Freescale Semiconductor, Inc.
User's Guide

Document Number: HVPKV46F150MUG
Rev. 0, 12/2014

HVP-KV46F150M User's Guide

by: Ivan Lovas

1 High voltage controller card HVP-KV46F150M

This document supports the HVP-MC3PH user's guide. It describes the HVP- KV46F150M controller card. This controller card is based on Freescale KV46F256VLL15 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-KV46F150M hardware is a simple yet sophisticated design featuring the Kinetis V-series MCU, built around the ARM® Cortex®-M4.

The Kinetis KV4x family of MCUs is a high-performance solution offering exceptional precision, sensing and control for some of the most demanding applications in motor and power control. It is built around the ARM Cortex-M4 core running at 150 MHz including DSP and floating point unit. It features advanced high-speed and high-accuracy peripherals such as high-resolution pulse width modulation (PWM) with 312 pS resolution, dual 12-bit analog-to-digital converters (ADCs) sampling at 4.1 mega samples per second

Contents

(MSPS), a total of 30 PWM channels for support of multi-motor systems, and dual FlexCAN modules. The KV4x is supported by a comprehensive enablement suite from Freescale and third-party resources, including reference designs, software libraries and motor configuration tools.

The HVP-KV46F150M 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 for the HVP-KV46F150M hardware. All of these documents are available online at freescale.com/HVP.

Table 1. Reference documents

Filename	Description
HVP-KV46F150M Quick Start Package	This is a quick start guide and supporting files for getting started with the HVP-KV46F150M.
HVP-KV46F150M User's Guide	This document provides overview and detailed information about the HVP-KV46F150M hardware.
HVP-MC3PH User's Guide	This document provides overview and detailed information about the HVP-MC3PH hardware.
HVP-KV46F150M Schematics	This document provides PDF schematics of the HVP-KV46F150M hardware.
HVP-KV46F150M Design Package	This is a zip file containing all design source files for the HVP-KV46F150M hardware.
OpenSDA User's Guide	This document provides overview and instructions for using the embedded OpenSDA.

3 Description

Key features:

- Usage of the KV46F256VLL15 MCU
- 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 for 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, providing safe debugging
- Controller card supporting standalone operation

Figure 1 shows a block diagram of the HVP-KV46F150M design. The primary components and their placement on the board is shown in Figure 2.

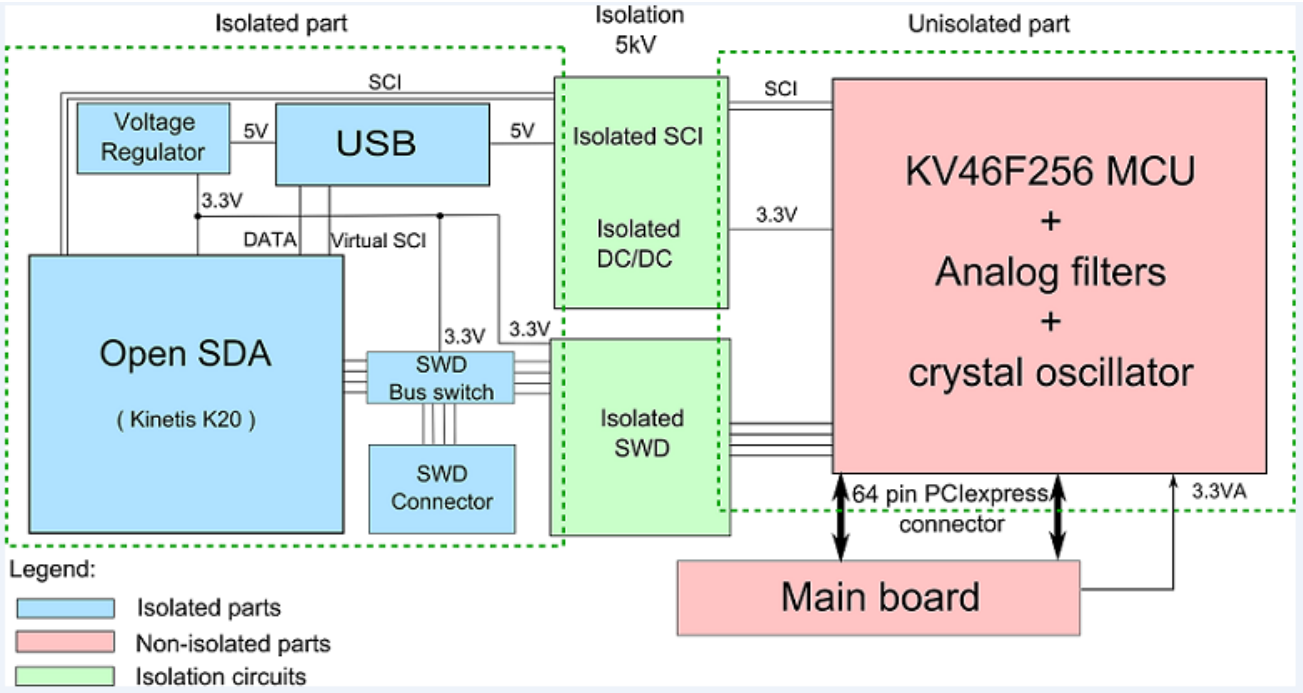

Figure 1. HVP-KV46F150M block diagram

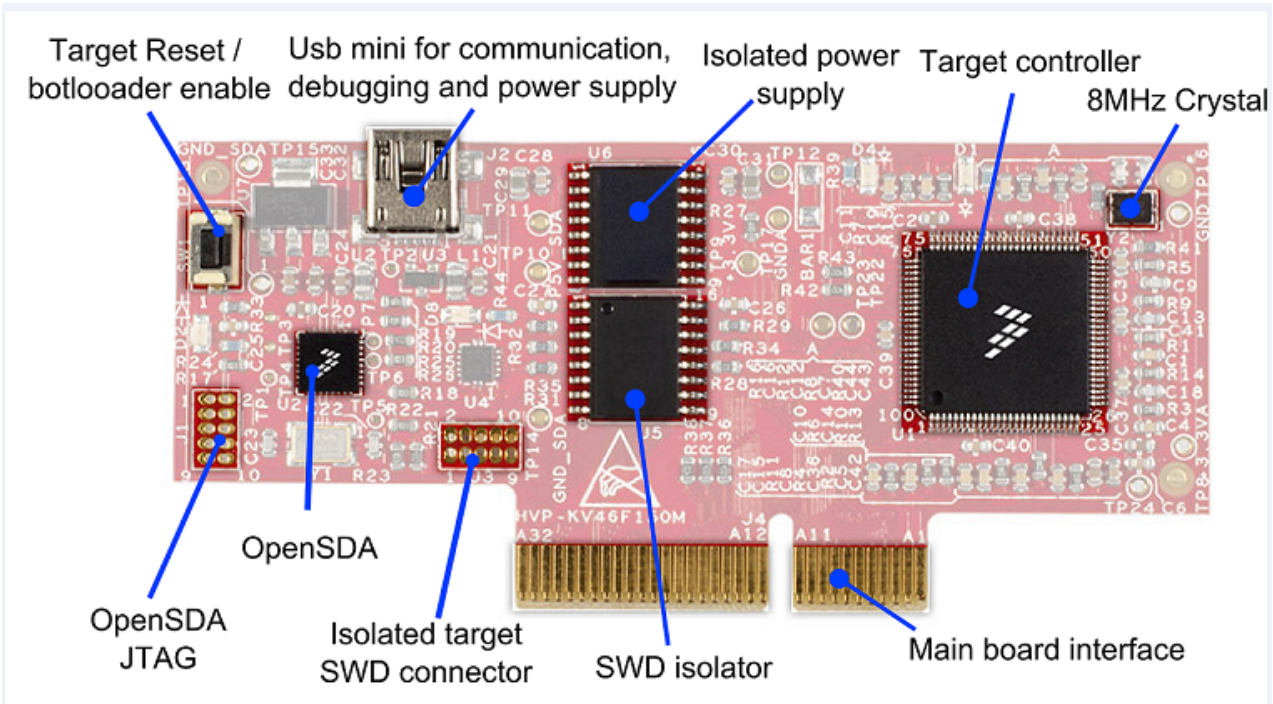

Figure 2. HVP-KV46F150M controller card description

3.1 Power supply

There are two power supply options available on the controller card. It can be powered either from the USB connector or from 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. The controller card is powered from the USB during standalone operation. Only digital circuits are powered during the standalone operation, while analog circuits stay unpowered. 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 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.

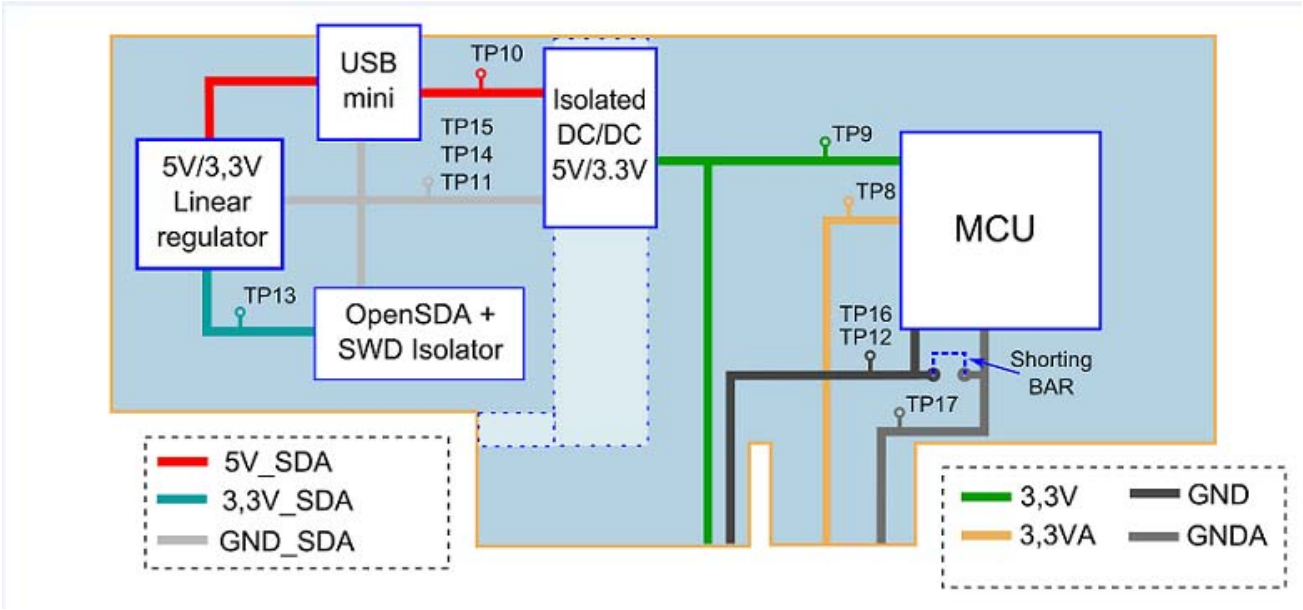

Figure 3. HVP-KV46F150M power distribution

3.2 Clocking

The Kinetis KV46 MCUs feature an on-chip oscillator compatible with the input crystal or resonator frequency of 32 kHz and 3 – 32 MHz (high frequency mode, high range). The KV46F256 MCU on the HVP-KV46F150M board is clocked by an 8 MHz crystal.

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 KV46 MCU. When an external debugger is used, the + 3.3 V power supply must be provided from the external debugger or using a mini-USB connector, to provide power for isolation circuits.

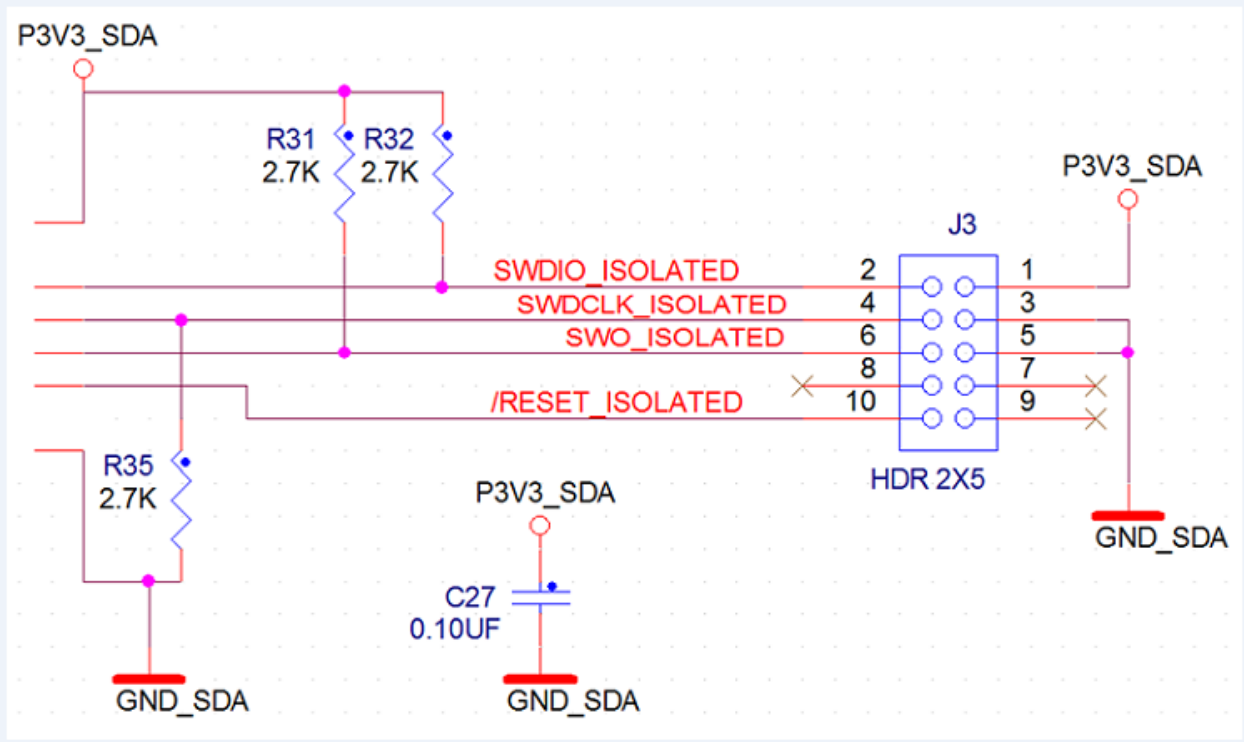

Figure 4. SWD connector

NOTE

Note that 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 then be used to connect the off-board SWD debugger to the target KV46 controller.

Table 2. J3 ARM SWD mini connector description

Pin	Function	Connection to KV46
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 KV46 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, and 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 and debug communication adapter known as OpenSDA. This circuit offers several options for serial communication, 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. 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.

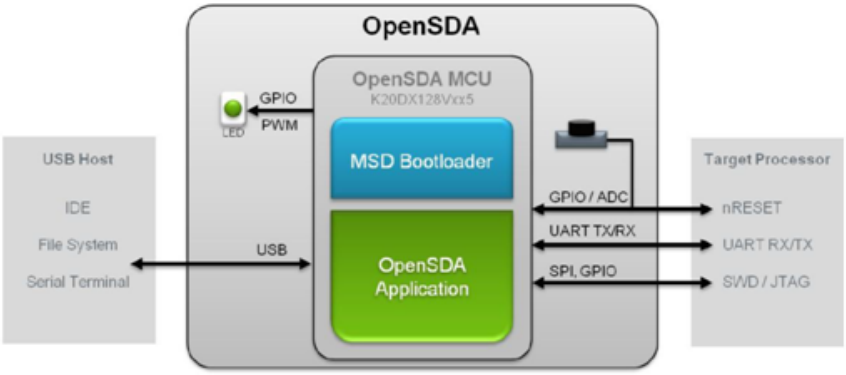

Figure 5. OpenSDA high-level block diagram

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, and places the OpenSDA circuit into bootloader mode. The SPI and GPIO signals provide an interface to any of the SWD debug ports on the K20. The signal connections are 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

A serial port connection between the OpenSDA MCU and the target controller is available. 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 the HVP-KV46F150M, this virtual serial port is connected to UART1 (PTC3 / PTC4). The other two serial communication interfaces are connected to UART0 (PTD6 / PTD7) and UART0 (PTE20 / PTE21) for communication with the main board or computer. Refer to the HVP-MC3PH user's guide for information about the connection of SCI lines on the main board.

Serial communication lines are connected as shown in Figure 6.

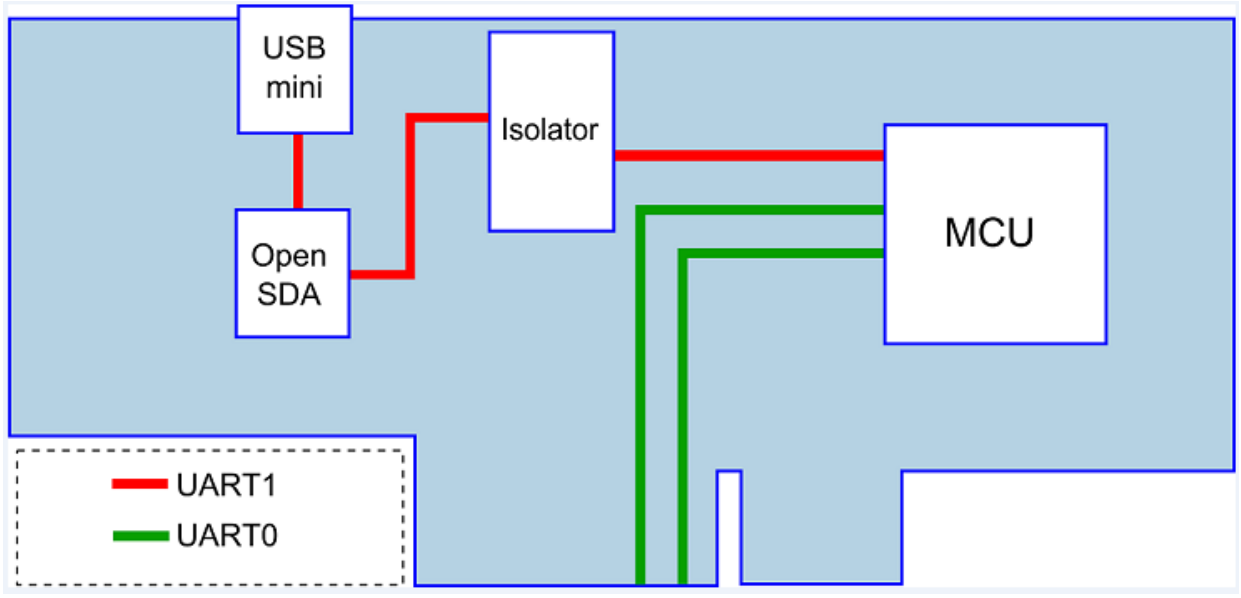

Figure 6. Serial lines block diagram

3.8 HVP-KV46F150M – HVP-MC3PH interface description

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

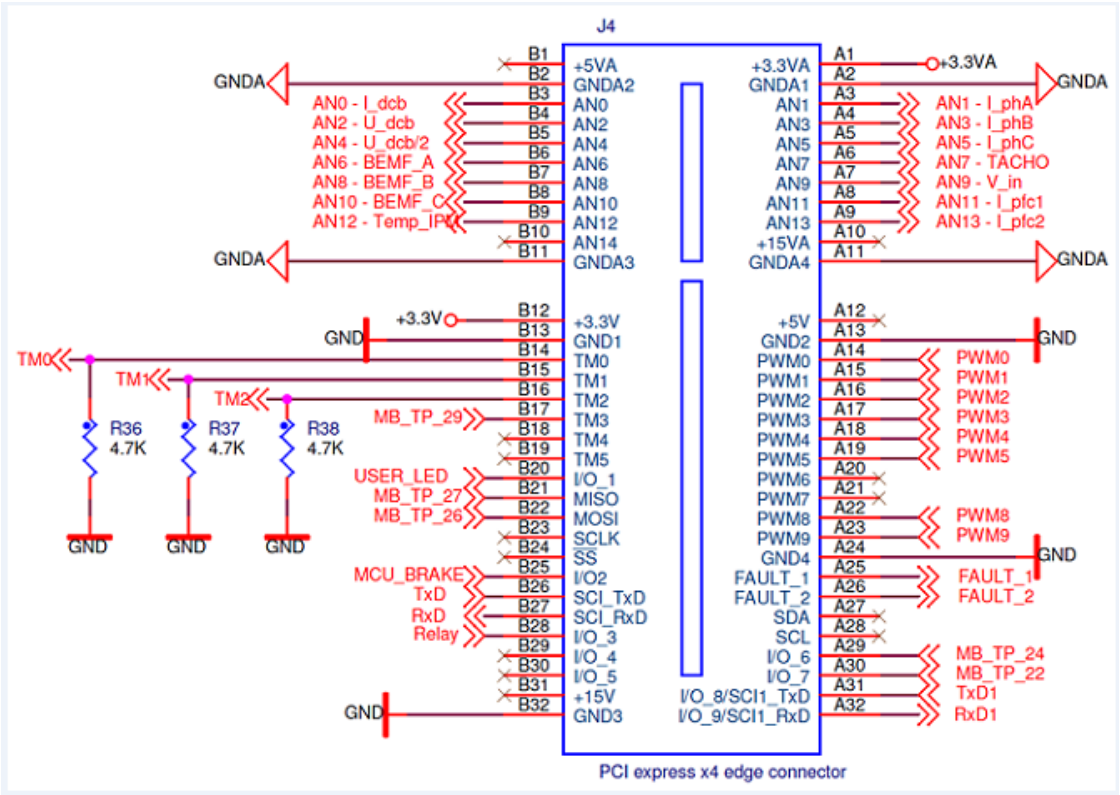

Figure 7. The HVP-KV46F150M – HVP-MC3PH interface

4 Revision history

Table 4. Document revision history

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

How to Reach Us:

Home Page:
freescale.com

Web Support:
freescale.com/support

Document Number: HVPKV46F150MUG
Rev. 0
12/2014