Freescale Semiconductor, Inc.
User's Guide

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HVP-KV10Z32 User's Guide

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1 High voltage controller card HVP-KV10Z32

This document supports the HVP-MC3PH user's guide. It describes the HVP-KV10Z32 controller card. This controller card is based on the Freescale KV10Z32 MCU and it is intended to be used together with the HVP-MC3PH main board.

The Freescale high voltage development platform is a set of software and hardware tools for evaluation and development. It is ideal for rapid prototyping of MCU-based applications. The Freescale HVP-KV10Z32 card is a simple yet sophisticated design featuring the Kinetis V series MCU, based on the ARM® Cortex®-M0+.

The KV10 is an entry-level member of the Kinetis V series MCU family. It combines the processing power of the ARM M0+ CPU (up to 75 MHz) with up to 32 KB of flash memory, 8 KB of RAM, a motor control timer, and an ADC with the capability to capture two inputs simultaneously (for example two current phase measurements) within a period ranging from 800 nS to 1 µS at a 12-bit resolution.

Contents

It has a full set of programmable peripherals including a six-channel PWM timer to drive a three-phase complimentary inverter stage, two 16-bit ADCs with two capture & hold circuits, two UARTs, one SPI, I^2C, CRC block, analog comparators w/DAC, on-chip / off-chip clock sources, and a 12-bit DAC. It also includes a programmable delay block module for precise ADC sampling points timing. Each peripheral can be shut down independently to save power. It works with a power supply voltage ranging from 1.71 V to 3.6 V. The KV10 is targeted for a low-dynamic variable-speed sensorless motor control used in industrial pumps, compressors, fans, and power conversion, as well as in other general-purpose applications.

The HVP-KV10Z32 features the Freescale open-standard embedded serial and debug adapter known as the OpenSDA. This circuit offers several options for serial communications, flash programming and run-control debugging.

2 Reference documents

Table 1 provides a list of reference documents about the HVP-KV10Z32 hardware. All these documents are available online at freescale.com/HVP.

Table 1. Reference documents filenames

Filename	Description
HVP-KV10Z32 Quick Start Package	This is a quick start guide and supporting files for getting started with the HVP-KV10Z32.
HVP-KV10Z32 User's Guide	This document provides an overview and detailed information about the HVP-KV10Z32 hardware.
HVP-MC3PH User's Guide	This document provides an overview and detailed information about the HVP-MC3PH hardware.
HVP-KV10Z32 Schematics	This document contains PDF schematics for the HVP-KV10Z32 hardware.
HVP-KV10Z32 Design Package	This is a zip file containing all design source files for the HVP-KV10Z32 hardware.
OpenSDA User's Guide	This document provides overview and instructions on how to use the embedded OpenSDA.

3 Description

Key features:

- Usage of the KV10Z32 MCU
- SWD isolation for up to 5 kV
- Programmable OpenSDA debugging interface with multiple applications available, including:
  - Mass-storage device flash programming interface
  - P&E Debug interface – provides run-control debugging and compatibility with IDE tools
  - Data-logging application
- Compatible with CodeWarrior 10.x, IAR, Keil
- Design optimized for low noise

- On-board isolated power supply allowing safe debugging
- Controller card supporting standalone operation

Figure 1 shows a block diagram of the HVP-KV10Z32 design. The primary components and their placement on the card is shown in Figure 2.

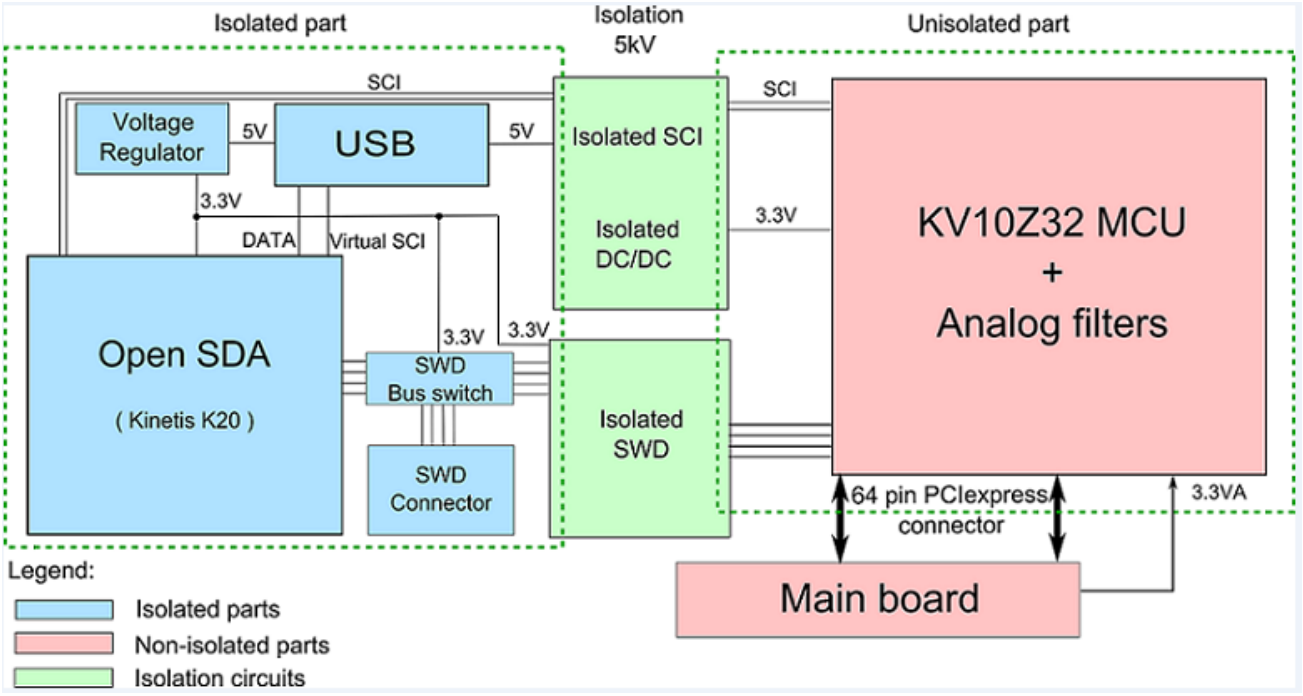

Figure 1. HVP-KV10Z32 block diagram

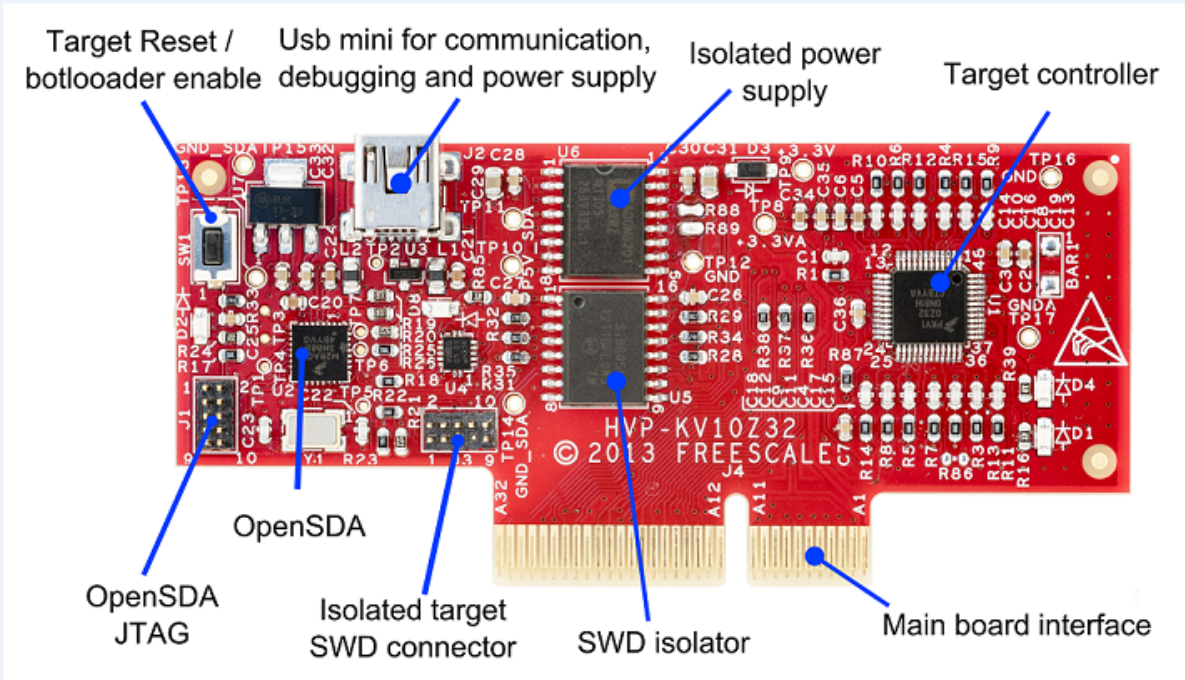

Figure 2. HVP-KV10Z32 controller card description

3.1 Power supply

There are two power supply options available for the controller card. It can be powered either using the USB connector, or using the main board 3.3 V supply. When the controller card is unplugged from the HVP-MC3PH, the USB voltage is regulated using a 3.3 V on-board linear regulator to provide power. In this case, the controller card is powered from the USB during standalone operation. Only digital circuits are powered during standalone operation, analog circuits are not powered. Thus, the ADC measurement cannot be evaluated. When the card is connected to the main board, the power is drawn from the main board and the analog circuits are working. When the analog circuits need to be evaluated during standalone operation, the test points placed on the controller card (TP9 and TP8) need to be shorted.

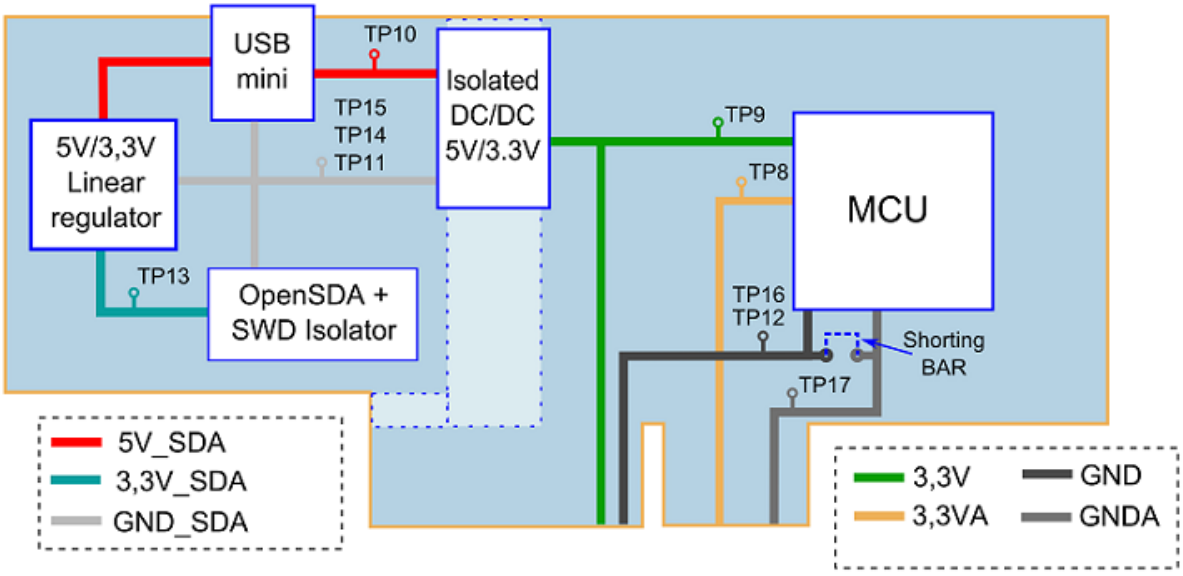

Figure 3. HVP-KV10Z32 power distribution

3.2 Clocking

The controller card does not include any clock source. Thus, the controller must be clocked from the internal clock of the KV10.

3.3 ARM SWD target debug interface

The Cortex-M debug SWD connector J3 is a standard 2×5 pin (0.05") connector. It provides a connection for an external debugger, with access to the KV10 MCU. When an external debugger is used, the + 3.3 V power supply must be provided by the external debugger or from a mini USB connector to provide power for isolation circuits.

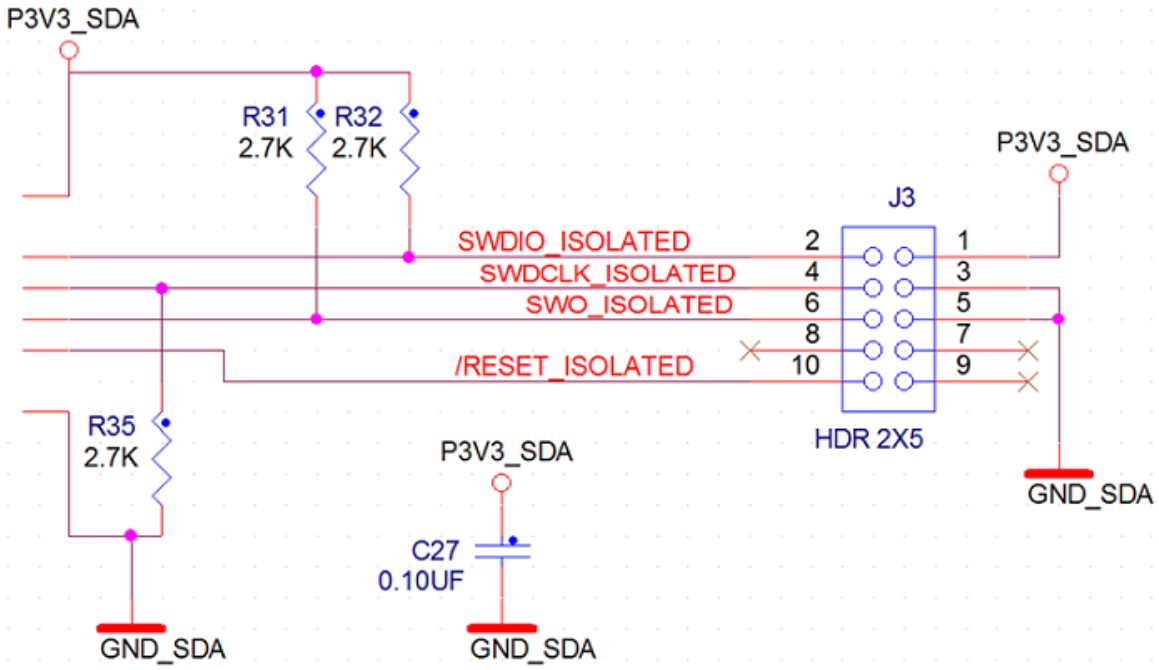

Figure 4. SWD connector

NOTE

The J3 is not populated by default. The Samtec FTSH-105-02-F-D or a compatible connector can be connected to the J3 through-hole connector. A mating cable, such as the Samtec FFSD IDC cable, can be used to connect the off-board SWD debugger to the target KV10 controller.

Table 2. ARM SWD mini connector J3 description

Pin	Function	Connection to KV10
1	P3V3	+ 3.3 V OpenSDA power supply
2	SWDIO / TMS	PTA3 / SWD_DIO
3	GND	GND
4	SWDCLK / TCK	PTA0/SWD_CLK
5	GND	GND
6	SWO / TDO	NC
7	NC	NC
8	NC	NC
9	NC	NC
10	$\overline{\text{RESET}}$	PTA20 / RESET

3.4 Reset

The $\overline{\text{RESET}}$ signal on the KV10 is connected to the SW1 push-button and the OpenSDA circuit via a galvanic isolator. The reset button can be used to force an external reset event in the target MCU. Also, the reset button can be used to force the OpenSDA circuit into bootloader mode. Please see Section 3.6, "Serial and debug adapter (OpenSDA)" for more details.

3.5 On-board LEDs, testpoints and connectors

Table 3. Test points, LEDs and connectors

Name	Ref. des.	Functionality
TP8	+ 3.3 VA	+ 3.3 V analog power supply for analog circuits (not powered during the standalone operation)
TP9	+ 3.3 V	+ 3.3 V digital power supply for logic circuits
TP10	P5V_SDA	+ 5 V from the USB mini connector
TP11,TP14,TP15	GND_SDA	GND connected to the USB mini connector (isolated side)
TP12,TP16	GND	GND connected to the target controller (non-isolated side)
TP13	P3V3_SDA	+ 3.3 V for OpenSDA, provided by linear voltage regulator
TP17	GNDA	Analog GND
D1	–	User LED 2
D2	–	OpenSDA status LED
D4	–	Non-isolated side + 3.3 V power indicator
D8	–	Isolated side + 3.3 V power indicator
J4	–	Controller card connector
J2	–	Galvanically isolated USB to SCI OpenSDA, debugging, communication
SW1	–	Target $\overline{\text{RESET}}$ for entering bootloader mode

The Cortex-based controller cards feature the Freescale open-standard embedded serial and debug communication adapter known as the OpenSDA. This circuit offers several options for serial communications, flash programming and run-control debugging.

3.6 Serial and debug adapter (OpenSDA)

The OpenSDA is an open-standard serial and debug adapter. It bridges serial and debug communications between USB host and embedded target processor, as shown in Figure 5. The hardware circuit is based on Freescale Kinetis K20 family MCU with 128 KB of embedded flash and an integrated USB controller. The OpenSDA features a mass-storage device (MSD) bootloader, which provides a quick and easy mechanism for loading different OpenSDA applications such as flash programmers, run-control debug interfaces, serial-to-USB converters, and more. Refer to the OpenSDA user's guide for more details.

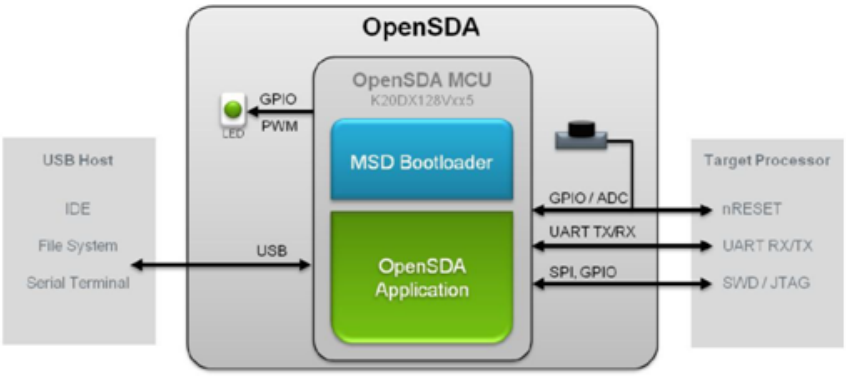

Figure 5. OpenSDA high-level block diagram

The OpenSDA circuit includes a status LED (D2) and a push-button (SW1). The push-button asserts the $\overline{\text{RESET}}$ signal to the target MCU. Also, it can be used to place the OpenSDA circuit into bootloader mode. The SPI or GPIO signals provide an interface to the SWD debug port of the K20. In addition, the signal connections are available to implement the UART serial channel. The OpenSDA circuit receives power when the USB connector J2 is plugged into a USB host.

3.7 Virtual serial port

A serial port connection is available between the OpenSDA MCU and the target controller. Several default OpenSDA applications provided by Freescale, including the MSD flash programmer and the P&E debug application, provide the USB communications device class (CDC) interface that bridges serial communications between a USB host and the serial interface on the K20. On the HVP-KV10Z32, this virtual serial port is connected to UART1 (PTD0 / PTD1). If this serial line needs to be used, the R88 and R89 need to be populated, because the serial line is connected also to the HVP-MC3PH board. Another serial communication interface is connected to UART0 (PTB16 / PTB17). Refer to the HVP-MC3PH user's guide for details on how to connect the SCI lines on the main board.

The connection of serial communication lines is shown in Figure 6.

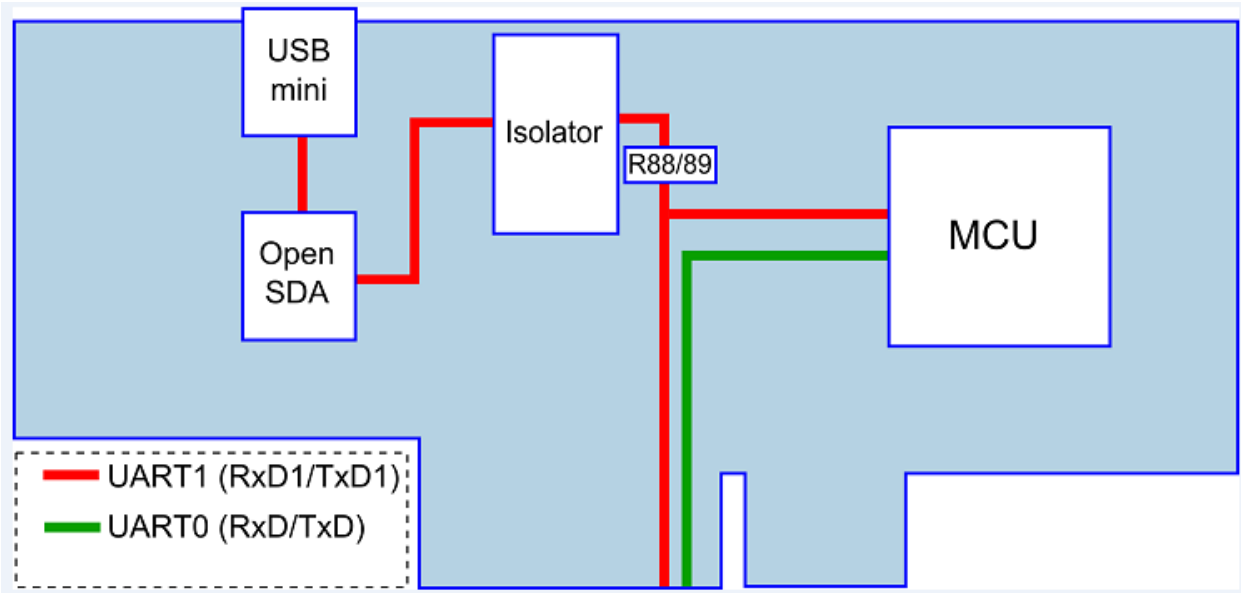

Figure 6. Serial lines block diagram

3.8 HVP-KV10Z32 – HVP-MC3PH interface description

The interface between the controller card and the main board is provided by 64-pin PCI express edge connector. Figure 7 describes the functionality of each pin of this interface.

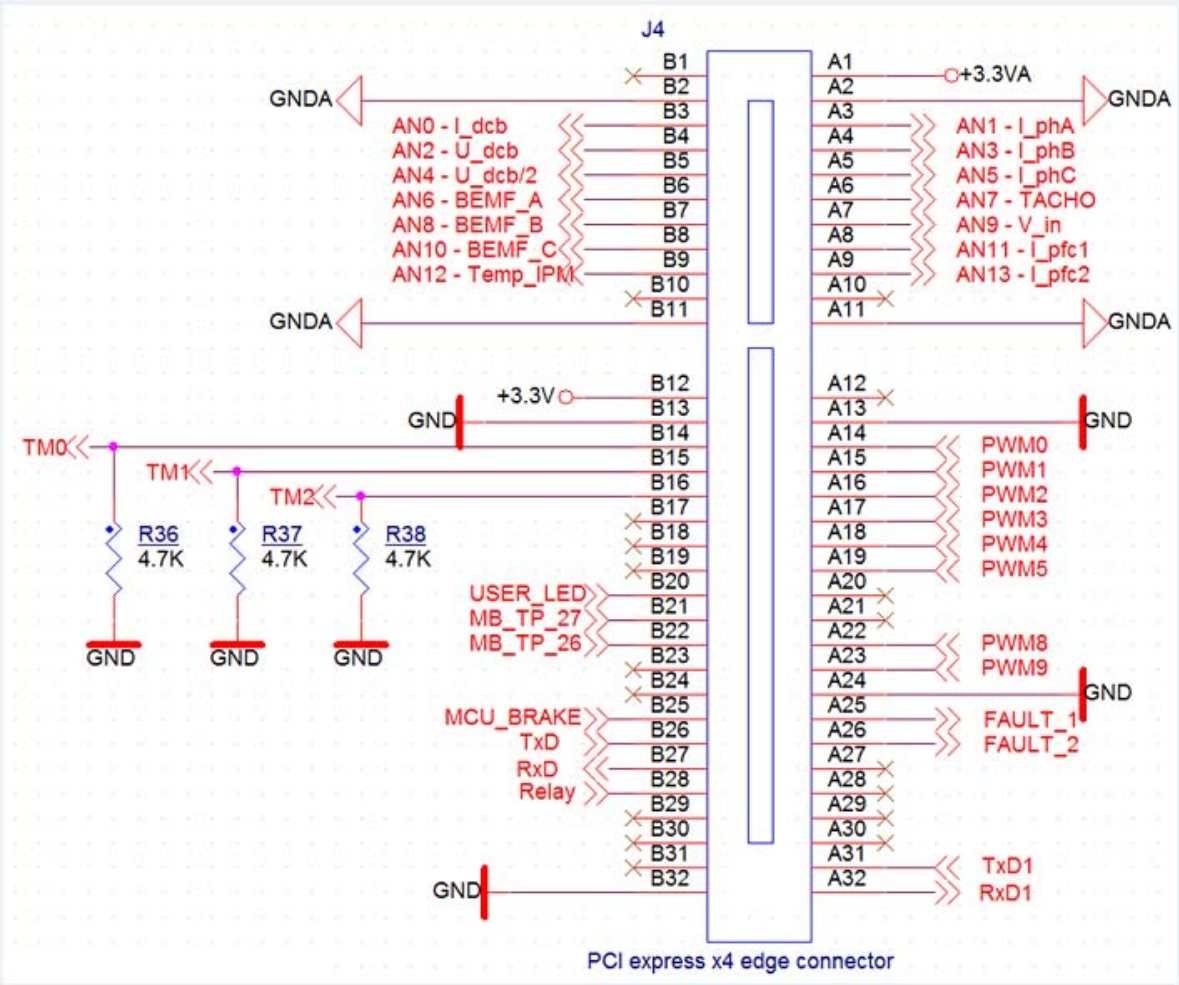

Figure 7. Main board interface

4 Revision history

Table 4. Document revision history

Rev. number	Date	Substantive change(s)
0	12/01/2014	Initial release

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