NXP Semiconductors
User's Guide

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TWR-KV58F220M Tower Module User's Guide

1. Introduction

The TWR-KV58F220M microcontroller module is designed to work either in standalone mode or as a part of the NXP Tower System, a modular development platform that enables rapid prototyping and tool reuse through reconfigurable hardware. Take your design to the next level and begin constructing your Tower System today by visiting for additional Tower System microcontroller modules and compatible peripherals. For TWR-KV58F220M specific information and updates, visit www.nxp.com/TWR-KV58F220M.

2. Contents

The TWR-KV58F220M microcontroller module contents include:

- TWR-KV58F220M board assembly
- Three foot A to micro-AB USB cable for debug interface and power
- Quick Start Guide

Contents

3. TWR-KV58F220M Features

- Tower compatible microcontroller module
- MKV58F1M0VLQ24 MCU (240 MHz, 1 MB Flash, 128 KB RAM, and 144LQFP package)
- General purpose Tower Plug-in (TWRPI) socket
- OpenSDA debug circuit with virtual serial port
- Three axis accelerometer/magnetometer combination IC (FXOS8700)
- Four user-controllable LEDs
- Four user pushbutton switches
- Potentiometer
- Compatibility with the following tower peripheral boards:
  - TWR-MC-LV3PH Motor Control Tower Board
  - TWR-SER Serial Peripheral Board
  - TWR-LCD

4. Get to Know the TWR-KV58F220M Module

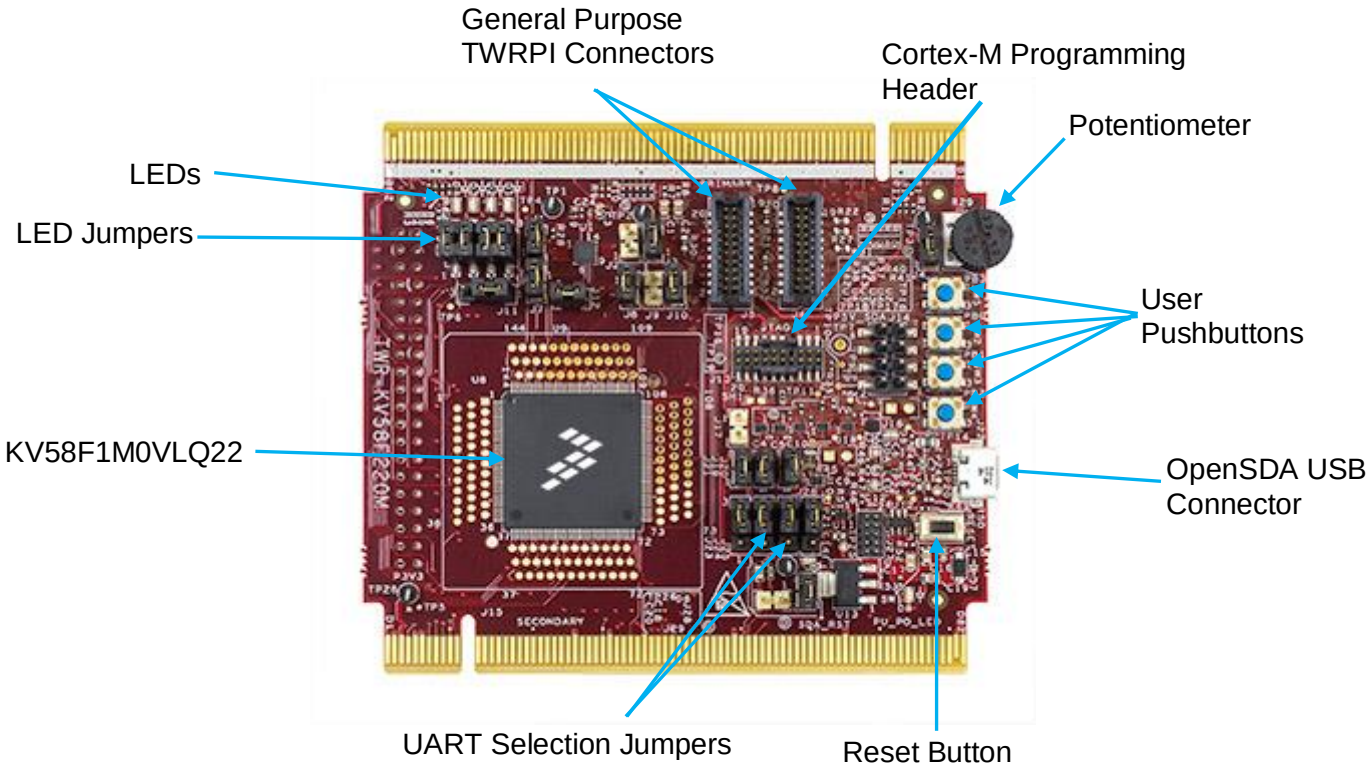

Figure 1. TWR-KV58F220M Front side

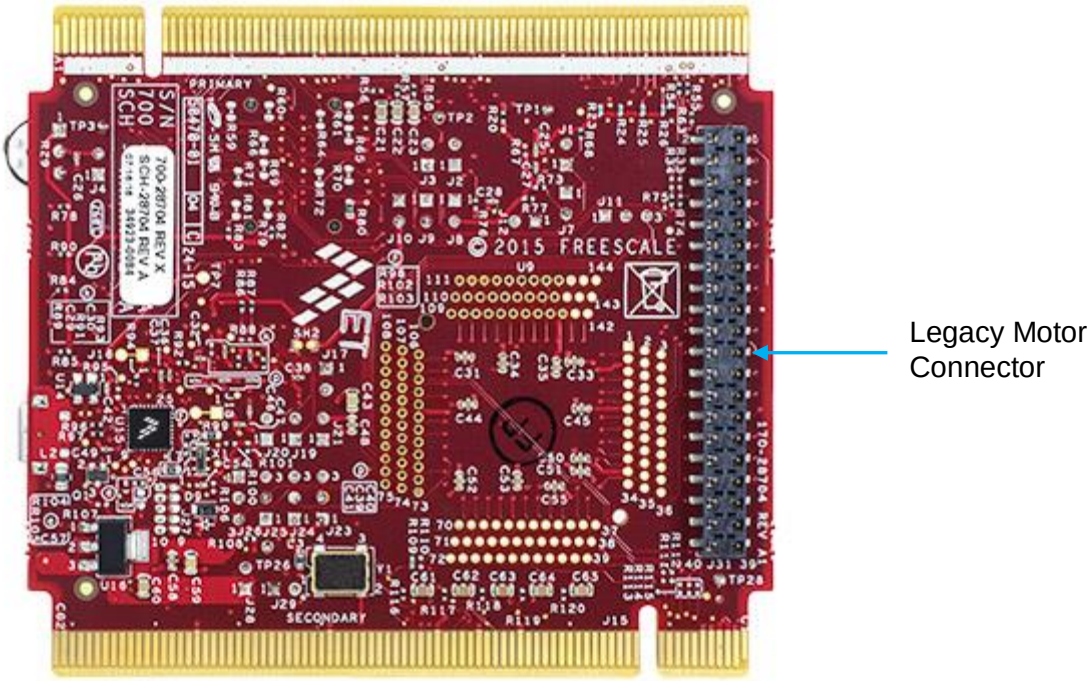

Figure 2. TWR-KV58F220M Back side

5. Hardware Description

The TWR-KV58F220M is a Tower MCU Module featuring the MKV58F1M0VLQ24, a Kinetis microcontroller featuring an ARM® Cortex® CM7 core with a 5Msps 12-bit ADC and nano-edge resolution pulse-width modulation (PWM) modules. It is intended for use in the NXP Tower System development platform but can also operate in a stand-alone mode. An on-board debug circuit, OpenSDA, provides a SWD interface and a power supply input through a single USB micro-AB connector.

The block diagram of the TWR-KV58F220M board is shown in the following figure.

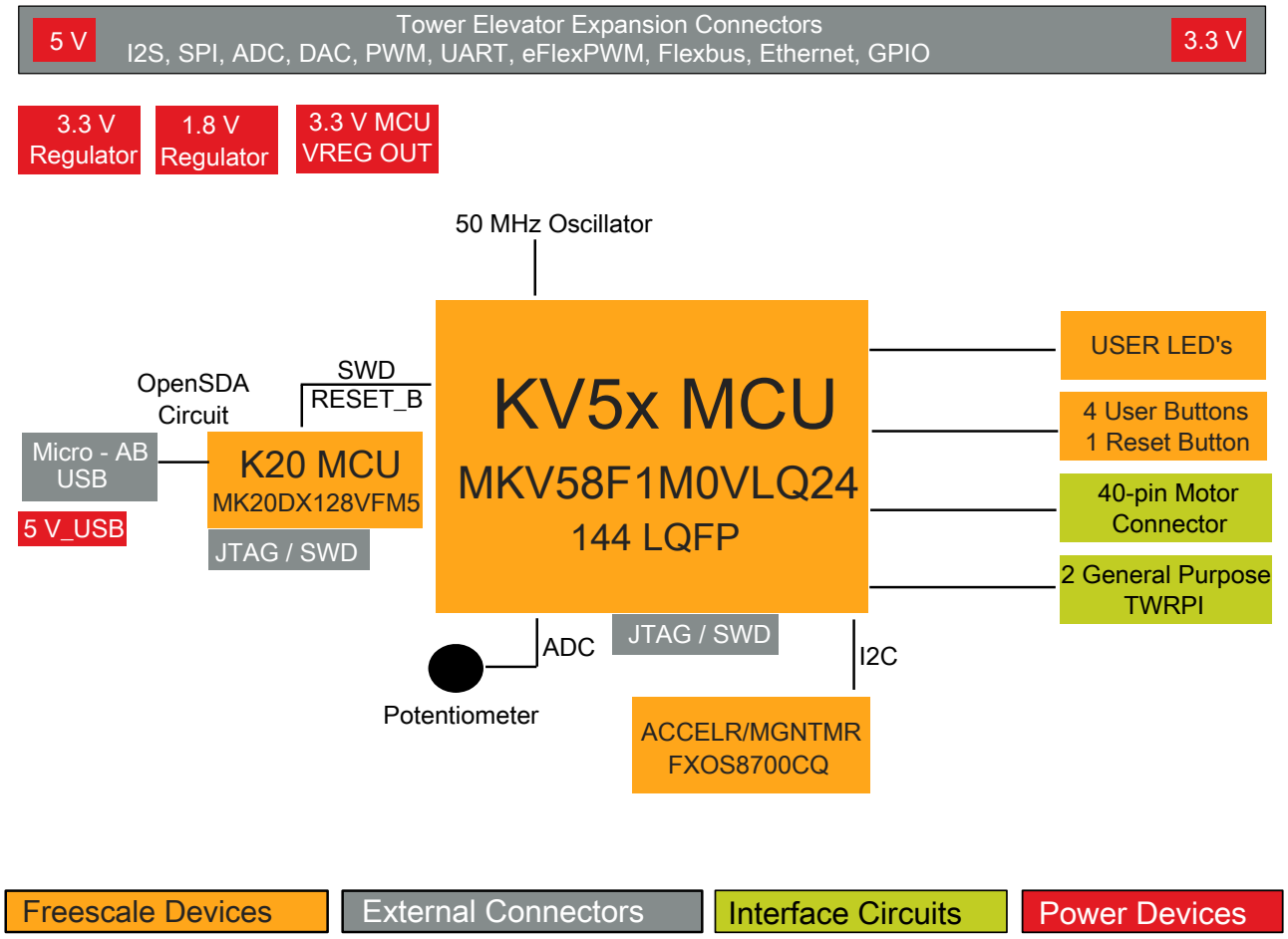

Figure 3. TWR-KV58F220M Tower System module

5.1. Microcontroller

The TWR-KV58F220M module features the MKV58F1M0VLQ24 MCU. This 240 MHz microcontroller is a part of the Kinetis KV5x family and is available in a 144LQFP or 100LQFP package. The following table lists the features of the MKV58F1M0VLQ24 MCU.

Table 1. Features of the MKV58F1M0VLQ24 MCU

Feature	Description
Ultra-low power	• 11 low-power modes with power and clock gating for optimal peripheral activity and recovery times. 4 µs wake-up from Stop mode. • Full memory and analog operation down to 1.71 V for extended battery life. • Low-leakage wake-up unit with up to eight internal modules and 16 pins as wake-up sources in the very low-leakage stop (VLLS) modes. • Low-power timer for continual system operation in reduced power states
Flash, SRAM, and FlexBus	• 512 KB–1024 KB flash featuring fast access times, high reliability, and four levels of security protection.128 KB–256 KB of SRAM. • Programming and erase functions operational over the full operating voltage range (1.71 – 3.6 V).
Mixed-signal capability	• High-speed 12-bit ADC with configurable resolution. • Single or differential input modes. • 200 ns conversion time achievable. • 19:1 multiplexed inputs. • 12-bit Digital-to-Analog Converter (DAC). • Four high-speed comparator (CMP) modules with internal 6-bit DAC to provide a trigger point. • One 16-bit ADC for high resolution ADC measurements
Performance	• 240 MHz ARM Cortex-M7 core featuring dual issue and execution for most instructions, DSP instruction set, single precision Floating Point Unit (FPU), Memory Protection Unit (MPU), 64 KB of Tightly Coupled Memory for Instructions (ITCM), and 128 KB of Tightly Coupled Memory for Data (DTCM). • Up to 32 channels of eDMA for peripheral and memory servicing with reduced CPU loading and faster system throughput. • Cross bar switch enables concurrent multi-master bus accesses, increasing bus bandwidth.
Timing and control	• Two eFlexPWM modules with four submodules each. • One nano-edge placement block connected to an eFlexPWM for enhancedPWM control. • Four FlexTimers (FTMs) with a total of 20 channels. • Hardware dead-time insertion and quadrature decoding for motor control. Four-channel 32-bit periodic interrupt timer provides time base for RTOS task scheduler or trigger source for ADC conversion and programmable delay block. • One PDB module to provide delayed triggering from the FTMs to the ADCs. • One Low-Power Timer module (LPTMR). • One external and one internal WDOG module.
Connectivity and communications	• Six UARTs with RS-232 and RS-485 support and IrDA (two contain ISO7816). • Two Inter-Integrated Chip (IIC) modules. • Three DSPI modules. • Three FlexCAN modules. • One optional Ethernet module.
Reliability, safety and security	• Memory protection unit provides memory protection for all masters on the cross bar switch, increasing software reliability. • Cyclic redundancy check (CRC) engine validates memory contents and communication data, increasing system reliability. • True Random Number Generator to aid in the implementation of security algorithms. • Watchdog module guards against clock skew or code runaway for fail-safe applications such as the IEC 60730 safety standard for household appliances. • External watchdog monitor drives output pin to safe state for external components in the event that a watchdog timeout occurs. • This product is included in the NXP product longevity program, with assured supply for a minimum of 10 years after launch.

5.2. Clocking

The KV58 microcontroller boots from an internal digitally controlled oscillator (DCO). Software can enable the main external oscillator (EXTAL0/XTAL0), if desired. The external oscillator/resonator can range from 32 kHz up to 40 kHz in low range, or from 4 MHz up to 32 MHz in high range.

An external oscillator can directly drive the EXTAL pin. The TWR-KV58F220M module is equipped with a 50 MHz canned oscillator circuit. This enables the creation and evaluation of RMII Ethernet applications as the RMII reference clock is tied directly to the EXTAL pin (through OSCERCLK).

5.3. System power

When installed into a Tower System, the TWR-KV58F220M module is powered by from either an onboard source or from another source in the assembled Tower System.

In stand-alone operation, the main power source (5.0 V) for the TWR-KV58F220M module is derived from the OpenSDA USB micro-AB connector (J22). Two low-dropout regulators provide 3.3 V and 1.8 V supplies from the 5.0 V input voltage. All the selectable options are configured using one header, J23.

5.4. Debug interface

There are two debug interface options provided. The on-board OpenSDA circuit and an external ARM Cortex Debug+ETM connector. The ARM Cortex Debug+ETM connector is a standard 2 x 10-pin connector providing an external debugger cable with access to the JTAG and Trace interface of the KV58F1M0VLQ24 MCU. Alternatively, the on-board OpenSDA debug interface is used to access the debug interface of the KV58F1M0VLQ24 MCU.

5.5. OpenSDAv2

OpenSDAv2 is a serial and debug adapter circuit that includes an open-source hardware design, an open-source bootloader, and debug interface software. OpenSDAv2 bridges serial and debug communications between a USB host and an embedded target processor as shown in Figure 4. The hardware circuit is based on a NXP Kinetis K20 family microcontroller (MCU) with 128 KB of embedded flash and an integrated USB controller. OpenSDAv2 comes preloaded with the CMSIS-DAP bootloader, an open-source mass storage device (MSD) bootloader and the CMSIS-DAP Interface firmware, also referred to as mbed interface that provides a MSD flash programming interface, a virtual serial port interface, and a CMSIS-DAP debug protocol interface. For more information on the OpenSDAv2 software, visit www.mbed.org and https://github.com/mbedmicro/CMSIS-DAP.

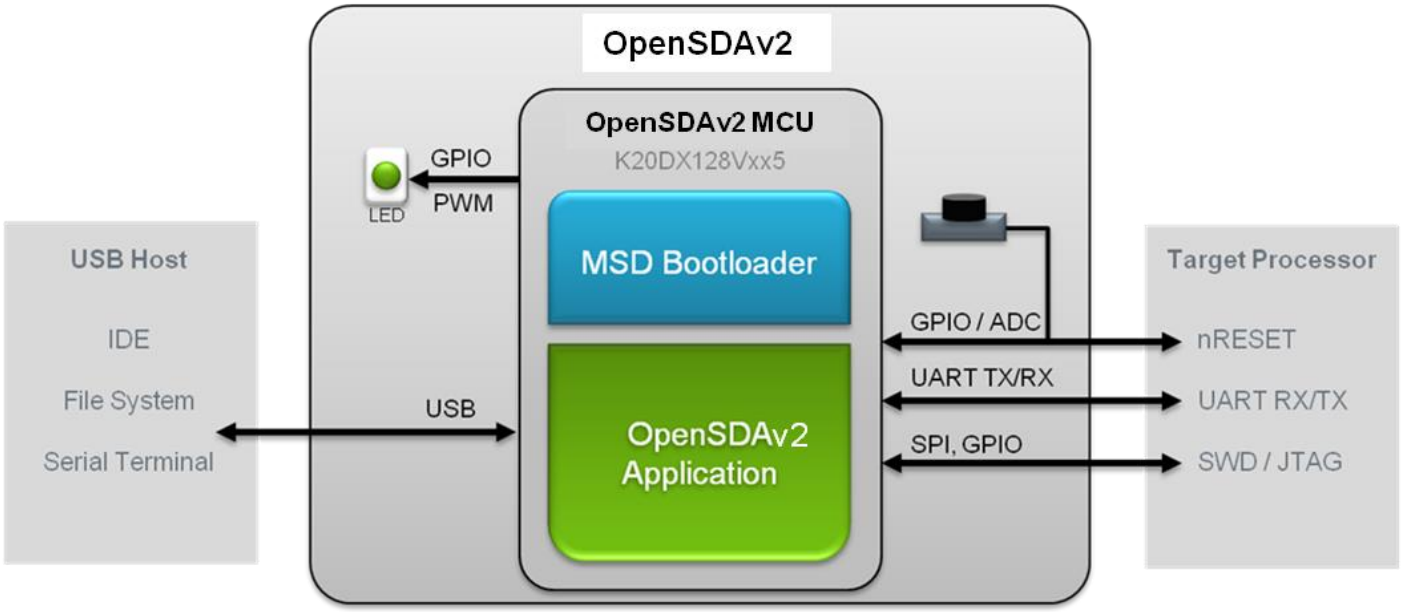

Figure 4. OpenSDA high-level block diagram

OpenSDAv2 is managed by a Kinetis K20 MCU built on the ARM Cortex-M4 core. The OpenSDAv2 circuit includes a status LED (D5) and a pushbutton (SW1). The pushbutton asserts the Reset signal to the KV58F target MCU. It is used to place the OpenSDAv2 circuit into bootloader mode. SPI and GPIO signals provide an interface to either the SWD debug port or the K20. Additionally, signal connections are available to implement a UART serial channel. The OpenSDAv2 circuit receives power when the USB connector J22 is plugged into a USB host.

5.5.1. Debug interface

Signals with SPI and GPIO capability are used to connect directly to the SWD of the KV58. These signals are also brought out to a standard 10-pin (0.05 inches) Cortex debug connector (J13). It is possible to isolate the KV58 MCU from the OpenSDAv2 circuit using J19 and J20.

5.5.2. Virtual serial port

A serial port connection is available between the OpenSDAv2 MCU and pins PTB0 and PTB1 of the KV58.

5.6. Accelerometer/magnetometer

An FXOS8700CQ digital accelerometer/magnetometer combo is connected to the KV58F1M0VLQ24 MCU through an I2C bus connected to pins PTD8 (SCL) and PTD9 (SDA).

5.7. Potentiometer, pushbuttons, and LEDs

The TWR-KV58F220M module features four pushbutton switches (SW2, SW3, SW4, and SW5 connected to PTE4, PTA4, PTB4, and PTB5, respectively), four user-controllable LEDs connected to GPIO signals (Red LED to PTE11, Green LED to PTE12, Blue LED to PTE29, and Orange LED to PTE30), and a potentiometer connected to an ADC input signal (ADCA_CH6D).

NOTE:

The LEDs require the appropriate jumper to be installed for connection with the MCU pin. Also, some LEDs may not operate when the board is powered with 1.8 V.

5.8. General Purpose Tower Plug-in (TWRPI) socket

The TWR-KV58F220M module features a socket that can accept a variety of different Tower plug-in modules featuring sensors, RF transceivers, and more. The General Purpose TWRPI socket provides access to I2C, SPI, IRQs, GPIOs, timers, analog conversion signals, TWRPI ID signals, reset, and voltage supplies. The pinout for the TWRPI Socket is defined in Table 2.

Table 2. TWRPI connector pinout

TWRPI pin	Signal	MCU pin or signal		TWRPI pin	Signal	MCU pin or signal
J5-1	5V	P5V		J6-1	GND	GND
J5-2	VDD	V_BRD		J6-2	GND	GND
J5-3	GND	GND		J6-3	I2C_SCL	PTB2
J5-4	VDDA	VDD_MCU		J6-4	I2C_SDA	PTB3
J5-5	VSSA	GND		J6-5	GND	GND
J5-6	VSSA	GND		J6-6	GND	GND
J5-7	VSSA	GND		J6-7	GND	GND
J5-8	Analog 0	PTE5		J6-8	GND	GND
J5-9	Analog 1	PTE30		J6-9	MISO	PTB23
J5-10	VSSA	GND		J6-10	MOSI	PTB22
J5-11	VSSA	GND		J6-11	SS	PTB20
J5-12	Analog 2	PTB9		J6-12	CLK	PTB21
J5-13	VSSA	GND		J6-13	GND	GND
J5-14	VSSA	GND		J6-14	GND	GND
J5-15	GND	GND		J6-15	GPIO0/IRQ	PTE24
J5-16	GND	GND		J6-16	GPIO1/IRQ	PTB8
J5-17	TWRPI ID 0	PTB6		J6-17	UART0_RX /GPIO2	PTE28
J5-18	TWRPI ID1	PTE13		J6-18	GPIO3	PTB7
J5-19	GND	GND		J6-19	GPIO4	PTE25
J5-20	Reset	RESET_B		J6-20	UART0_TX /GPIO5	PTD7

6. Jumper Options

The following is a list of all valid jumper options. The default installed jumper settings are shown in bold.

Table 3. Default configuration, board powered by OpenSDA USB at 3.3 V

Signal	Jumper designator	Option	Setting
V_BRD	J23	**2-3**	**V_BRD to P3V3**
		1-2	V_BRD to P1V8
VDD_MCU	J21	**1-2**	**VDD_MCU to V_BRD**
Crystal Oscillator (VDD)	J28	**1-2**	**P3V3 to Oscillator VDD**
		Open	Oscillator power off
Crystal Oscillator (Enable)	J29	**Open**	**Oscillator on**
		1-2	Oscillator off
OpenSDA	J20	**1-2**	**KV58 JTAG_TMS -> OpenSDA TMS**
		Open	KV58 JTAG_TMS -> KV58 Cortex Header (J2)
OpenSDA	J19	**1-2**	**KV58 JtAG_TCLK -> OpenSDA Tclk**
		Open	KV58 JTAG_TCLK -> KV58 Cortex Header (J2)
Reset	J26	**1-2**	**OpenSDA circuit resets KV58**
		2-3	KV58 reset is controlled only from the reset switch.
Potentiometer	J4	**1-2**	**Enable (ADCA_CH6D)**
		Open	Disabled
UART RX	J24	**2-3**	**OpenSDA UART buffer**
		1-2	Elevator UART connections
UART TX	J25	**2-3**	**OpenSDA UART buffer**
		1-2	Elevator UART connections
Accelerometer /magnetometer			
SCL Accelerometer Enable	J1	**1-2**	**PTD8**
SDA Accelerometer Enable	J7	**1-2**	**PTD9**
ACCELEROMETER INT1	J2	**Open**	**PTC18**
ACCELEROMETER INT2	J9	**Open**	**PTC19**
FXOS8700CQ Address 0 signal	J12	**1-2**	**N/A**
FXOS8700CQ Address 1 signal	J8	**1-2**	**N/A**

Table 3. Default configuration, board powered by OpenSDA USB at 3.3 V (contd…)				
Signal	**Jumper designator**	**Option**	**Setting**	
LEDs				
LED Red enable	J30	**1-2**	**PTE11**	
LED Green enable		**3-4**	**PTE12**	
LED Blue enable		**5-6**	**PTE29**	
LED Orange		**7-8**	**PTE30**	
RSTOUT_B signal select	J11	**RESET_B**	**1-2**	**Enables the MCU reset line (RESET_B) to be connected to the RSTOUT_B elevator signal (used by certain peripheral cards.**
		PTB4	2-3	Enables GPIO pin PTB4 to be connected to the RSTOUT_B elevator signal.
Push Buttons	SW2	Pushbutton1	PTE4	
	SW3	Pushbutton0	PTA4	
	SW4	Pushbutton3	PTB4	
	SW5	Pushbutton2	PTB5	

7. References

For more information on the P0 Kinetis family, see the following documents.

- TWR-KV58F220M-QSG: Quick Start Guide (document: TWRKV58QSG)
- TWR-KV58F220M-SCH: Schematics (document: TWR-KV58F220M-SCH)
- TWR-KV58F220M-PWA: Design Package (document: TWR-KV58F220M-PWA)
- KV58P144M220SF0RM: Reference Manual (document: KV58P144M220SF0RM)
- Tower Configuration Tool (document: TOWER_CONFIG_TOOL)
- Tower Mechanical Drawing (document: TWRKV58MD)

8. Useful Links

- nxp.com
  - nxp.com/kds
  - nxp.com/ksdk
- www.iar.com/nxp
- pemicro.com
  - pemicro.com/opensda/
- segger.com
  - segger.com/jlink-flash-download.html
- segger.com/opensda.html

9. Revision History

Table 4. Revision history

Revision number	Date	Substantive changes
0	10/2015	Initial release
1	05/2016	The part numbers MKV58F1M0VLQ22 were changed to MKV58F1M0VLQ24.
2	11/2016	Updated Table 3, lines J28 and J29 were swapped.

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