ZKit-51-RD2, 8051 Development Kit

User Manual

1.1, June 2011

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Chapter 1. Introduction

ZKit-51-RD2 is a 8051 micro-controller development kit from Zilogic Systems. ZKit is designed for easy usage, immediate prototyping and extensive product design.

1. Features

The ZKit-51-RD2 comes with

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

2. Applications

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

3. Board Details

The ZKit-51-RD2 offers the following features

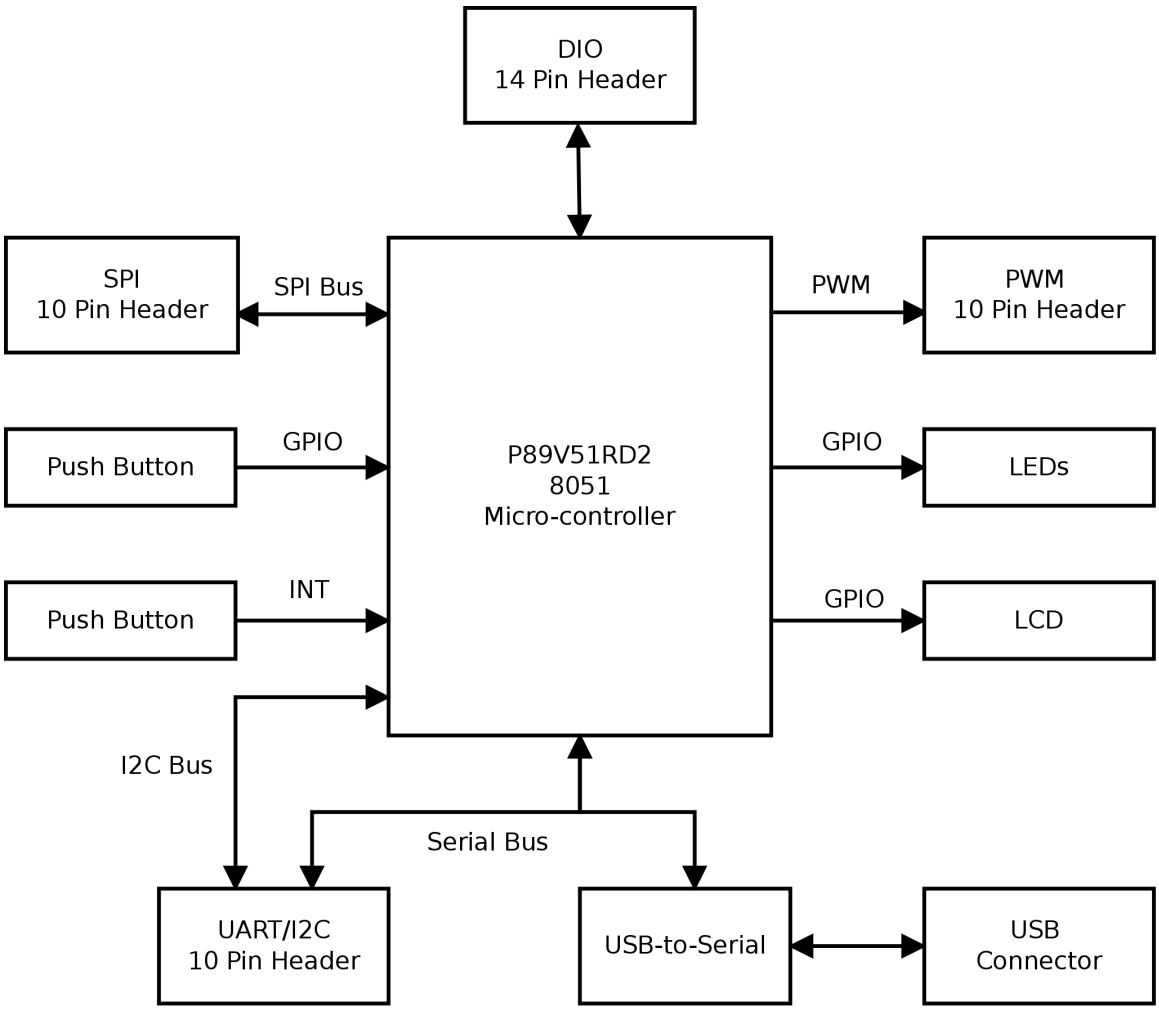
- NXP P89V51RD2 micro-controller with 64KB Flash and 1KB RAM
- 18.432MHz crystal
- Power supply
  - USB
  - External 7.5V supply
- On-board Peripherals
  - 16x2 character LCD, with backlight
  - USB serial interface, for communication and program download
  - Four button keypad
  - Push button with hardware 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 serial communication / I²C
  - 10 pin header for SPI
  - 10 pin header for PWM

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.

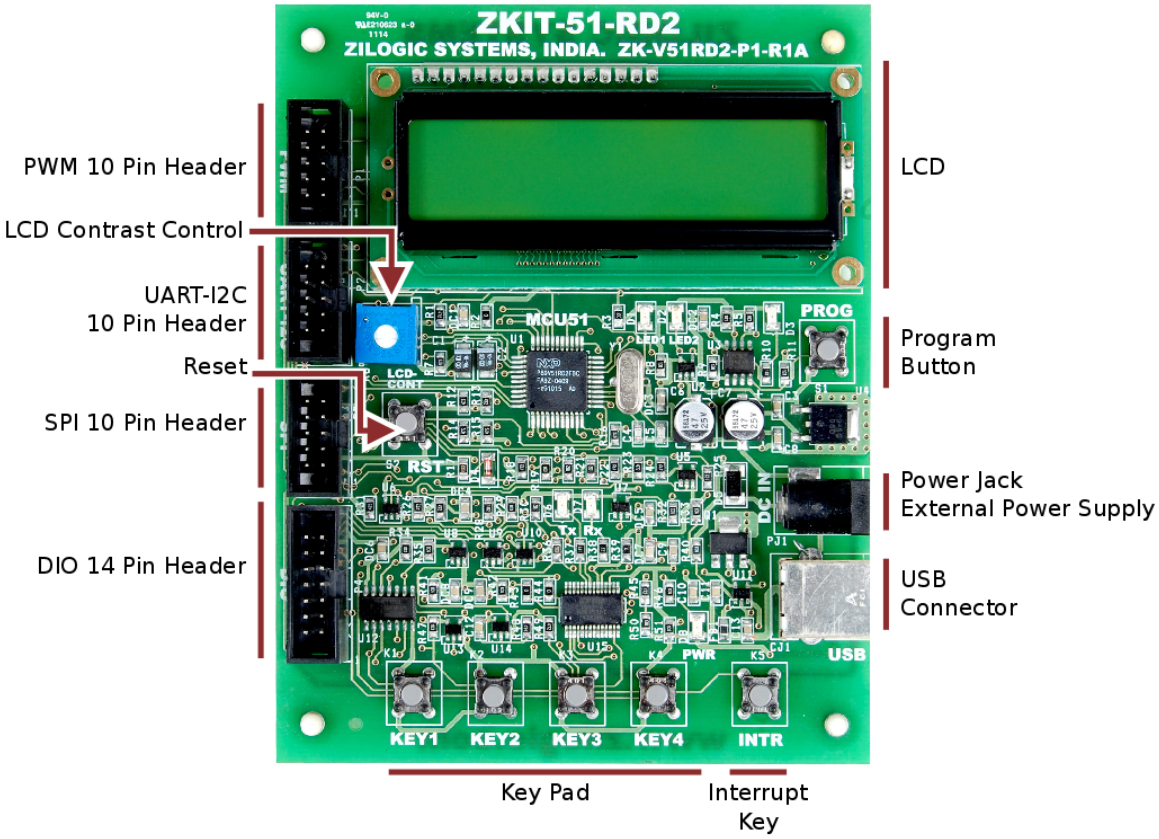
Figure 2.1. Block Diagram



2. Locating Components

The location of the components on the board are indicated in the following diagrams.

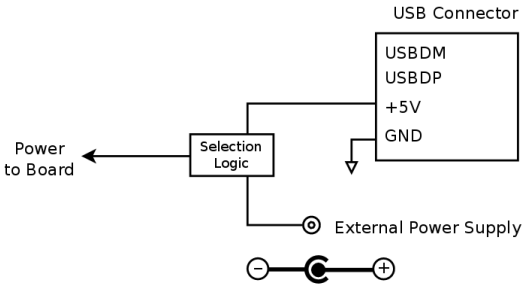
Figure 2.2. Front View



3. Power Supply

The ZKit-51-RD2 can be powered through USB or an external 7.5V regulated 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-RD2 is an NXP P89V51RD2 micro-controller. The P89V51RD2 is an 8-bit 80C51 5V low power micro-controller with 64 kB Flash, 1KB of data RAM and supports In-System Programming (ISP).

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

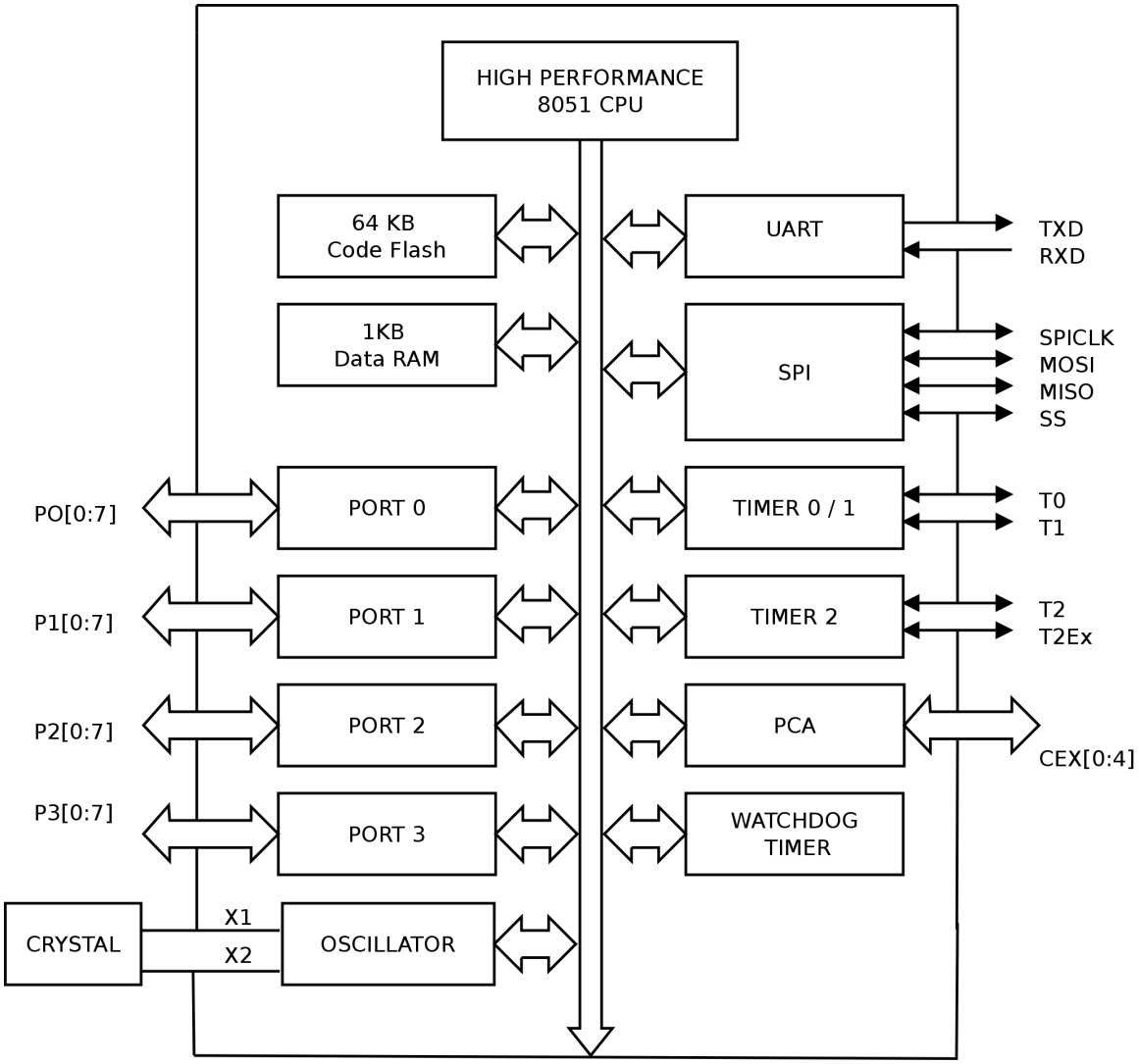
- 0 MHz to 40 MHz operating frequency in 12x mode, 20 MHz in 6x mode
- 64 kB of on-chip flash user code memory with ISP and IAP
- 1 kB RAM
- SPI (Serial Peripheral Interface) and enhanced UART
- PCA (Programmable Counter Array) with PWM and Capture/Compare functions
- Three 16-bit timers/counters
- Four 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 7.5V external regulated power supply or from USB power.

Figure 2.4. Micro-controller Block Diagram



5. USB Serial

The ZKit-51-RD2 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.
- Supports transmit and receive LED drive signals.

The ZKit-51-RD2 uses USB Serial UART for serial communication between PC and the P89V51RD2 MCU. This is also used to download firmware by activating the bootloader of P89V51RD2 MCU. This is called In-System Programming (ISP).

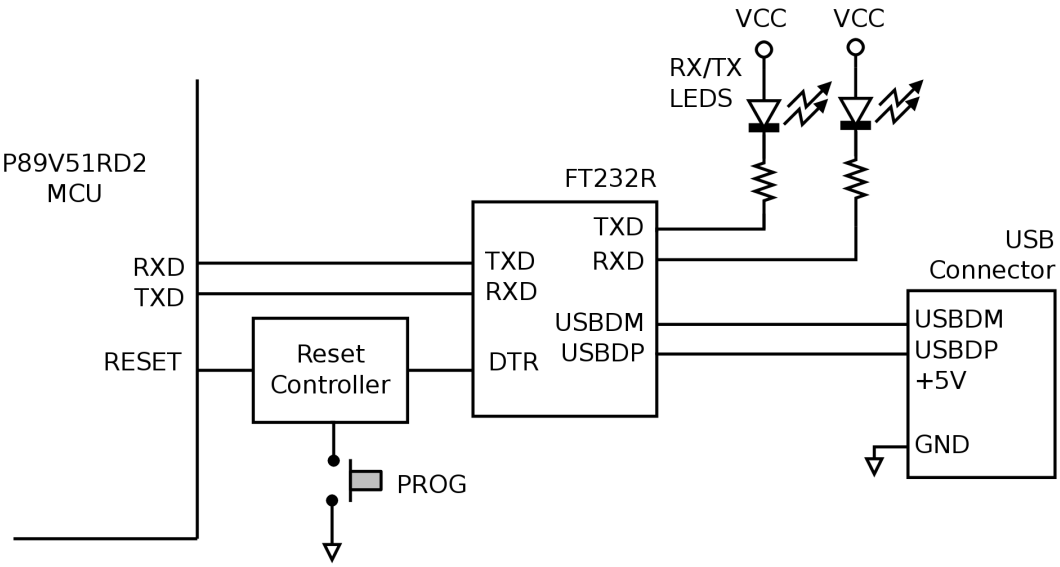
5.1. In-System Programming

The ZKit-51-RD2 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 Programming mode.

In Programming mode, the RTS is connected to the RESET 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.

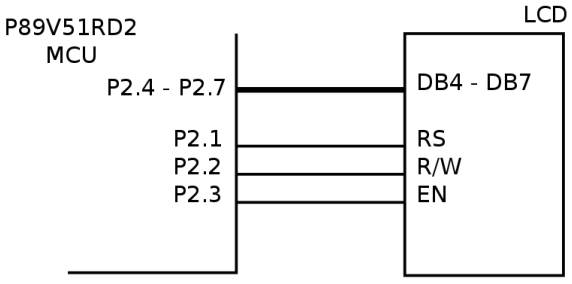
Figure 2.5. FT232R Connection Diagram



6. LCD Display

The ZKit-51-RD2 has a HD44780 Hitachi chipset compatible, 16x2 character, LCD. The LCD data lines are connected to P2.4 to P2.7 and the control lines (RS, R/W, EN) are connected to P2.1, P2.2, P2.3 respectively. The following diagram shows the LCD pin connection details.

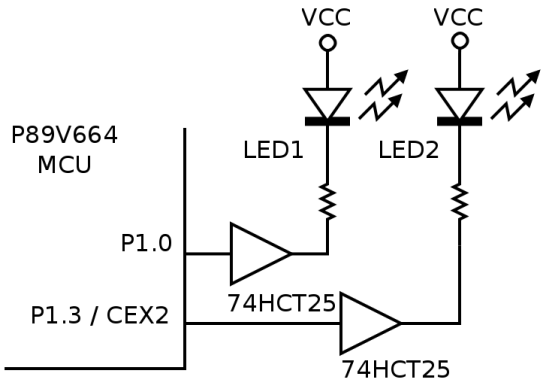
Figure 2.6. LCD Connection Diagram



7. Debug LEDs

The ZKit-51-RD2 has two debug LEDs, LED1 and LED2, connected to P1.0 and P1.3, through a non-inverting buffer, respectively. By driving P1.0 and P1.3 low, the LEDs can be switched On. The on-chip PCA (Programmable Counter Array) can be used to generate a PWM signal to control the LED brightness of LED2.

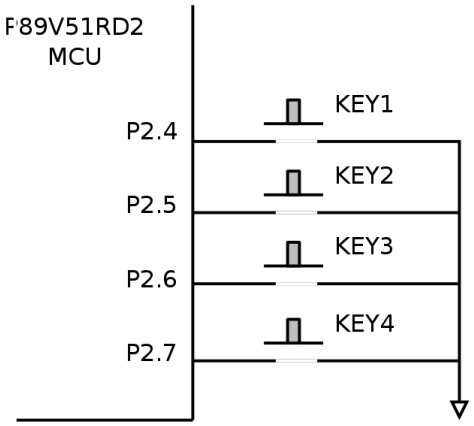
Figure 2.7. LEDs Connection Diagram



8. Keypad

The ZKit-51-RD2 has 4 tactile push button switches connected to P2.4 to P2.7. The keypad connection details are shown in the following diagram.

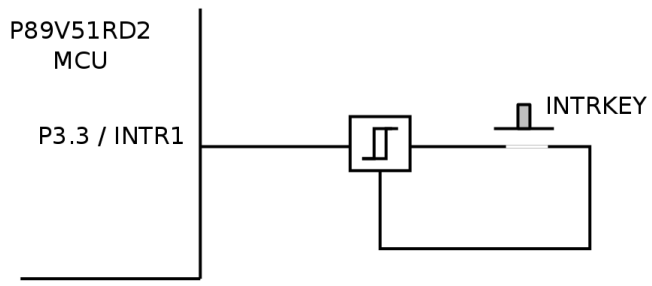
Figure 2.8. Keypad Connection Diagram



9. Interrupt Key

The ZKit-51-RD2 has 1 tactile push button switch for testing interrupts. The push button is hardware debounced and connected to INTR1, through a On/Off dip switch. When the switch is Off, INTR1 is available for external usage, through PIO-BUS header. The following diagram shows the interrupt key connection details.

Figure 2.9. Interrupt Key Connection Diagram



Chapter 3. Connecting to ZKit-51-RD2

In this chapter we will describe the connectors in the ZKit-51-RD2.

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.

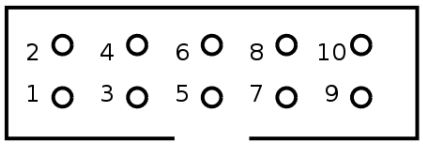


Table 3.1. PWM Header

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

VCC (Pin 1)

This is the power supply for the external sensors. The supply has a total current limit of 200mA when powered through USB.

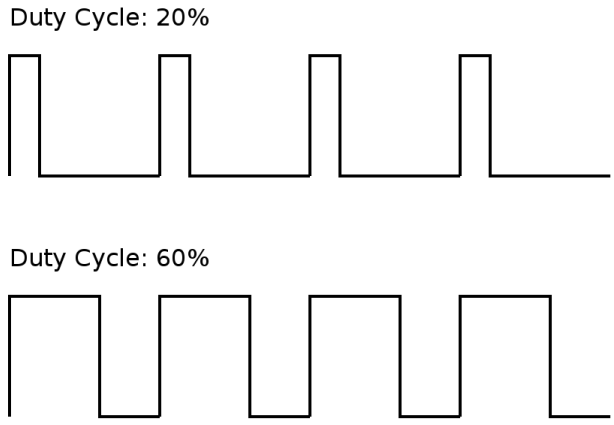
PWM Output (Pin 2 - 6)

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.

Figure 3.1. PWM signals with various pulse widths



`Freq-In` (Pin 7 - 9)	These are input signals and can be used for event counting, frequency measurement, etc. The Freq-In signal is a CMOS/TTL input.
`GND` (Pin 10)	This is the ground signal. All other signals are referenced to this signal.

2. 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 like MMC/SD card, EEPROM etc., can be connected through this header.

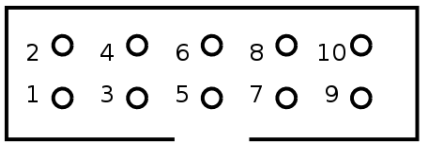


Table 3.2. SPI Header

Pin #	Header Signal	MCU Signal
1	VCC	VCC
2	SCK	P1.7/SCK
3	MISO	P1.6/MISO
4	MOSI	P1.5/MOSI
5	SS	P1.4/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 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, 7, 8, 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.

3. UART-I2C Pinmap

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

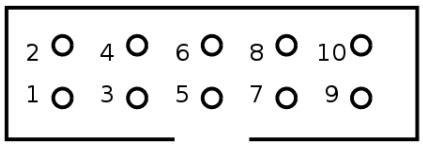


Table 3.3. UART-I2C Header

Pin #	Header Signal	MCU Signal
1	VCC	VCC
2	RXD	P3.0/RXD
3	TXD	P3.1/TXD
4	SCL	P3.4/SCL
5	SDA	P3.5/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 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, 7, 8, 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 I²C devices.

GND (Pin 10)	This is the ground signal. All other signals are referenced to this signal.

4. 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, to the ZKit-51-RD2.

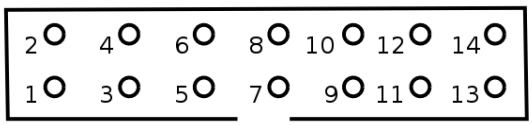


Table 3.4. DIO Header

Pin #	Header Signal	MCU Signal
1	VCC	VCC
2	DO0	P0.0/AD0
3	DO1	P0.1/AD1
4	DO2	P0.2/AD2
5	DO3	P0.3/AD3
6	DO4	P0.4/AD3
7	DO5	P0.5/AD4
8	DO6	P0.6/AD5
9	DO7	P0.7/AD6
10	DIO0	P1.0/CS
11	DIO1	P1.1/ALE
12	DIO2	P1.2/R/W#
13	DIO3	P3.3/INT1
14	GND	GND

VCC (Pin 1)	This is the 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.
DIO (Pin 6, 7, 8, 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.
GND (Pin 14)	This is the ground signal. All other signals are referenced to this signal.

Appendix A. Legal Information

1. Copying

2. Disclaimers

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