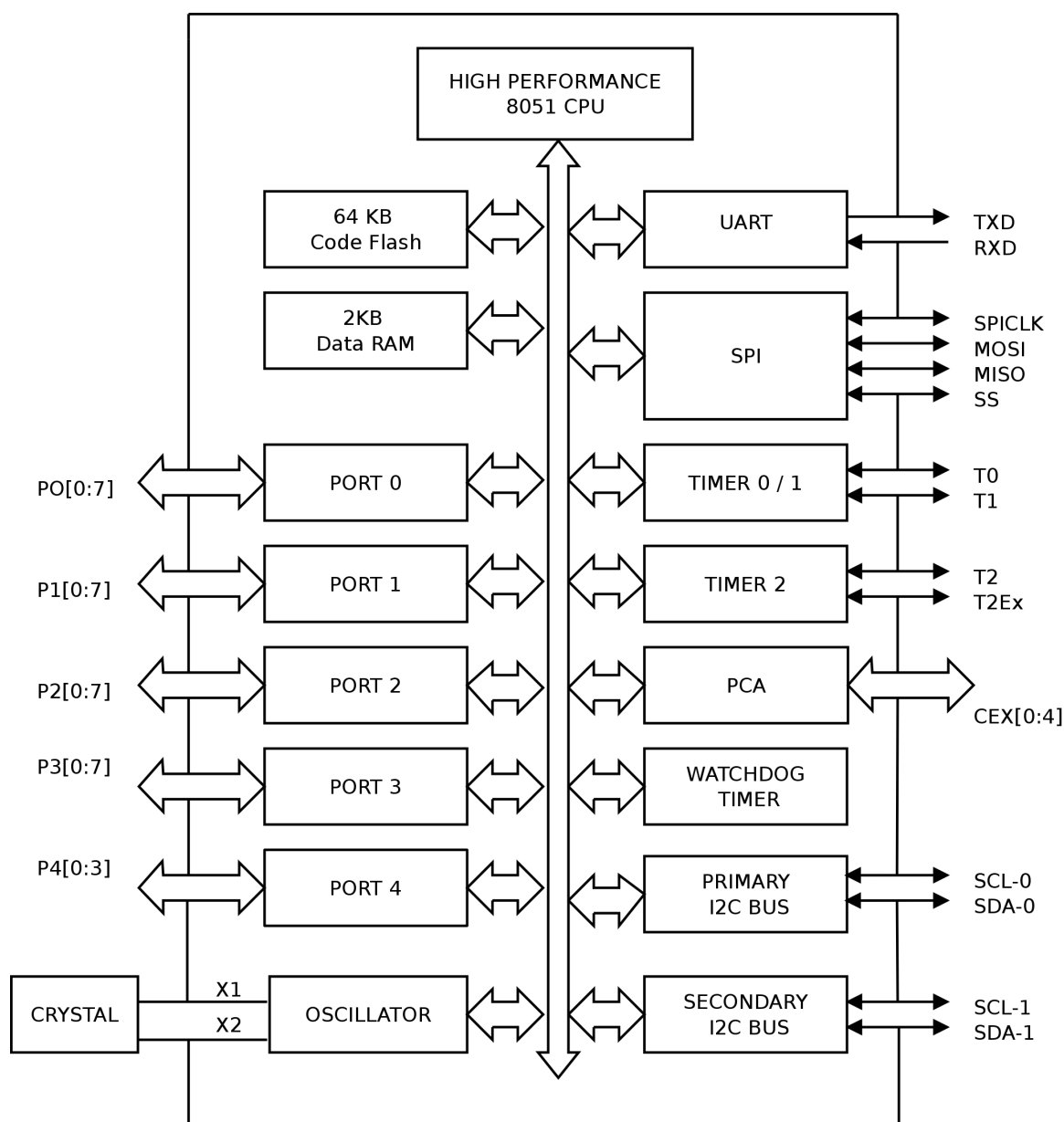
The main features of the micro-controller are listed below.

- 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).

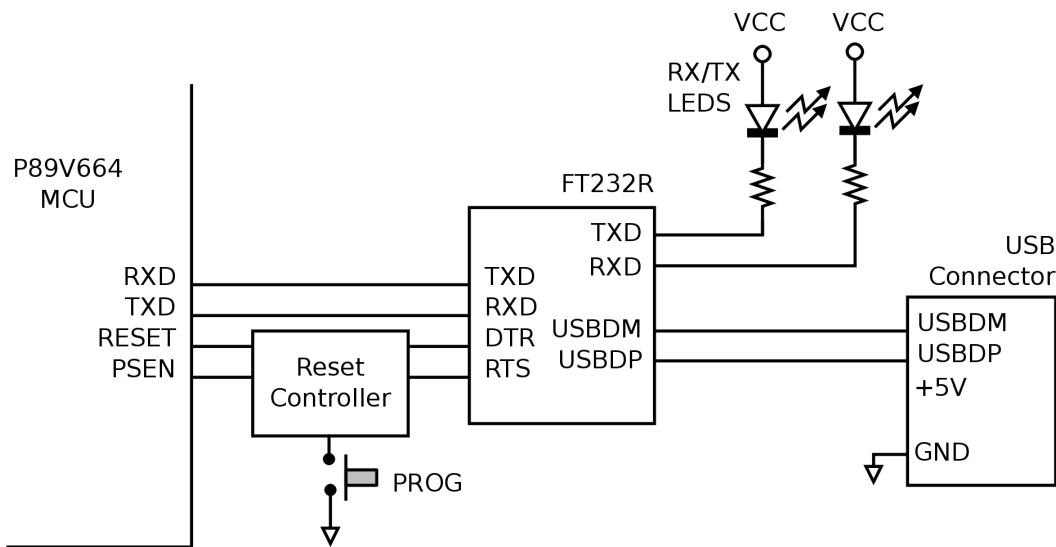
5.1. In-System Programming

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.

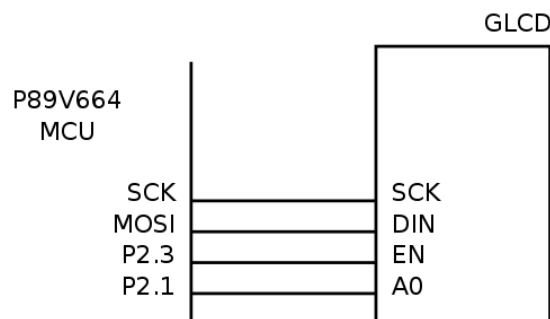
Figure 2.5. FT232R Connection Diagram



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

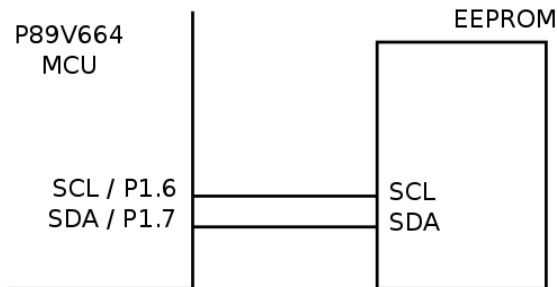


7. I²C EEPROM

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

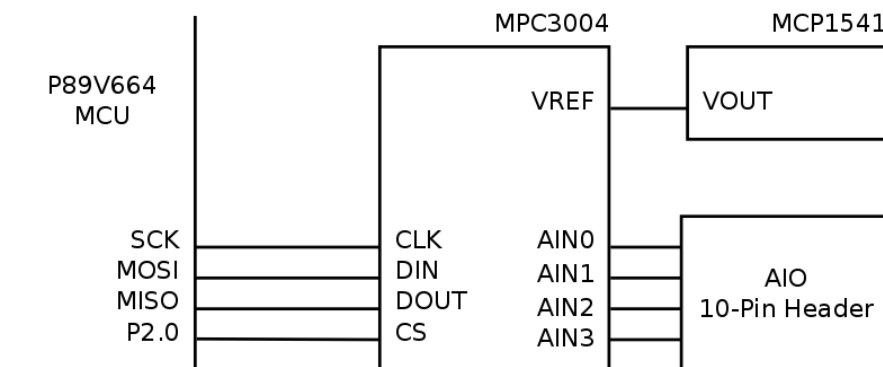


8. SPI ADC

The ZKit-51-V664 has a Microchip MCP3004 ADC for analog to digital conversion. 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.

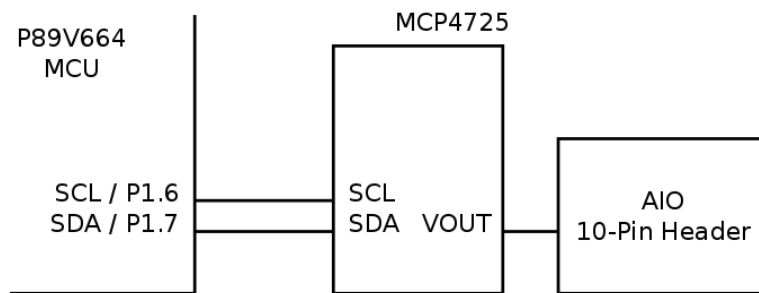
Figure 2.8. SPI ADC Connection Diagram



9. I²C DAC

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

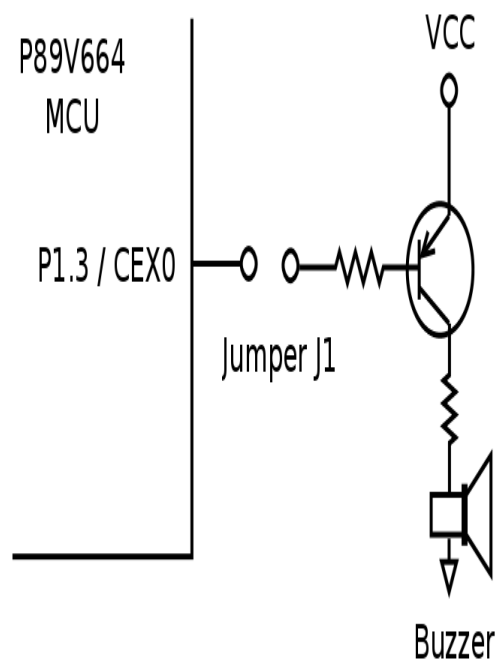
This device is accessed using the I²C interface. The following diagram shows the DAC pin configuration details.

Figure 2.9. I²C DAC Connection Diagram

10. Piezoelectric Buzzer

The ZKit-51-V664 has a piezoelectric 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.

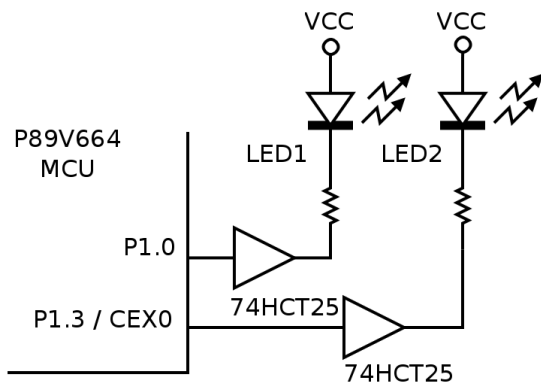
The buzzer is connected to P1.3 pin, through jumper J1. When the jumper is closed, P1.3 is connected to the buzzer. The following diagram shows the buzzer connection details.

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.

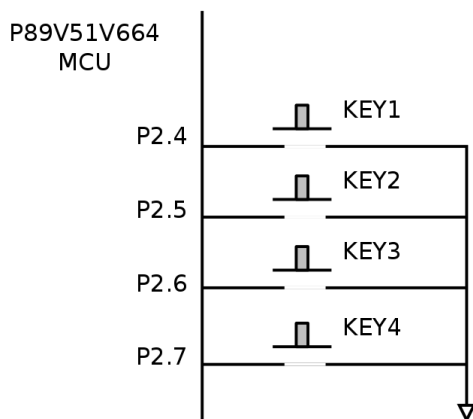
Figure 2.11. LEDs Connection Diagram



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.

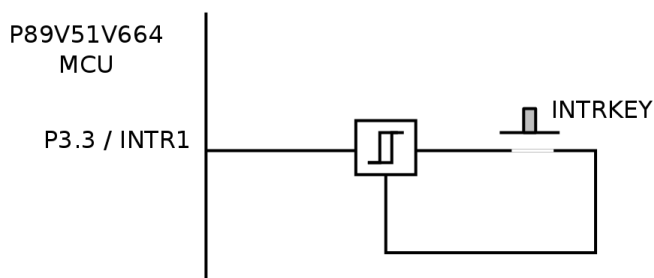
Figure 2.12. Keypad Connection Diagram



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.

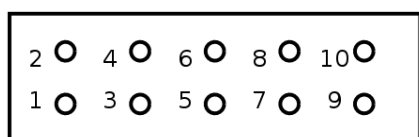


Table 3.1. PWM Header

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	ECl/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.

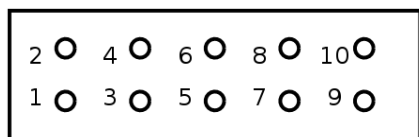
The PWM signal is a 5V CMOS/TTL output.

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)

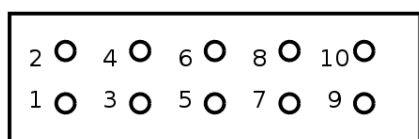
This is the ADC's reference voltage.

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
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

Pin #	Header Signal	MCU Signal
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.

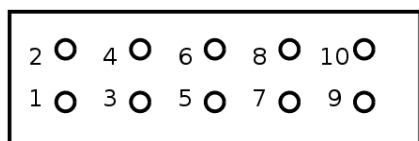


Table 3.4. UART-I2C Header

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
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 I ² C bus signals(clock, data), and can be used to connect I ² C devices. Any 5V tolerant I ² C 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.

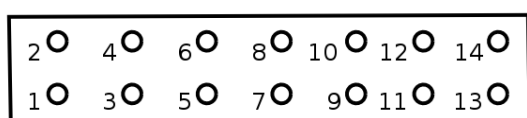


Table 3.5. DIO Header

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
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

This work is licensed under the Creative Commons Attribution-Share Alike 2.5 India License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-sa/2.5/in/> or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.

2. Disclaimers

NO WARRANTY. ZILOGIC SYSTEMS' DEVELOPMENT KITS (AND TECHNICAL SUPPORT, IF ANY) ARE PROVIDED "AS IS" AND WITHOUT ANY WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. TO THE MAXIMUM EXTENT PERMITTED UNDER APPLICABLE LAWS, ZILOGIC SYSTEMS EXPRESSLY DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NONINFRINGEMENT. ZILOGIC SYSTEMS DOES NOT WARRANT THAT THE FUNCTIONS CONTAINED IN ZILOGIC SYSTEMS' DEVELOPMENT KITS WILL MEET YOUR REQUIREMENTS, OR THAT THE OPERATION WILL BE UNINTERRUPTED OR ERROR-FREE, OR THAT DEFECTS IN ZILOGIC SYSTEMS' DEVELOPMENT KITS WILL BE CORRECTED. FURTHERMORE, ZILOGIC SYSTEMS DOES NOT WARRANT OR MAKE ANY REPRESENTATIONS REGARDING THE USE OR THE RESULTS OF THE USE OF THE ZILOGIC SYSTEMS' DEVELOPMENT KITS IN TERMS OF THEIR CORRECTNESS, ACCURACY, RELIABILITY, OR OTHERWISE. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OF IMPLIED WARRANTIES, SO THE ABOVE EXCLUSION MAY NOT APPLY OR MAY BE LIMITED.

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 reasonably be expected to result in personal injury, death or severe property or environmental damage. Zilogic Systems accepts no liability for inclusion and/or use of Zilogic Systems' development kits in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.