HVP-KV58F220M User's Guide

1. HVP-KV58F220M high-voltage controller card

This document supports the HVP-MC3PH user's guide and describes the HVP-KV58F220M controller card. This controller card is based on the KV58F1M0VLQ24 MCU and intended to be used together with the HVP-MC3PH main board.

The 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 HVP-KV58F220M hardware is a simple, yet sophisticated design featuring the Kinetis V-series MCU, built around the ARM® Cortex®-M7 core. The Kinetis KV5x MCU family is a high-performance solution offering exceptional precision, sensing, and control targeting industrial motor control, industrial drives, automation, and power conversion applications. The Kinetis KV5x MCU is built around the ARM Cortex-M7 core running at 240 MHz with a single precision floating-point unit. It features high-resolution Pulse-Width Modulation (PWM) with 260 picosecond resolution, 4×12-bit Analog-to-Digital Converters (ADCs) sampling at five mega samples per second (MS/s), three FlexCAN modules, optional Ethernet communications, comprehensive enablement suite from NXP and third-party resources including reference designs, software libraries, and motor configuration tools.

Contents

HVP-KV58F220M features the 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-KV58F220M hardware. These documents are available online at nxp.com/HVP:

Table 1.   Reference documents

Filename	Description
HVP-KV58F220M Quick Start Package	This is a quick start guide and supporting files for getting started with the HVP-KV58F220M hardware.
HVP-KV58F220M User's Guide	This document contains the overview and detailed information about the HVP-KV58F220M hardware.
HVP-MC3PH User's Guide	This document contains the overview and detailed information about the HVP-MC3PH hardware.
HVP-KV58F220M Schematics	This document contains the PDF schematics of the HVP-KV58F220M hardware.
HVP-KV58F220M Design Package	This is a ZIP file containing all design source files for the HVP-KV58F220M hardware.
OpenSDA User's Guide	This document contains the overview and instructions for using the embedded OpenSDA.

3. Description

Key features:

- Use of the KV58F1M0VLQ24 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 Embedded Workbench®, and Keil® IDEs.
- Design optimized for low noise.

Figure 1 shows a block diagram of the HVP-KV58F220M design. The primary components and their placement on the board is shown in Figure 2.

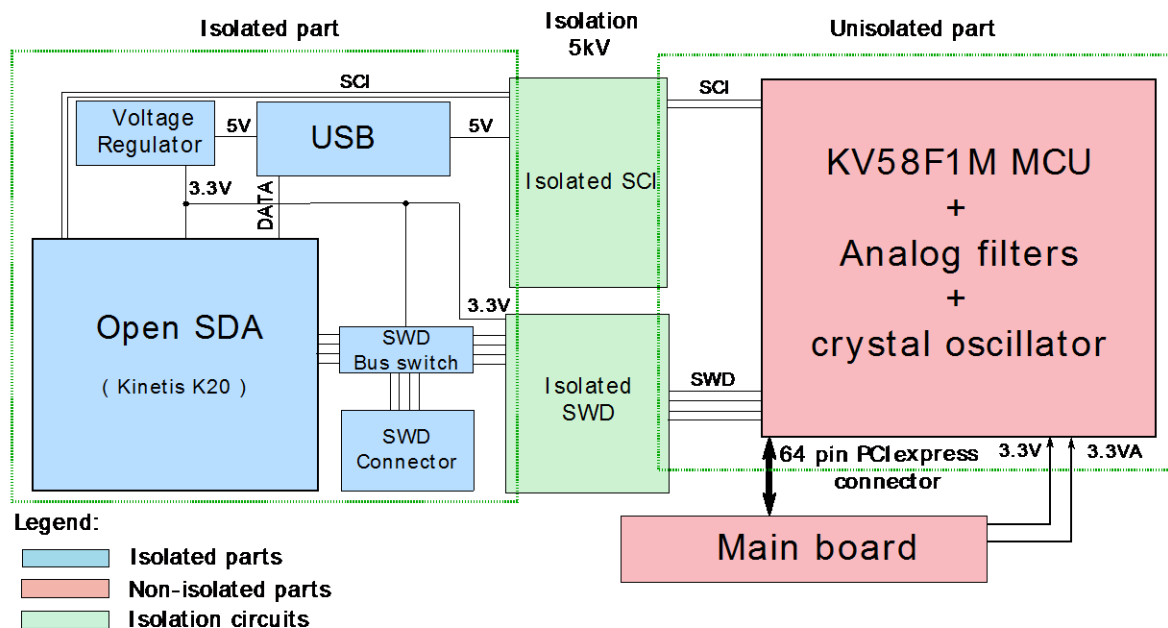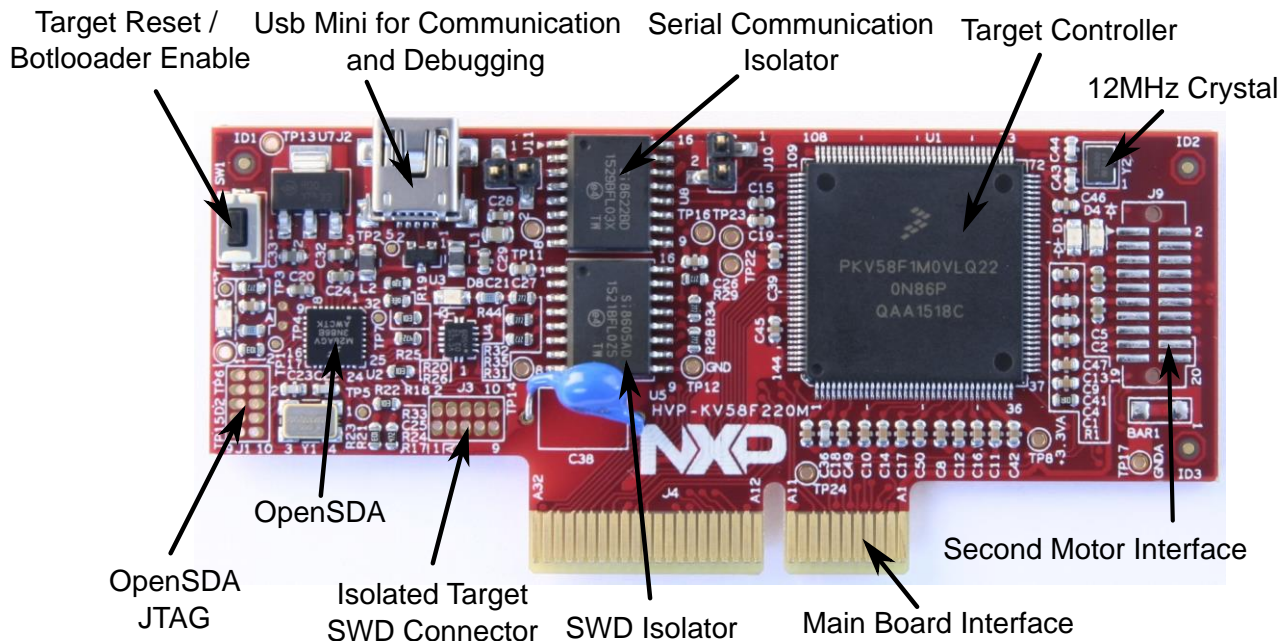**Figure 1. HVP-KV58F220M block diagram**

Figure 2. HVP-KV58F220M controller card description

3.1. Power supply

When compared to other HVP controller cards, the HVP-KV58F220M card doesn't have an on-board isolated power supply capable of supplying the KV5x CPU via the USB mini connector. Therefore, it can only be powered from the HVP-MC3PH main board.

If a standalone controller card operation is required, the J10 connector can be used to connect an external power supply for the MCU. This power supply must be isolated because the MCU is connected to dangerous voltages. Only the digital circuits are powered during the standalone operation, while the analog circuits are not powered. Thus, the ADC measurement cannot be evaluated. When the analog circuits must be evaluated during standalone operation, the test points placed on the controller card (TP9 and TP8) must be shorted.
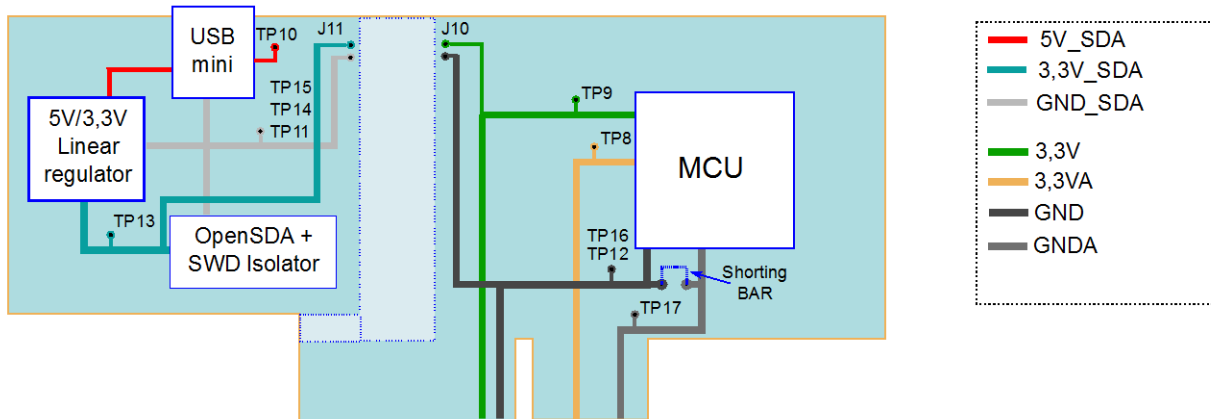

Figure 3. HVP-KV58F220M power distribution

3.2. Clocking

The Kinetis KV58 MCUs feature an on-chip oscillator compatible with input crystals or resonators in the frequency ranges of 32 kHz (low-range mode) and 3–32 MHz (high-range mode). The KV58F1M0VLQ24 MCU on the HVP-KV58F220M board is clocked by a 12-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 that provides connection for an external debugger with access to the KV58 MCU. When an external debugger is used, the +3.3 V power supply must be provided from the external debugger or the mini-USB connector must be connected to provide power for the isolation circuits.
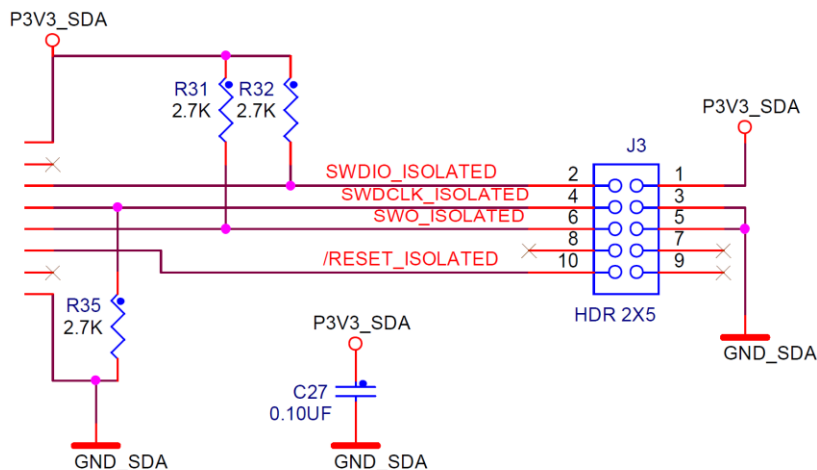
Figure 4. SWD connector

NOTE

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 KV58 controller.

Table 2.   J3 ARM SWD mini connector description

Pin	Function	Connection
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	RESET	RESET

3.4. Reset

The RESET signal on the KV58 MCU 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 the bootloader mode. See Section 3.6, "Serial and debug adapter
(OpenSDA)" for more details.

3.5. On-board LEDs, test points, 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
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
TP24	Spare Analog	Spare analog input
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 RESET for entering bootloader mode

3.6. Serial and debug adapter (OpenSDA)

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

OpenSDA is an open-standard serial and debug adapter. It bridges the serial and debug communications between the USB host and the embedded target processor, as shown in Figure 5. The hardware circuit is based on the Kinetis K20 family MCU with 128 KB embedded flash and an integrated USB controller. OpenSDA features the 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.
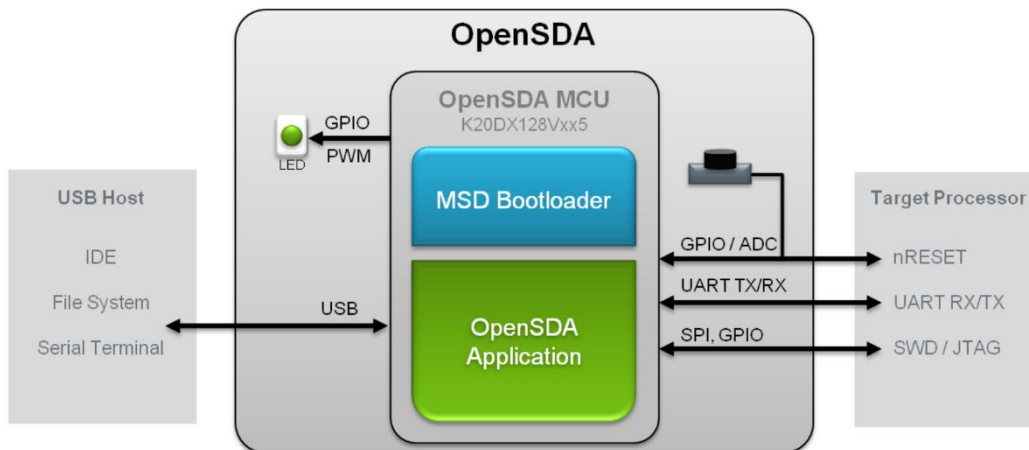
Figure 5. OpenSDA high-level block diagram

The OpenSDA circuit includes a status LED (D2) and a push-button (SW1). The push-button asserts the RESET signal to the target MCU and places the OpenSDA circuit into the bootloader mode. The SPI and GPIO signals provide the interface to all SWD debug ports on K20. The signal connections are available to implement the UART serial channel. When the J2 USB connector 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 default OpenSDA applications are provided, including the MSD flash programmer and the P&E debug application. They provide the USB Communications Device Class (CDC) interface that bridges the serial communications between the USB host and the serial interface on K20. On HVP-KV58F220M, 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 a computer. Refer to the HVP-MC3PH user's guide for information about the connection of SCI lines on the main board.

The serial communication lines are connected as shown in Figure 6.
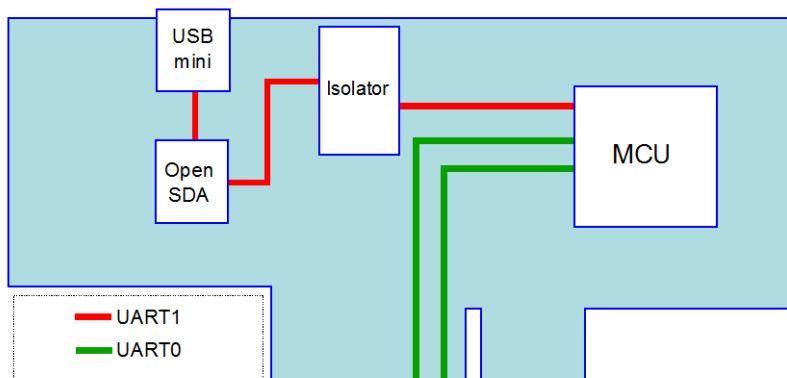
Figure 6. Serial lines block diagram

3.8. HVP-KV58F220M—HVP-MC3PH interface description

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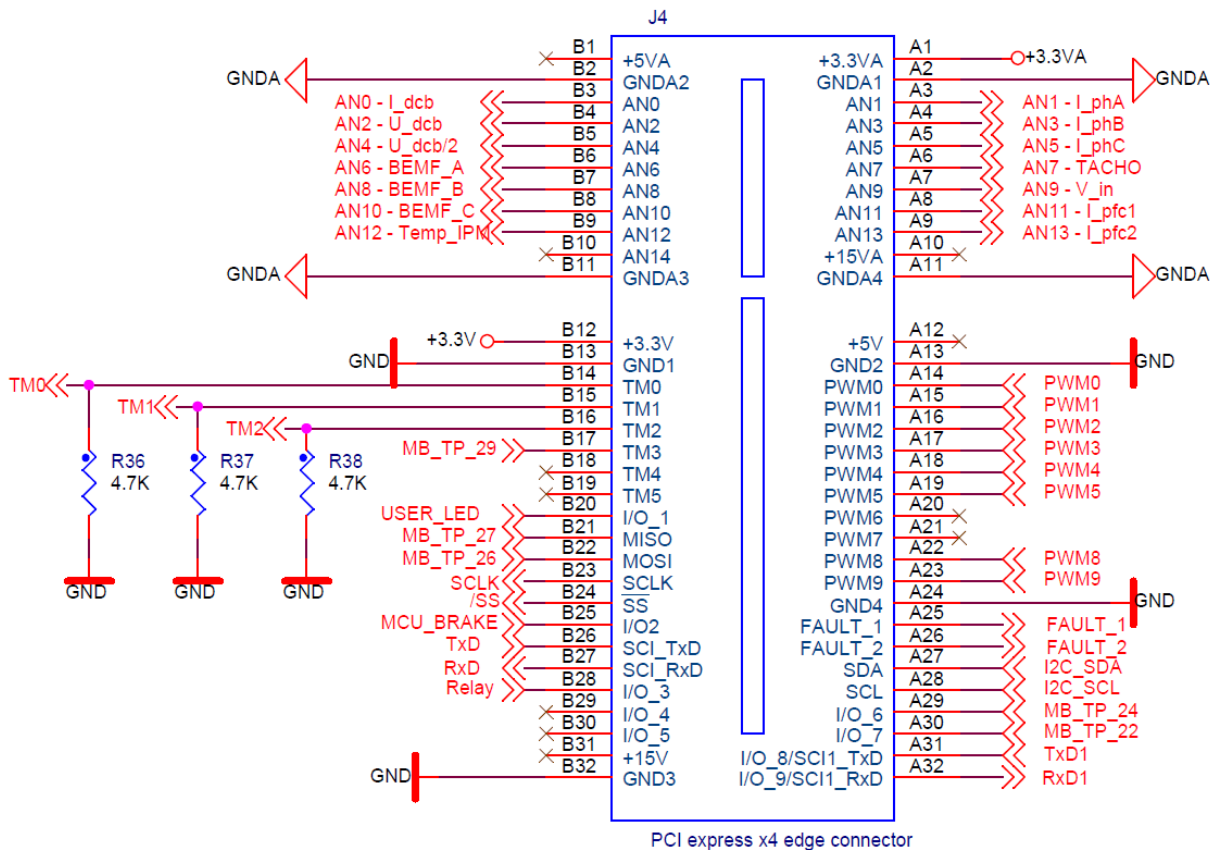

Figure 7. HVP-KV58F220M—HVP-MC3PH interface

3.9. Useful links

- KV5x product page
- KV5x reference manual
- KV5x datasheet
- HVP-MC3PH web page

4. Revision history

Table 4 summarizes the changes done to this document since the initial release.

Table 4. Revision history

Revision number	Date	Substantive changes
0	04/2017	Initial release

Document Number: HVPKV58F220MUG
Rev. 0
04/2017