Freescale Semiconductor, Inc.
User's Guide

Document Number: HVPKV31F120MUG
Rev. 0, 12/2014

HVP-KV31F120M User's Guide

by: Ivan Lovas

1 High voltage controller card HVP-KV31F120M

This document supports the HVP-MC3PH user's guide. It describes the HVP-KV31F120M controller card. This controller card is based on Freescale KV31F512VLL12 device 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-KV31F120M hardware is a simple yet sophisticated design featuring a Kinetis V series MCU, built around the ARM® Cortex®-M4.

The KV30 and KV31 MCU families are members of the Kinetis V series and provide a high-performance solution for three-phase BLDC, PMSM and ACIM motor control. They are built around the ARM Cortex-M4 core operating at 100 / 120 MHz with DSP and floating-point unit. Features include dual 16-bit analog-to-digital converters with 835 nS conversion time in 12-bit mode, multiple motor-control timers, programmable-delay block, 64 KB to 512 KB of flash memory, and an external bus interface.

Contents

The KV3x MCUs are offered in 100LQFP, 64LQFP, 48LQFP, and 32QFN packages. All Kinetis V series MCUs are supported by a comprehensive enablement suite from Freescale and third-party resources, including reference designs, software libraries, and motor configuration tools. For further information on other Freescale Kinetis MCUs, visit freescale.com/kinetis.

The HVP-KV31F120M features the Freescale open-standard embedded serial and debug adapter called 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-KV31F120M hardware. All of these documents are available online at freescale.com/HVP.

Table 1. Reference documents

Filename	Description
HVP-KV31F120M Quick Start Package	This is a quick start guide and supporting files for getting started with the HVP-KV31F120M.
HVP-KV31F120M User's Guide	This document provides overview and detailed information about the HVP-KV31F120M hardware.
HVP-MC3PH User's Guide	This document provides overview and detailed information about the HVP-MC3PH hardware.
HVP-KV31F120M Schematics	This document provides PDF schematics for the HVP-KV31F120M hardware.
HVP-KV31F120M Design Package	This is a zip file that contains all design source files for the HVP-KV31F120M hardware.
OpenSDA User's Guide	This document contains overview and instructions on how to use the embedded OpenSDA.

3 Description

Key features:

- Usage of target MCU MKV31F512VLL12
- SWD isolation up to 5 kV
- Programmable OpenSDA debug 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-KV31F120M card. The primary components and their placement on the card is shown in Figure 2.

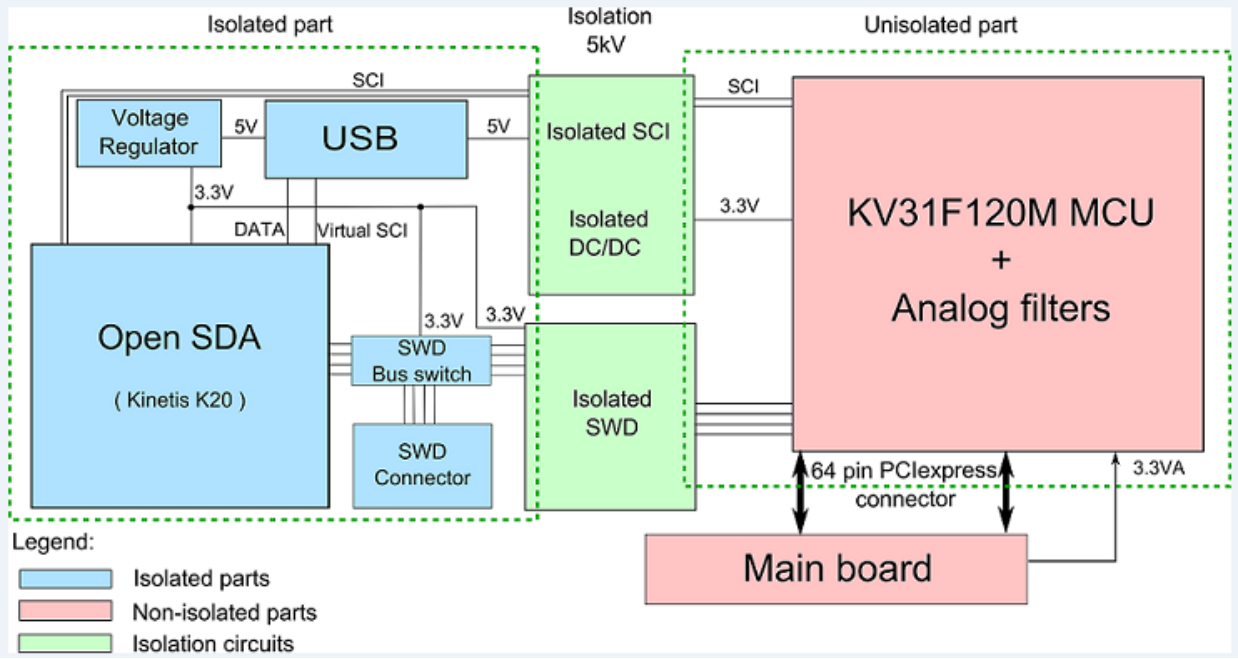

Figure 1. HVP-KV31F120M block diagram

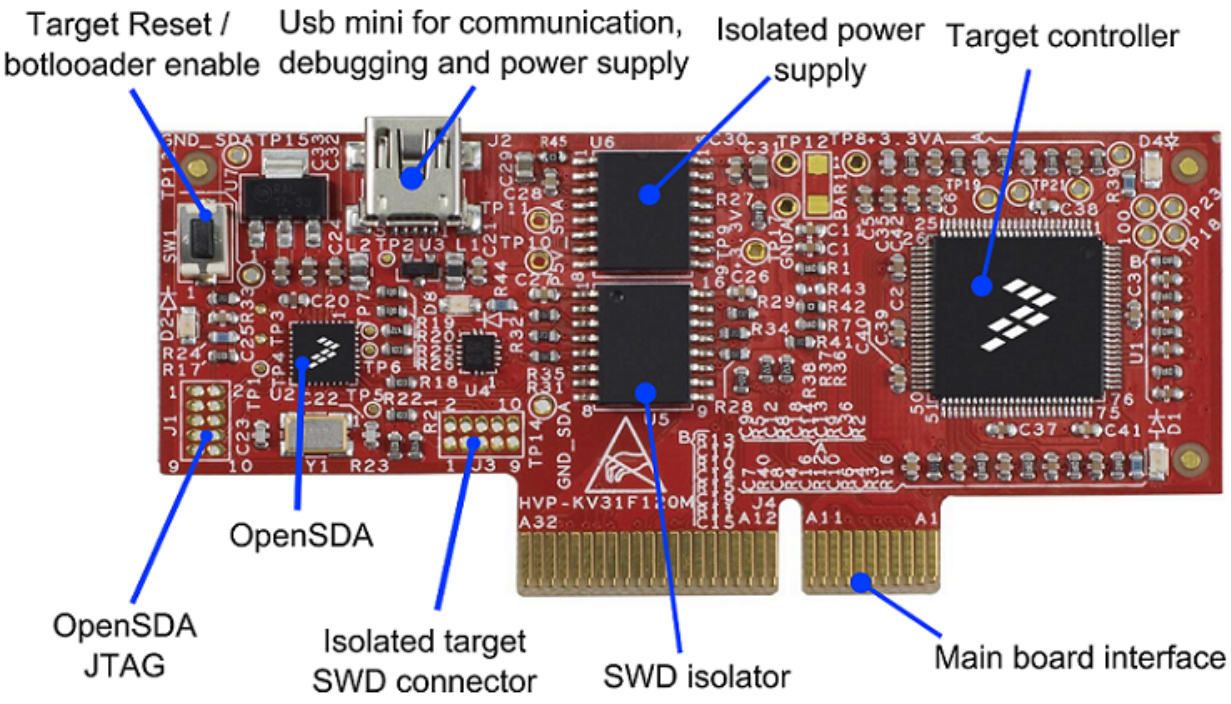

Figure 2. HVP-KV31F120M controller card description

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 the power. In this case the controller card is powered from the USB during standalone operation. Only digital circuits are powered during the standalone operation, analog circuits remain unpowered. Thus, the ADC measurement cannot be evaluated. When the card is inserted into the main board, the power is drawn from the main board and analog circuits start to work. 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.

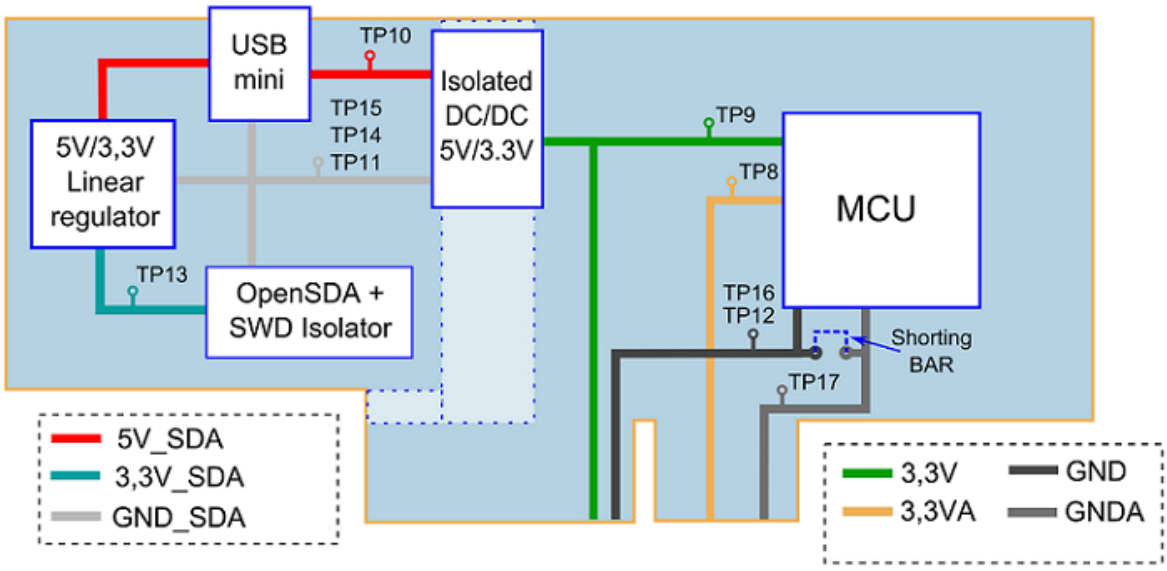

Figure 3. HVP-KV31F120M power distribution

3.2 Clocking

The controller card does not include any clock source. Thus, the controller is clocked using the internal clock of KV31.

3.3 ARM SWD target debug interface

The Cortex-M debug SWD connector J3 is a standard 2×5-pin (0.05") connector providing a connection for an external debugger with access to the KV31 MCU. When an external debugger is used, the + 3.3 V power supply needs to be provided by the external debugger or using a mini USB connector to provide power for isolation circuits.

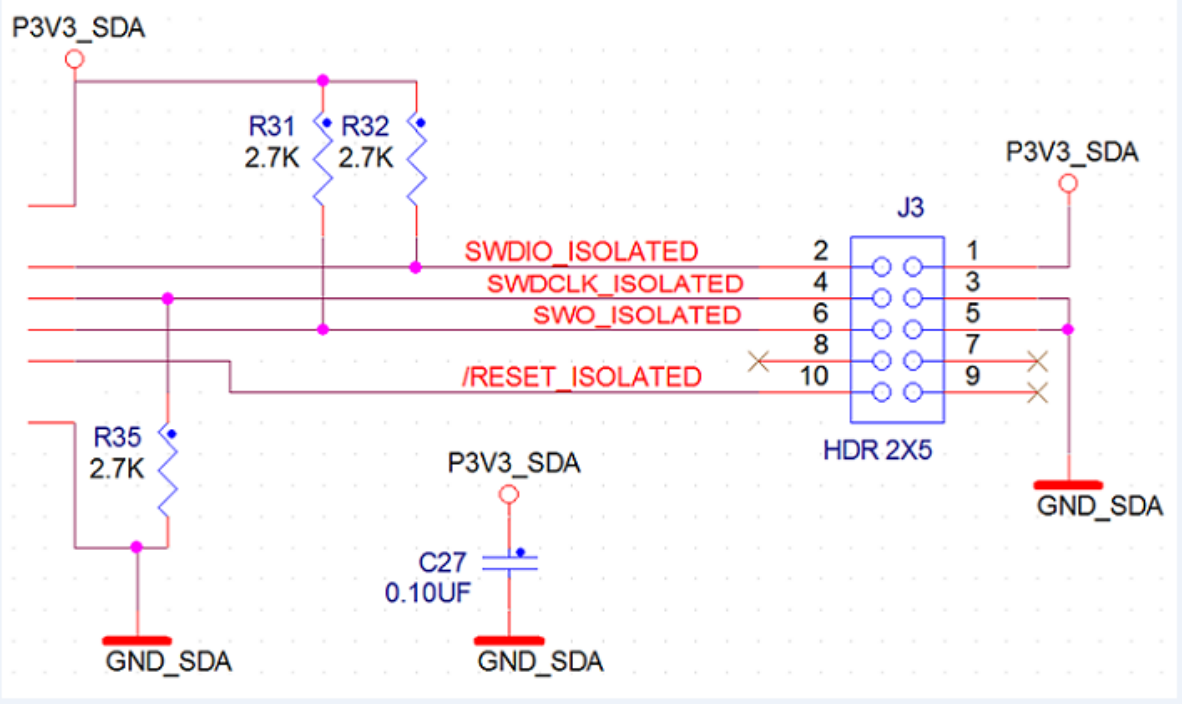

Figure 4. SWD connector

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 KV31 controller.

Table 2. ARM SWD mini connector J3 description

Pin	Function	Connection to KV31
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	PTA2 / TRACE_SWO
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 KV31 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 or to force the OpenSDA circuit into bootloader mode. Please refer to 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 USB mini connector
TP11,TP14,TP15	GND_SDA	GND connected to USB mini connector (isolated side)
TP12,TP16	GND	GND connected to target controller (non-isolated side)
TP13	P3V3_SDA	+ 3.3 V for OpenSDA, provided by linear voltage regulator
TP17	GNDA	Analog GND
TP18	/SS	General use test point
TP19	MISO	General use test point
TP20	SCK	General use test point
TP21	MOSI	General use test point
TP22	SDA0	General use test point
TP23	SCL0	General use test point
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 for OpenSDA, debugging and SCI communication
SW1	–	Target $\overline{\text{RESET}}$, for entering bootloader mode

The Cortex-based controller cards feature the Freescale open-standard embedded serial, debug and communication adapter called 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 the serial and debug communications between USB host and embedded target processor, as shown in Figure 4. 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 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.

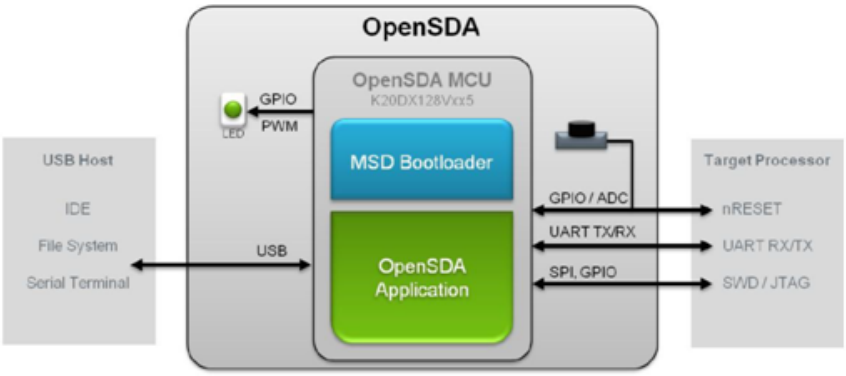

Figure 5. OpenSDA high-level block diagram

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 and GPIO signals provide an interface to the SWD debug port of the K20. There are signal connections available to implement the UART serial channel. When the USB connector J2 is plugged into a USB host, the OpenSDA circuit receives power.

3.7 Virtual serial port

There's a serial port connection available between the OpenSDA MCU and the target controller. Several of the default OpenSDA applications provided by Freescale, including the MSD flash programmer and the P&E debug application, provide a USB communications device class (CDC) interface that bridges serial communications between the USB host and the serial interface on the K20. On HVP-KV31F120M, this virtual serial port is connected to UART0 (PTB16 / PTB17). Another two serial communication interfaces are connected to UART1 (PTE0 / PTE1) and UART2 (PTE16 / PTE17) for communication with the main board or computer. For information on how to connect the SCI lines on main board refer to the HVP-MC3PH user's guide.

Serial communication lines are connected as shown in Figure 6.

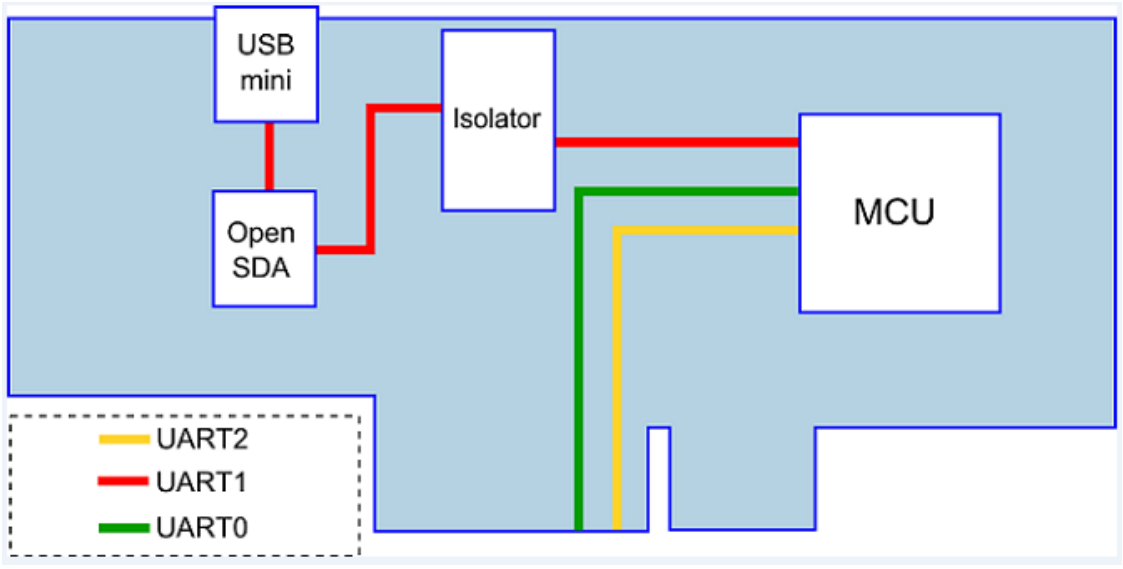

Figure 6. Serial lines block diagram

3.8 HVP-KV31F120M – 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.

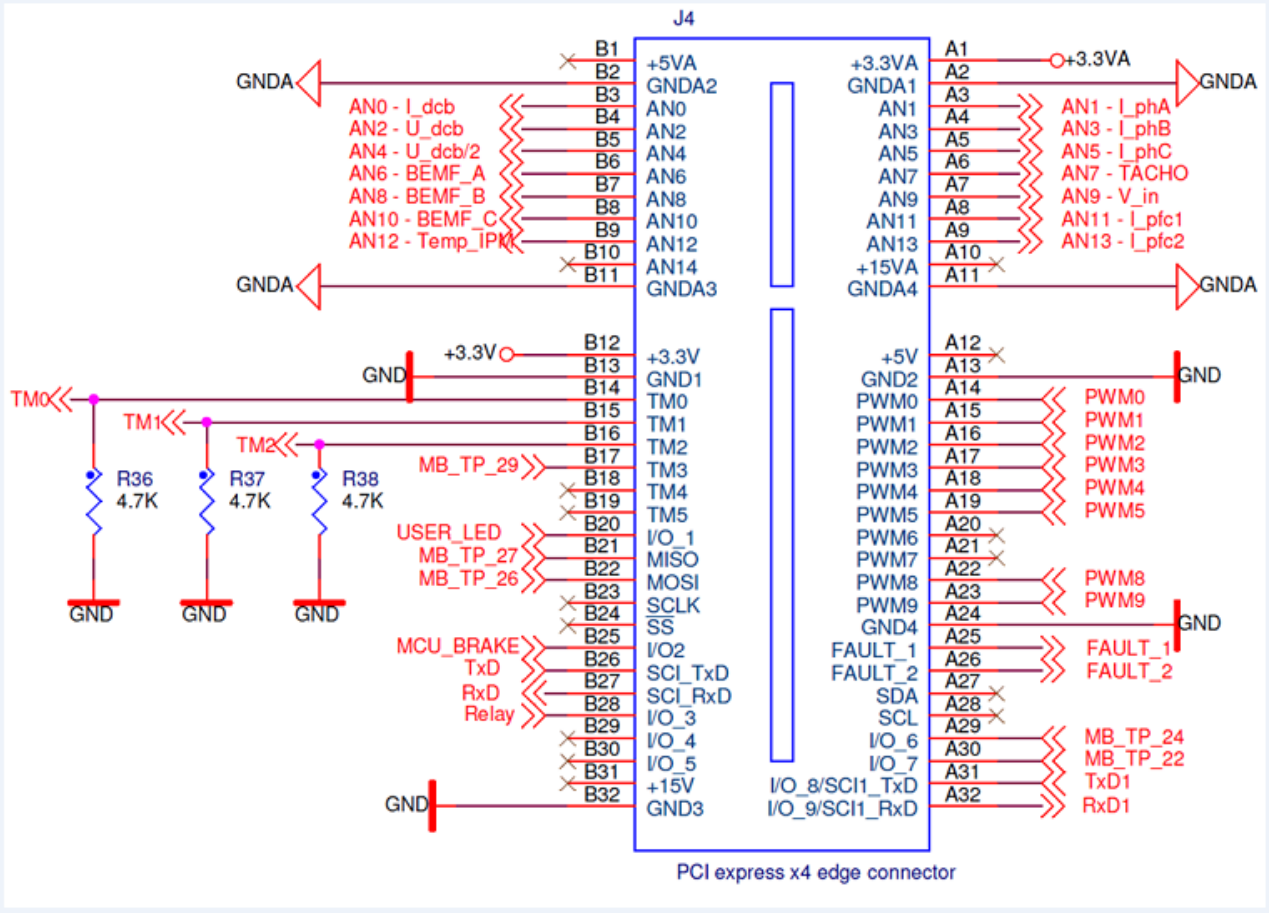

Figure 7. Main board interface

4 Revison history

Table 4. Document revision history

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

How to Reach Us:

Home Page:
freescale.com

Web Support:
freescale.com/support

Information in this document is provided solely to enable system and software implementers to use Freescale products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits based on the information in this document.

Freescale reserves the right to make changes without further notice to any products herein. Freescale makes no warranty, representation, or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. “Typical” parameters that may be provided in Freescale data sheets and/or specifications can and do vary in different applications, and actual performance may vary over time. All operating parameters, including “typicals,” must be validated for each customer application by customer’s technical experts. Freescale does not convey any license under its patent rights nor the rights of others. Freescale sells products pursuant to standard terms and conditions of sale, which can be found at the following address: freescale.com/SalesTermsandConditions.

Document Number: HVPKV31F120MUG
Rev. 0
12/2014