

TWR-KV46F150M Tower Module User's Guide

1 Introduction

The TWR-KV46F150M MCU module is designed to work in a stand-alone mode or as a part of the Freescale 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 freescale.com/tower for additional Tower system MCU modules and compatible peripherals.

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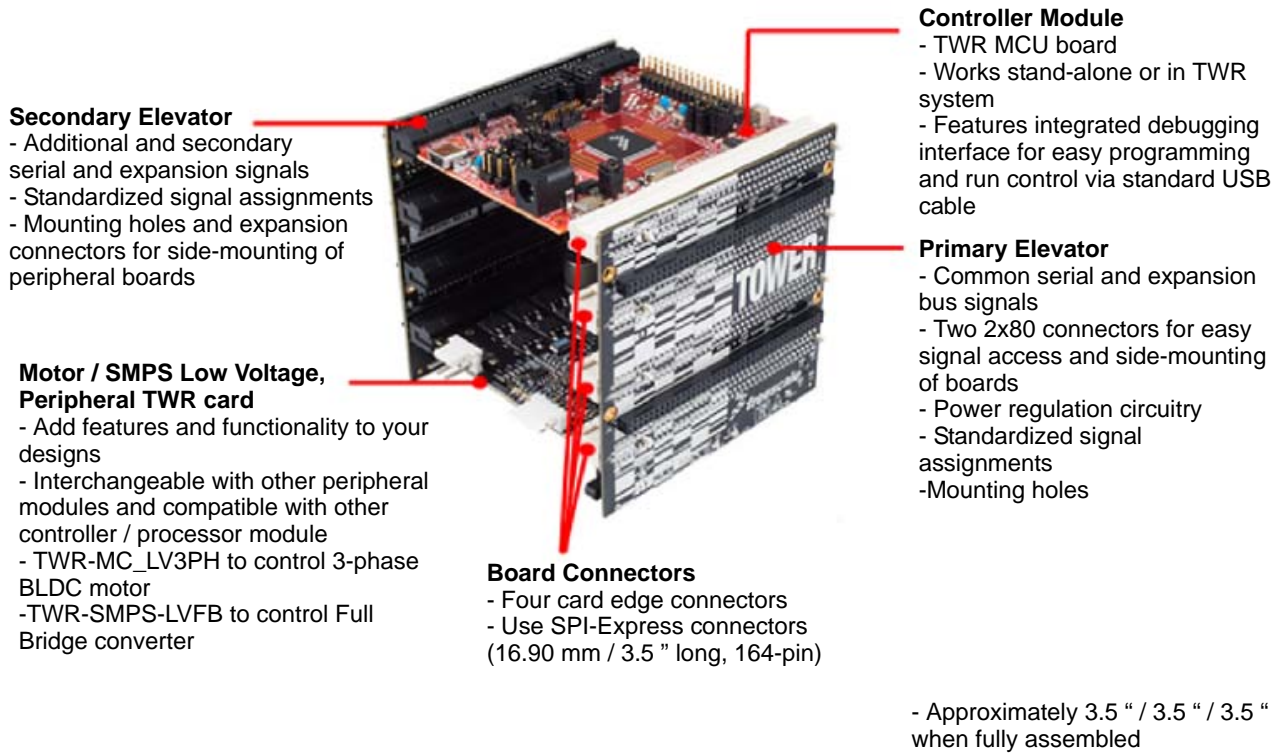


Figure 1. Freescale Tower system overview

2 Contents

The TWR-KV46F150M contents include:

- TWR-KV46F150M board assembly
- Micro-B USB cable for debug interface and power
- Quick start guide

3 TWR-KV46F150M features

- Tower-compatible MCU module
- KV46F256VLL15 MCU (150 MHz, 256 KB Flash, 32 KB RAM, low-power, 100 LQFP package)
- On-board debug circuit K20DX128VFM5 (OpenSDA) with virtual serial port
- Nine user-controllable LEDs plus
- Two user push-button switches for GPIO interrupts
- One user push-button switch for MCU reset
- One potentiometer

4 Getting to know the TWR-KV46F150M

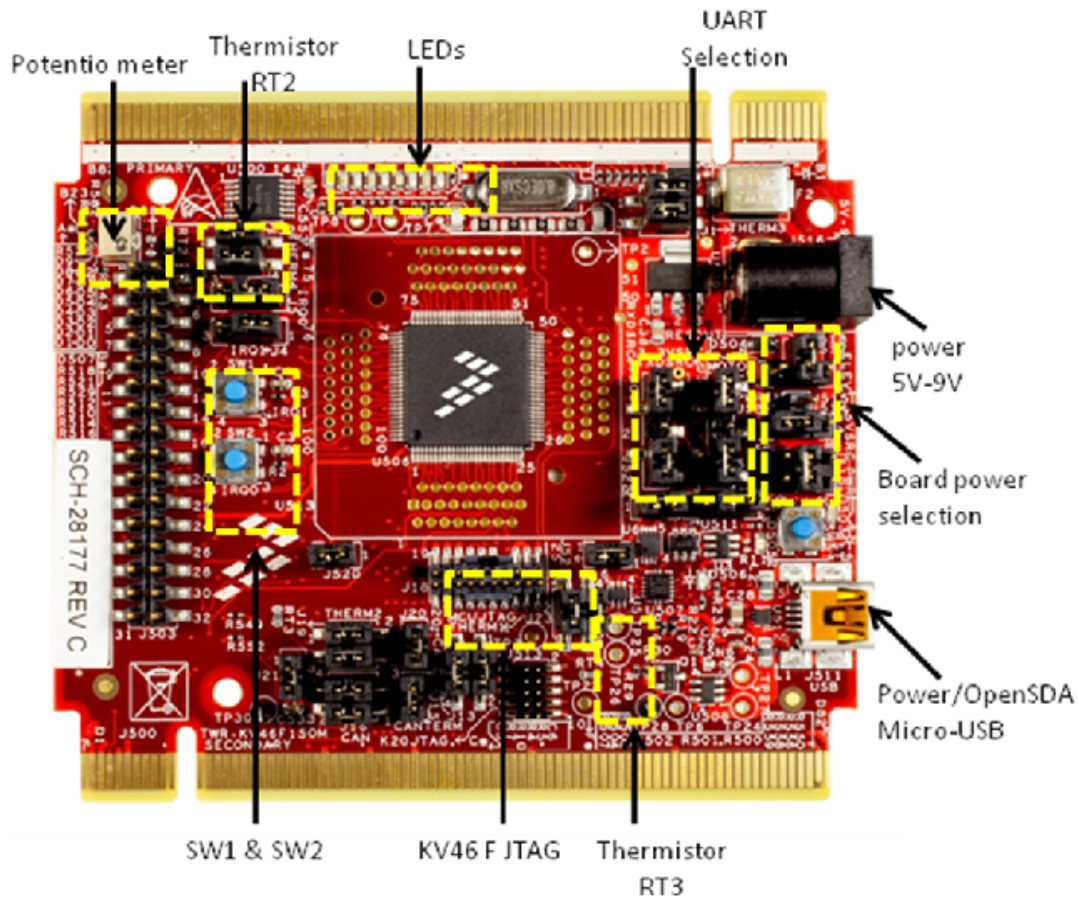


Figure 2. Front side of the TWR-KV46F150M module

5 Reference documents

The documents listed below should be referenced to for more information on the Kinetis V series, Tower system and MCU modules. These can be found in the documentation section at freescale.com/kinetis.

- TWR-KV46F150M-SCH (schematics)
- Tower configuration tool
- Tower mechanical drawing
- TWR-KV46F150M – QSG (quick start guide)

6 Hardware description

The TWR-KV46F150M is a Tower MCU module featuring the KV46F256VLL15 – a Kinetis V Series MCU in a 100 LQFP package with high-speed run mode. It is intended to be used in the Freescale Tower system but can also operate in stand-alone mode. The on-board OpenSDA debug circuit provides a Serial Wire Debug (SWD) interface and a power supply input through a single micro-USB connector.

The block diagram of the TWR-KV46F150M board is shown in [Figure 3](#):

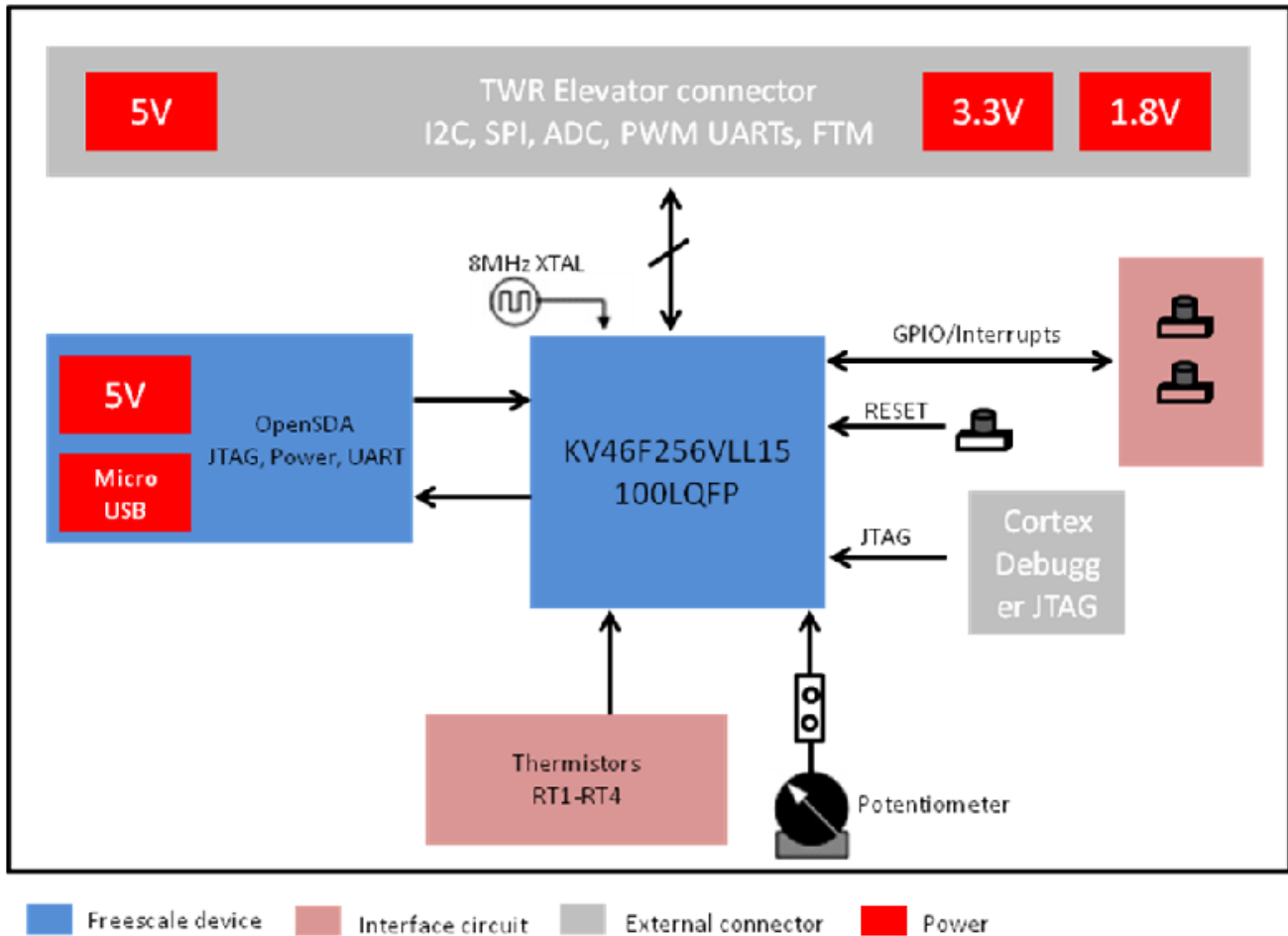


Figure 3. Block diagram of the TWR-KV46F150M

6.1 MCU

The TWR-KV46F150M features the KV46F256VLL15 MCU. This 150 MHz MCU is part of the Kinetis KV4x family and is implemented in a 100 LQFP package. [Table 1](#) describes some of the features of the KV46F256VLL15 MCU.

Table 1. KV46F256VLL15 features

Feature	Description
Ultra low-power	<ul style="list-style-type: none"> • Seven low-power modes with power and clock gating for optimal peripheral activity and recovery times • Full memory and analog operation down to 1.71 V for extended battery life • Low-leakage wake-up unit with up to three internal modules and eight pins used as wake-up sources in low-leakage stop (LLS) and very low-leakage stop (VLLS) modes • Low-power timer for continual system operation in reduced power states
Flash and SRAM	<ul style="list-style-type: none"> • 256 KB of flash featuring fast access times, high reliability and four levels of security protection • 32 KB of SRAM • No user or system intervention needed to complete programming and erase functions, and full operation down to 1.71 V
Mixed-signal capability	<ul style="list-style-type: none"> • Two 12-bit high-speed ADCs with 240 ns conversion time • Single or differential output modes for improved noise rejection • Four high-speed comparators providing fast and accurate motor over-current protection by driving PWMs to a safe state • Optional analog voltage reference provides an accurate reference to analog blocks and replaces external voltage references to reduce system cost
Performance	<ul style="list-style-type: none"> • 150 MHz ARM[®] Cortex[®]-M4+ core with DSP and FPU instruction sets, single-cycle MAC, and single instruction multiple data (SIMD) extensions • Up to 16-channel DMA for peripheral and memory servicing with reduced CPU loading and faster system throughput • Crossbar switch enables concurrent multi-master bus accesses, increasing bus bandwidth
Timing and control	<ul style="list-style-type: none"> • Up to three FlexTimer modules (FTM) with a total of 18 channels • Hardware dead-time insertion and quadrature decoding for motor control • Four-channel 32-bit periodic interrupt timer (PIT) provides a time base for the RTOS task scheduler, or a trigger source for the ADC conversion and programmable delay block
Connectivity and communications	<ul style="list-style-type: none"> • Two UARTs: <ul style="list-style-type: none"> – UART supporting RS232 hardware flow control (RTS / CTS) – UART clocked from fast bus clock • MSB / LSB configuration on data • One SPI module and one I²C module
Reliability, safety, and security	<ul style="list-style-type: none"> • Cyclic redundancy check (CRC) engine validates memory contents and communication data, increasing system reliability • Independently-clocked COP prevents clock skew or code run-away for fail-safe applications such as the IEC 60730 safety standard for household appliances • External watchdog monitor drives output pins to a safe state for external components in case the watchdog time-out occurs • Included in Freescale's product longevity program, with assured supply for a minimum of 10 years after launch

6.2 Clocking

The Kinetis V Series MCUs start up from an internal digitally-controlled oscillator (DCO). The main external oscillator (EXTAL0 / XTAL0) can be enabled by software if desired. The external oscillator / resonator can range from 31.25 KHz up to 39.0635 KHz. An 8 MHz crystal is the default external source for the MCG oscillator inputs (XTAL / EXTAL). Resistors R4 and R10 enable other external clock sources for the KV46F256VLL15, which can be provided through the TWR-ELEV module or pin 8 and pin 10 of the J502 connector.

6.3 System power

When installed into the Tower system, the TWR-KV46F150M can be powered from either an on-board source or from another source in the assembled Tower system.

In stand-alone operation, the main power source (5.0 V) for the TWR-KV46F150M module can be derived from the OpenSDA USB micro-B connector (J511) or from power jack connector (J516). Two low-dropout regulators provide 3.3 V and 1.8 V supplies from the 5.0 V input voltage. All of the user-selectable options can be configured using headers J114, J515, J517, J518, and J519. Refer to page number seven of the TWR-KV46F150M schematics for more details.

6.4 Debug interface

There are two debug interface options provided: the on-board OpenSDA circuit and the external ARM Cortex JTAG connector. The ARM Cortex JTAG connector (J18) is a standard 2×10-pin connector that provides an external debugger cable access to the JTAG interface of the KV46F256VLL15. Alternatively, the on-board OpenSDA debug interface can be used to access the debug interface of the KV46F256VLL15.

6.4.1 OpenSDA

The on-board K20DX128VFM5-based OpenSDA circuit provides a SWD debug interface to the KV46F256VLL15. A standard USB A male to micro-B male cable (provided) can be used for debugging via the USB connector (J21).

The OpenSDA interface also provides a USB-to-serial bridge. The drivers for the OpenSDA interface are provided in the P&E Micro OpenSDA Tower Toolkit. These drivers and more utilities can be found online at www.pemicro.com/opensda.

6.4.2 Cortex debug connector

The Cortex debug connector is a 20-pin (0.05") connector providing access to the SWD, JTAG and cJTAG on the KV46 device. The pin-out and KV46 pin connections to the debug connector (J18) are listed in [Table 2](#).

Table 2. Cortex debug connector

Pin	Function	TWR-KV46F150M connection
1	VDD	3.3 V MCU supply (MCU_PWR)
2	TMS / SWDIO	PTA3 / JTAG_TMS / SWD_DIO / UART0_RTS / FTM0_CH0 / XBARIN9
3	GND	GND
4	TCK / SWCLK	PTA0 / JTAG_TCLK / SWD_CLK / UART0_CTS / UART0_COL
5	GND	GND
6	TDO/SWO	PTA2 / JTAG_TDO / NOETM_TRACE_SWO / UART0_TX / FTM0_CH7
7	Key	–

Table 2. Cortex debug connector (continued)

Pin	Function	TWR-KV46F150M connection
8	TDI	PTA1 / JTAG_TDI / UART0_RX / FTM0_CH6 / CMP0_OUT
9	GNDDetect	PTA4 / LLWU_P3 / NMI / FTM0_CH1 / XBARIN10 / FTM0_FLT3 / FLEXPWM_B0
10	nRESET	CPU_RESET_B
11	Target Power	5 V supply (via jumper J21)
12	–	NC
13	Target Power	5 V supply (via jumper J21)
14	–	NC
15	GND	GND
16	–	NC
17	GND	GND
18	–	NC
19	GND	GND
20	–	NC

6.5 Thermistors and analog input

The TWR-KV46F150M board provides four thermistors (RT1- RT4) near the corners of the board that can be used as single-ended or differential analog inputs to the KV46F256VLL15 as shown on sheet number six of the schematic. All the thermistors are 10 k Ω . All four thermistor circuits are designed to provide usable differential inputs over the temperature range of 90°C to –20°C.

6.6 Potentiometer, push-buttons and LEDs

The TWR-KV46F150M also features:

- One potentiometer connected to ADC channel ADCB_CH6A and ADCA_CH5 to ADC input signal
- Three pushbutton switches SW1, SW2 and SW3
- SW1 and SW2 for IRQ (interrupt request) and SW5 for RESET.
- Nine user-controllable LEDs connected to the FlexPWM / GPIO signals
- LED RED D503 for power on indication

7 TWR-KV46F150M jumper options and headers

There are several headers provided for isolation, configuration and feature selection. Refer to [Table 3](#) for details. The default jumper positions are represented in **bold**.

Table 3. TWR-KV46F150M jumper table

Jumper	Function	Shunts	Description
J1	Thermistor RT1 Connect	1-2, 3-4	Connect RT1 circuit to the KV46F256VLL15
		none	Disconnect RT1 circuit from the KV46F256VLL15
J2	Thermistor RT2 Connect	1-2, 3-4	Connect RT2 circuit to the KV46F256VLL15
		none	Disconnect RT2 circuit from the KV46F256VLL15
J4	IRQ1 Select	1-2	Connect SW1 to KV46F256VLL15 pin PTC7 / CMP3_IN4 / CMP0_IN1 / SPI0_SIN
		2-3	Connect SW1 to KV46F256VLL15 pin GPIOB23 / PWM_X3
		none	Disconnect SW1 from the KV46F256VLL15
J5	IRQ0 Select	1-2	Connect SW2 to KV46F256VLL15 pin PTE6 / LLWU_P16 / FTM3_CH1
		2-3	Connect SW2 to KV46F256VLL15 pin GPIOE5 / FTM3_CH0
		none	Disconnect SW2 from the KV46F256VLL15
J15	CAN Termination Enable	1-2	Connect the 120 Ω CAN termination resistor
		Open	No CAN termination
J16	CAN Enable	1-2, 3-4	Connect the CAN transceiver TXD and RXD to: <ul style="list-style-type: none"> •KV46F256VLL15 pins •GPIOA12/CAN0_TX •GPIOA13/CAN0_RX
		Open	Disconnect the CAN transceiver
J19	Thermistor RT3 Connect	1-2, 3-4	Connect RT3 circuit to the KV46F256VLL15
		none	Disconnect RT3 circuit from the KV46F256VLL15
J21	Debug Target Power	1-2	Connect P5V_TRG_USB to target power
		Open	Disconnect P5V_TRG_USB to target power
J23	Thermistor RT4 Connect	1-2, 3-4	Connect RT4 circuit to the KV46F256VLL15
		none	Disconnect RT4 circuit from the KV46F256VLL15

Table 3. TWR-KV46F150M jumper table (continued)

Jumper	Function	Shunts	Description
J505	TXD Source Select (note that only one connection can be made to pin 3 at a time)	1-2	Connect ELEV_TXD0 from the Tower connector to KV46F256VLL15 pin PTD7 / UART0_TX
		2-3	Connect TXD_SEL from the USB Serial Bridge to KV46F256VLL15 pin PTD7 / UART0_TX
		Pin 2 open	Disconnect KV46F256VLL15 pin PTD7 / UART0_TX
		3-4	Connect TXD_SEL from the USB Serial Bridge to KV46F256VLL15 pin PTE0 / UART1_TX
		4-5	Connect ELEV_TXD1 from the Tower connector to KV46F256VLL15 pin PTE0 / UART1_TX
		Pin 4 open	Disconnect KV46F256VLL15 pin PTE0/UART1_TX
J506	RXD Source Select (note that only one connection can be made to pin 3 at a time)	1-2	Connect ELEV_RXD0 from the Tower connector to KV46F256VLL15 pin PTD6 / UART0_RX
		2-3	Connect RXD_SEL from the USB Serial Bridge to KV46F256VLL15 pin PTD6 / UART0_RX
		Pin 2 open	Disconnect KV46F256VLL15 pin PTD6 / UART0_RX
		3-4	Connect RXD_SEL from the USB Serial Bridge to KV46F256VLL15 pin PTE1 / UART1_RX
		4-5	Connect ELEV_RXD1 from the Tower connector to KV46F256VLL15 pin PTE1 / UART1_RX
		Pin 4 open	Disconnect KV46F256VLL15 pin PTE1 / UART1_RX
J514 & J515	VREG_IN Select	J514-1 to J514-2	Connect P5V_TRG_USB voltage to VREG_IN
		J515-1 to J514-2	Connect the PWR_IN voltage to VREG_IN
		J514-2 to J514-3	Connect P5V_ELEV voltage to VREG_IN
J517 & J518	1.8V (P1V8) Source Select	J517-1 to J517-2	Connect P3_3V_MOTOR voltage to P3V3_SELECTED
		J518-1 to J517-2	Connect the P3_3V_REG_OUT voltage to P3V3_SELECTED
		J517-2 to J517-3	Connect the P3_3V_ELEV voltage to P3V3_SELECTED
J519	VBRD Select	1-2	SDA_VOUT33 becomes VBRD power supply for the board
		3-4	P3V3_SELECTED becomes VBRD power supply for the board
		5-6	P1V8 becomes VBRD power supply for the board
J520	MCU VDD	1-2	Connect MCU_VDD to VBRD
J521 & J522	OpenSDA isolation connector	1-2	OpenSDA use to program and debug KV46F256VLL15
		Open	External debugger use to program and debug KV46F256VLL15 using

Figure 4 shows the default jumper position on the TWR-KV46F256VLL15.

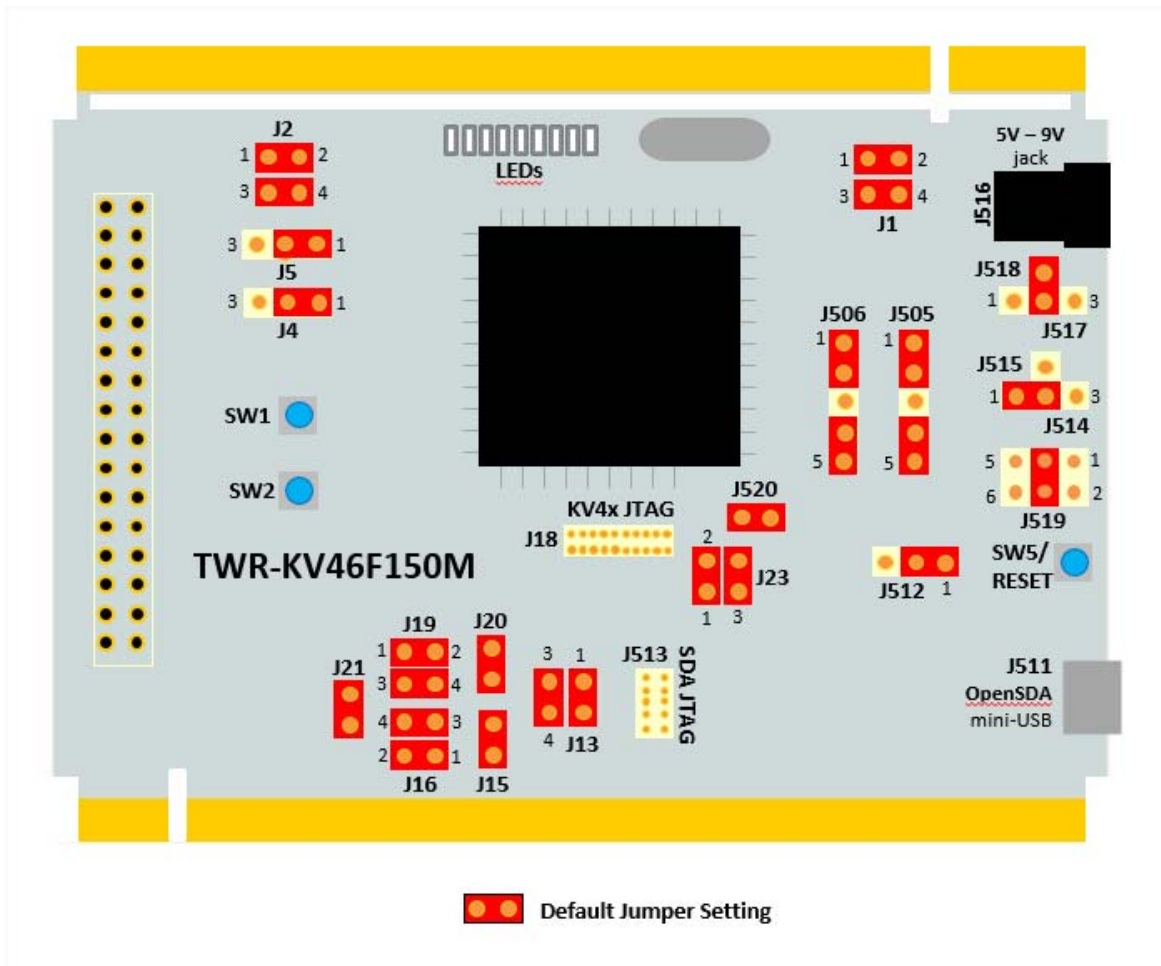


Figure 4. Default jumper position

8 Useful links

- freescale.com
— freescale.com/Kinetis
- www.iar.com/freescale
- www.pemicro.com
— <http://www.pemicro.com/opensda>
- www.segger.com
— <http://www.segger.com/jlink-flash-download.html>

9 Revision history

Table 4. Revision history

Revision number	Date	Substantial changes
0	01/2015	Initial release

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freescale.com

Web Support:
freescale.com/support

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