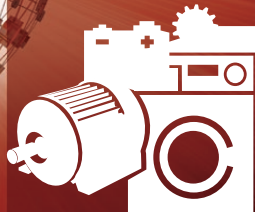


# Quick Start Guide

**TWR-KV31F120M**  
Development Kit for  
Kinetis KV3x Family



**TOWER SYSTEM**

# Get to Know the TWR-KV31F120M

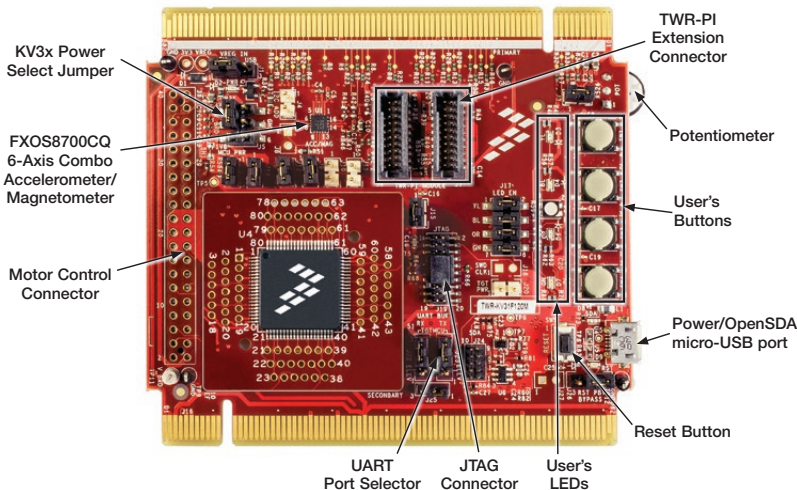


Figure 1: Front side of TWR-KV31F120M



## TWR-KV31F120M Freescale Tower System

The TWR-KV31F120M module is part of the Freescale Tower System, a modular development platform that enables rapid prototyping and tool re-use through reconfigurable hardware. Take your design to the next level and begin constructing your Tower System platform today.

# TWR-KV31F120M Features

The TWR-KV31F120M is a standalone development kit that can be used in conjunction with the Tower System development platform and the TWR-MC-LV3PH motor control module. To watch a video on how to configure the board, go to [freescale.com/TWR-KV31F120M](https://www.freescale.com/TWR-KV31F120M).

## This Quick Start Guide will teach you to:

- Easily program precompiled examples for the KV3x MCU
- Run an IAR Embedded Workbench project featuring an A/D conversion application
- Spin the 3-phase motor included in the TWR-MC-LV3PH kit with a PMSM sensorless FOC control algorithm while monitoring the motor with the FreeMASTER tool

## Tower System Module

- KV31F512VLL12 MCU (ARM® Cortex®-M4 120MHz with FPU, 512KB flash, 96KB RAM, 2x 16-bit ADCs, 4x FlexTimer/PWM with up to 20 ch, 2x 12-bit DACs, 100 LQFP)
- OpenSDA<sup>(1)</sup> debug circuit with Micro USB connector and virtual serial port
- FXOS8700CQ 6-axis combining accelerometer and magnetometer sensors
- Four user LEDs
- Four pushbuttons for user input or interrupts
- One potentiometer
- One motor control auxiliary connector and general-purpose Tower Plug-in (TWRPI) socket

## Tools Required

- IAR Embedded Workbench V7.10 or higher
- Freescale FreeMASTER for real-time debug monitoring and data visualization

<sup>(1)</sup> Refer to the OpenSDA User Guide available at [freescale.com](https://www.freescale.com)

# Step-by-Step Installation Instructions

## 1 Download Software and Tools

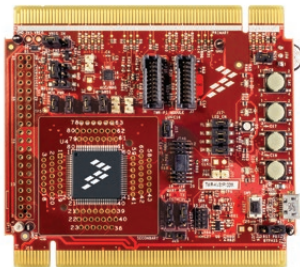
Download installation software and documentation under **“Jump Start Your Design”** at [freescale.com/TWR-KV31F120M](https://freescale.com/TWR-KV31F120M).



- Download and install the free debug monitoring and data visualization tool Freescale FreeMASTER v1.4 or later, at **[freescale.com/FreeMASTER](https://freescale.com/FreeMASTER)**.

## 2 Install the Software and Tools

- Download and install the IDE toolchain IAR Embedded Workbench® for ARM® v7.10 or later, 30-day free evaluation license, at **[iar.com/Freescale](https://iar.com/Freescale)**.
- Download and install the PEmicro Windows® USB Drivers at **[pemicro.com/OpenSDA](https://pemicro.com/OpenSDA)**.



### 3 Default Jumper Settings

See the default jumper settings in the table below. Refer to the TWR-KV31F120M User Guide at **freescaler.com/TWR-KV31F120M** for detailed jumper descriptions.

Option	Setting	Option	Setting
J1	1–2	J13	ON
J3	ON	J14	ON
J4	OPEN	J15	ON
J5	1–3	J17	1–2, 3–4, 5–6, 7–8
J8	OPEN	J20	OPEN
J9	ON	J22	2–3
J10	OPEN	J23	2–3
J11	OPEN	J25	1–2
J12	ON	J26	1–2

### 4 Tilt the Board

TWR-KV31F120M comes preloaded with the P&E OpenSDA Applications (MSD flash programmer and debug) and the accelerometer demo. Plug in the USB cable and angle the board left or right to make the corresponding pair of LEDs blink.

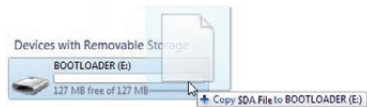
## 5 Program a Precompiled Example Using the OpenSDA MSD Application

### 1) Launch the Bootloader Mode

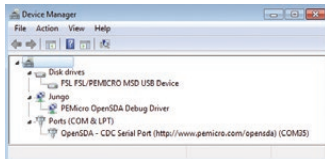
Press and hold the reset (SW5) button while plugging in the USB cable; then release it. Windows will detect a new BOOTLOADER drive and automatically install requested drivers.

### 2) Load the OpenSDA P&E Applications

Copy to the BOOTLOADER drive the MSD-DEBUG-TWR-KV31F120M\_Pemicro.SDA file from the OpenSDA Applications folder of the Quick Start Package, then unplug and replug the USB cable.



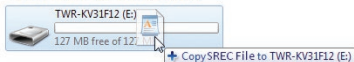
Windows will detect a new TWR-KV31F12 drive, a PEMicro OpenSDA Debug peripheral, an OpenSDA CDC Serial Port and will automatically install the requested drivers.



### 3) Program a Precompiled Example for the KV3x

In the TWR-KV31F12 drive, copy any SREC file from the Precompiled Examples folder of the Quick Start Package. Demo will start automatically when the download is complete. To program a new demo, just repeat the previous step. It is not necessary to disconnect the USB cable.

#### • Devices with Removable Storage



## 6 Debug Your First IAR Project

### 1) Load the OpenSDA P&E Debug Application

If you followed the previous exercise, you can jump directly to the following instruction; otherwise, follow Step 5 to load the OpenSDA P&E Applications.

### 2) Launch IAR EWARM 7.10 and Build the Potentiometer\_lab Project

Open the IAR project file `potentiometer_demo.eww` following the path `Project Labs\build\iar\kv31\Potentiometer_lab` in the Quick Start Package.

Clean the project before selecting the action **Rebuild All**.

**Note:** The compilation may return warning messages without consequence.

### 3) Run IAR EWARM V7.10, or later Debug Mode

From the toolbar, click on **Download and Debug**.

**Note:** If a Connection Manager window appears, check that your board is configured with the OpenSDA P&E Debug Application, then connect to the Interface OpenSDA Embedded Tower Debug-USB Port.

Start the debug session by selecting the **GO** option from the toolbar. Rotate the potentiometer to turn on LEDs D3, D4, D6 and D7. From the toolbar, suspend the demo using the **Break** option. Select **Stop** to return to the Edition Mode.

## 7 Spin the TWR-MC-LV3PH 3-phase Motor with a PMSM Sensorless FOC Control Algorithm and Monitor it with the FreeMASTER Tool

### 1) Load the OpenSDA P&E Debug Application

If you followed the previous exercise, you can jump directly to the following instruction; otherwise, follow Step 5 to load the OpenSDA P&E applications.

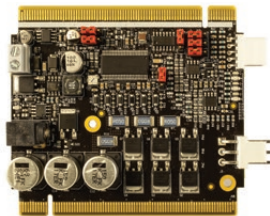
### 2) Connect the boards and the motor

Connect TWR-KV31F120M and TWR-MC-LV3PH with the jumper setup shown in the table below following the black and white markings on the Tower System elevators.

Connect the motor to the three-prong connectors (J5) of the motor module.

First, plug the 24V power supply included in the TWR-MC-LV3PH kit into the barrel connector (J1) of the motor module. Then, connect the USB cable to TWR-KV31F120M and the computer.

**Note:** Refer to the TWR-KV31F120M User Guide at [freescale.com/TWR-KV31F120M](http://freescale.com/TWR-KV31F120M) for detailed jumper description.



### TWR-MC-LV3PH: Jumper Settings

Option	Setting	Option	Setting
J2	1-2	J12	1-2
J3	1-2	J13	1-2
J10	1-2	J14	1-2
J11	1-2		

### 3) Compile the PMSM Sensorless FOC Demo with IAR EWARM v7.10, or later

Open the IAR project file PMSM\_Sensorless\_FOC.eww following the path Project Labs\build\iar\kv31\PMSM\_Sensorless\_FOC in the Quick Start Package.



Clean the project before selecting the action Rebuild All.

**Note:** The compilation may return warning messages without consequence.

#### 4) Run IAR EWARM V7.10, or later Debug Mode

From the toolbar, click on Download and Debug.

Start the debug session by selecting the GO option.

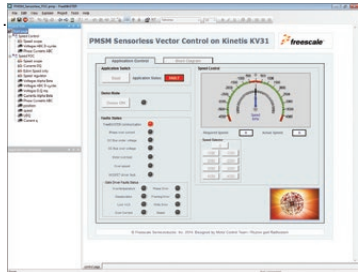
#### 5) Monitor the Project with Freescale FreeMASTER v1.4 or later

Launch Freescale FreeMASTER v1.4 or later from the Windows Start menu.

**Note:** At first start-up, you may have an error message regarding the COM connection.

Open the FreeMASTER project file PMSM\_Sensorless\_FOC.pmp following the path Project Labs\Freemaster\ PMSM\_Sensorless\_FOC in the Quick Start Package. The application interface, PMSM Sensorless Vector Control on Kinetis KV31, will appear in FreeMASTER.

The speed, position, voltage and current consumption of the motor can be monitored and controlled.



In the Project Options, set the COM port affected to the OpenSDA -CDC Serial Port (info available in Device Manager) and set the baud rate/speed to 19200 bps (check the option Do not Open Port at Startup to avoid error messages at FreeMASTER startup).

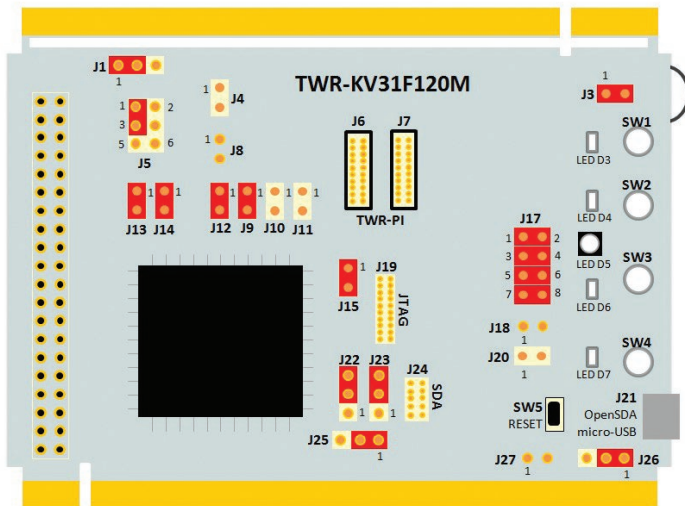
From the toolbar, select the action  
File->Start the communication.

Press button SW1 of the TWR-KV31F120M board to spin the motor counterclockwise. Press the SW1 button again to increase the speed of the motor. Press button SW2 to decrease the speed and stop the motor.

Or, in FreeMASTER speedometer or speed selector box, select the requested speed and the motor will spin automatically counterclockwise or clockwise.

In IAR EWARM, from the toolbar, suspend the demo using the Break option, or select Stop to return to the Edition Mode.

# TWR-KV31F120M Jumper Map



 Default Jumper Setting



## Get Started

Download installation software and documentation under  
**“Jump Start Your Design”** at **[freescale.com/TWR-KV31F120M](http://freescale.com/TWR-KV31F120M)**.

## Support

Visit **[freescale.com/support](http://freescale.com/support)** for a list of phone numbers within your region.

## Warranty

Visit **[freescale.com/warranty](http://freescale.com/warranty)** for complete warranty information.

For more information, visit **[freescale.com/TWR-KV31F120M](http://freescale.com/TWR-KV31F120M)**, **[freescale.com/Kinetis](http://freescale.com/Kinetis)** or **[freescale.com/Tower](http://freescale.com/Tower)**

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