Development Board EPC9147B Quick Start Guide

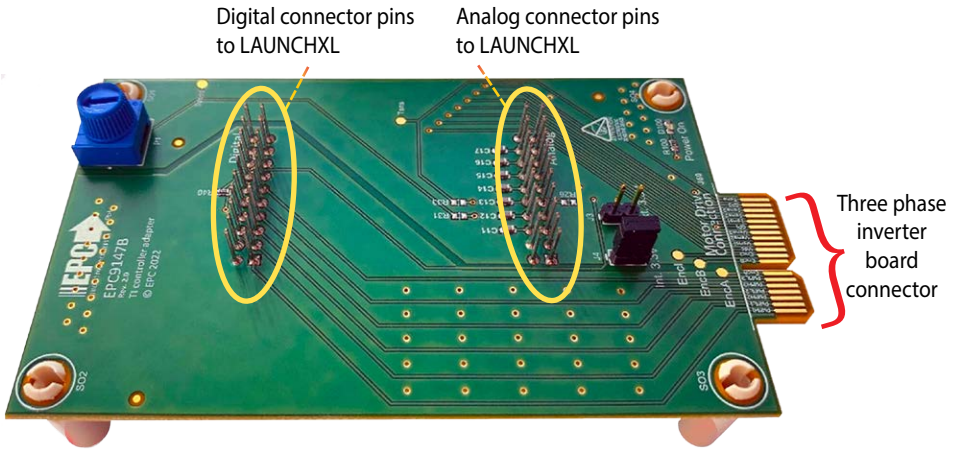
Motor Drive Controller Interface Board – Texas Instruments LAUNCHXL

Revision 2.0

EFFICIENT POWER CONVERSION

DESCRIPTION

The EPC9147B is an interface board that accepts the TI LAUNCHXL development kit, such as the F28379D, F28069M, or F280049 that features the TI C2000 microcontroller family, and connects to a compatible 3-phase eGaN® FET/ IC motor drive inverter board, as it can be seen in figure 1. This interface board allows users to utilize the existing TI InstaSPIN_UNIVERSAL GUI resources together with EPC- dedicated files to program the controller board and control a motor powered by an eGaN FET/IC 3-phase inverter using sensorless field oriented control and space vector pulse width modulation.



EPC9147B development board

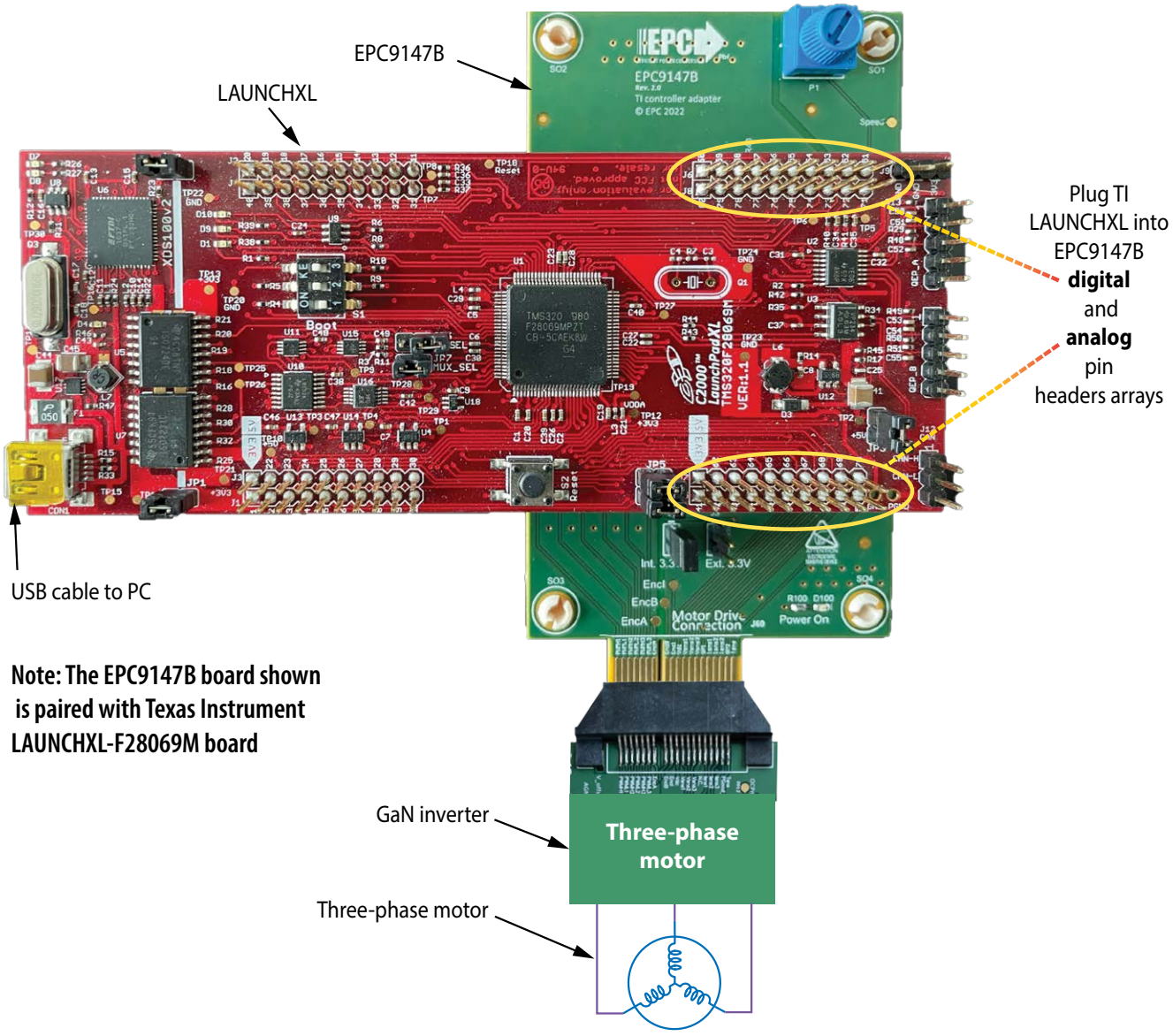


Figure 1: EPC9147B matched with TI LAUNCHXL-F28069M

RECOMMENDED OPERATING CONDITIONS

The EPC9147B combined with Texas Instruments LAUNCHXL family of controllers is compatible with the following EPC motor drive inverter boards: EPC9146, EPC9167HC, EPC9173, EPC9176, and EPC9186.

The firmware provided requires to measure the phase voltages. The firmware can be modified in order to measure the temperature of the power board and to control the speed via the potentiometer present on the control board EPC9147B.

DETAILED DESCRIPTION OF THE EPC9147B BOARD

Figure 2 shows an overview of the EPC9147B board detailing connections such as mounting options and interfaces; and human interfaces that measures the dimensions of the board are: 110 x 60 mm (L x W).

On EPC9147B board

- Power LED
- Speed adjust knob
- Internal 3.3 V supply jumper
- External 3.3 V supply connector

On LAUNCHX board

- Reset button
- Various jumpers

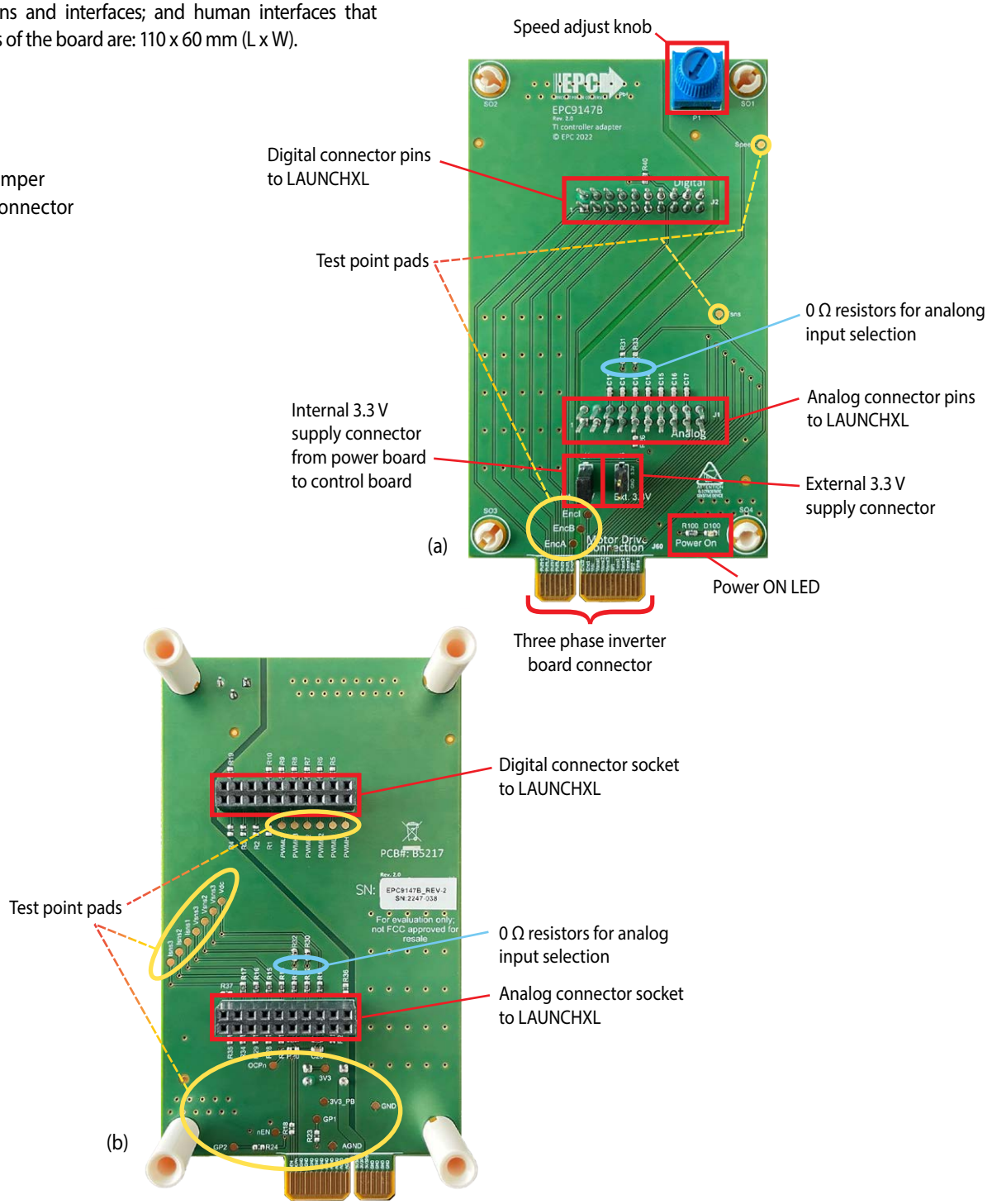
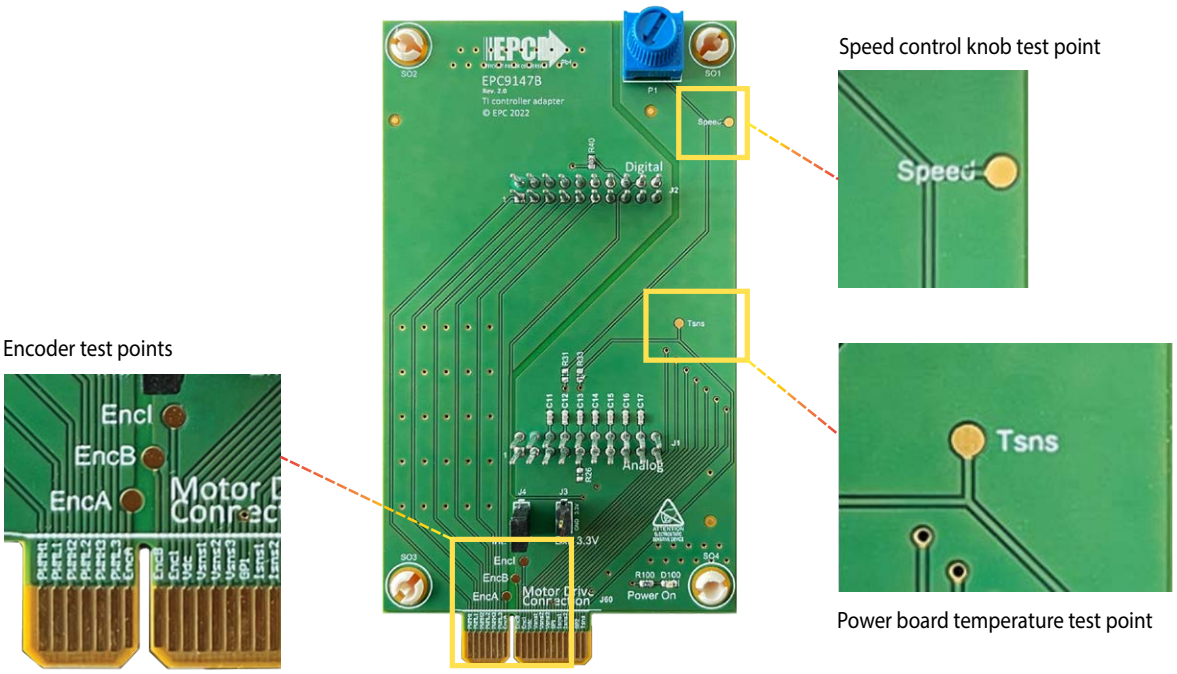


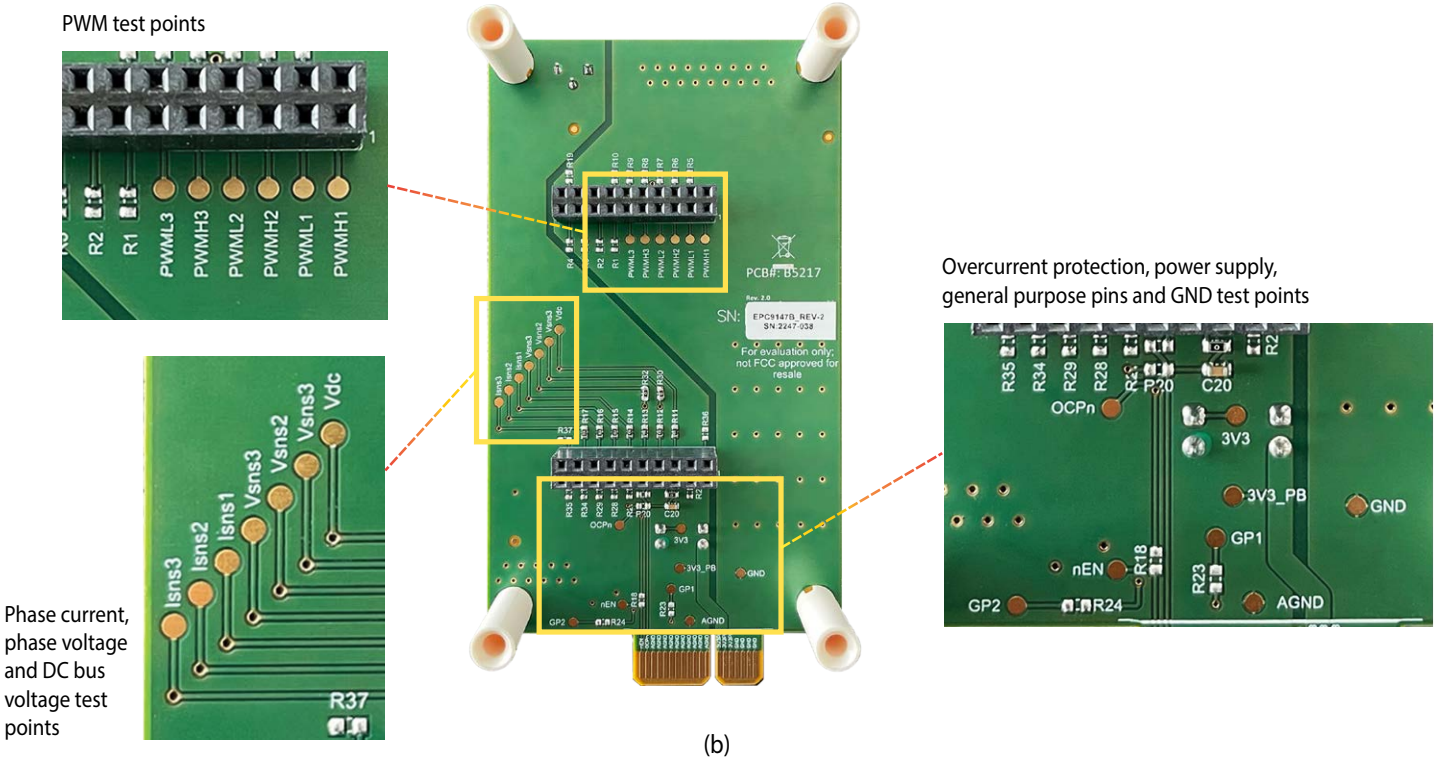
Figure 2: (a) EPC9147B top-side; (b) EPC9147B bottom-side

Test Points

Several test-points are available for measurement of various analog, error and PWM signals. Analog signals include voltage and current readings, input DC voltage to the drive, and current sense. The operator is encouraged to read the motor drive inverter drive QSG carefully to determine the correct scaling factors. The locations of the test points are shown in figure 3.



(a)



(b)

Figure 3: Test point locations (a) EPC9147B top-side; (b) EPC9147B bottom-side

Over-Current Detect

The EPC inverter boards are equipped with over-current detection circuits, but TI firmware does not provide over-current protection; contact Texas Instruments field-application engineers for firmware development support if over-current protection in control firmware is required.

0 Ω Resistors

Various 0 Ω resistors are that are present on the board that are used to send either phase voltages or other analog signals to the inputs of the ADC microcontroller. The default configuration is with phase voltage measurements. **Note that TI original firmware for LAUNCHXL uses measured phase voltages; to remove phase voltage measurements from ADC input, firmware needs to be modified.**

Place either R32 to measure the phase voltage of leg 2 or R33 to measure the temperature of the power board. Place either R30 to measure the phase voltage of leg 1 or R31 to have an analog signal from the on-board potentiometer to the ADC input.

Table 1

0 Ω resistor	Default configuration	Compatible with provided firmware	ADC I/O function
R30	Yes	Yes	Measure phase 1 voltage
R31	No	No, firmware needs changes	Measure signal from speed potentiometer
R32	Yes	Yes	Measure phase 2 voltage
R33	No	No, firmware needs changes	Measure temperature sensor on power board

Warning: The human interface controls and knob, as well as the entire EPC9147B, are not isolated. The EPC9147B is referenced to Power Ground and extreme caution has to be observed when operating the motor while the computer is attached to the EPC9147B via USB interface. It is recommended to use the opto-isolated USB communication option on the LAUNCHXL board to avoid damage to the computer.

CONNECTION DETAILS

Inverter

A 40 pin connector is used to interface power, PWM signals and analog feedback signals between the interface board and the motor drive inverter. Table 3 gives the map for each signal.

Table 2: Motor interface connection (J2) pin allocation map

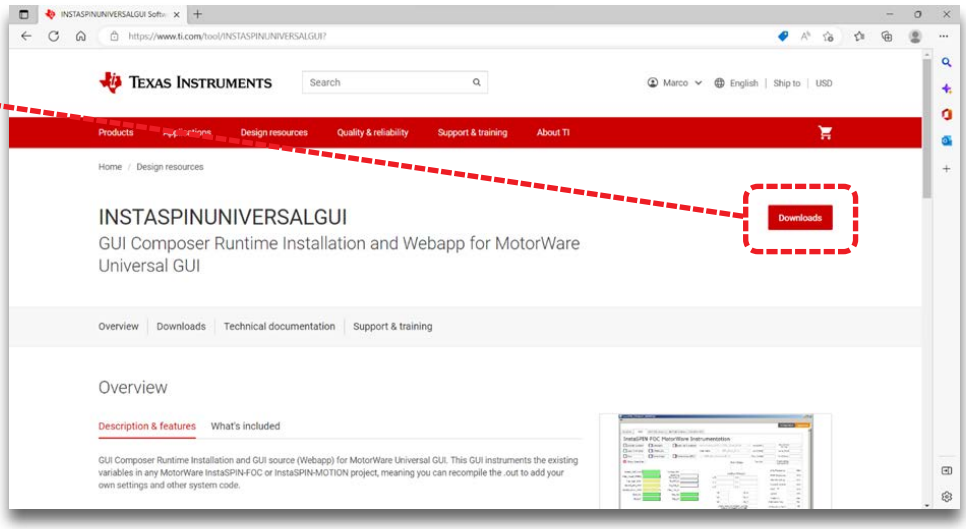
Pin #	Pin Name		Pin #
2	PWMH1	GND	1
4	PWML1	GND	3
6	PWMH2	GND	5
8	PWML2	GND	7
10	PWMH3	3V3	9
12	PWML3	3V3	11
14	EncA	3V3	13
Index			
18	EncB	AGND	17
20	EncI	AGND	19
22	Vdc	AGND	21
24	Vsns1	AGND	23
26	Vsns2	AGND	25
28	Vsns3	AGND	27
30	GP1	AGND	29
32	Isns1	AGND	31
34	Isns2	AGND	33
36	Isns3	AGND	35
38	GP2	OCPn	37
40	Tsns	nEN	39

CONTROLLING A TEKNIC M-3411P-LN-08D MOTOR USING INSTASPIN UNIVERSAL GUI

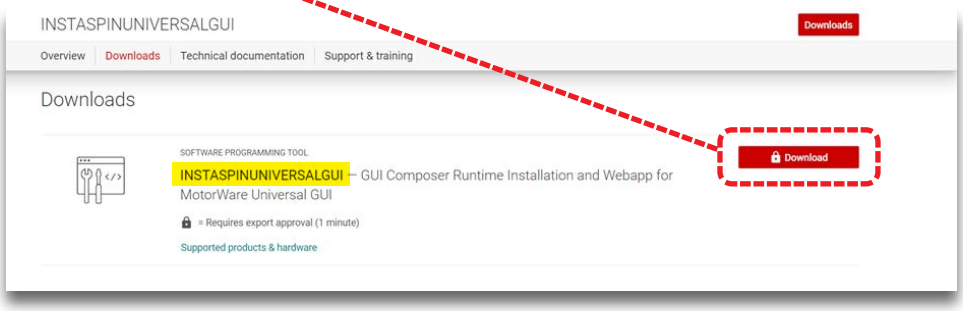
The TI LAUCNHXL-F28069M board can be programmed using the InstaSPIN Universal GUI. The basic steps to run a Teknic motor Teknic_M-3411P-LN-08D using EPC inverter board-specific firmware and using the LAUNCH-XL-F28069M are explained below.

I. Download Texas Instruments Resources

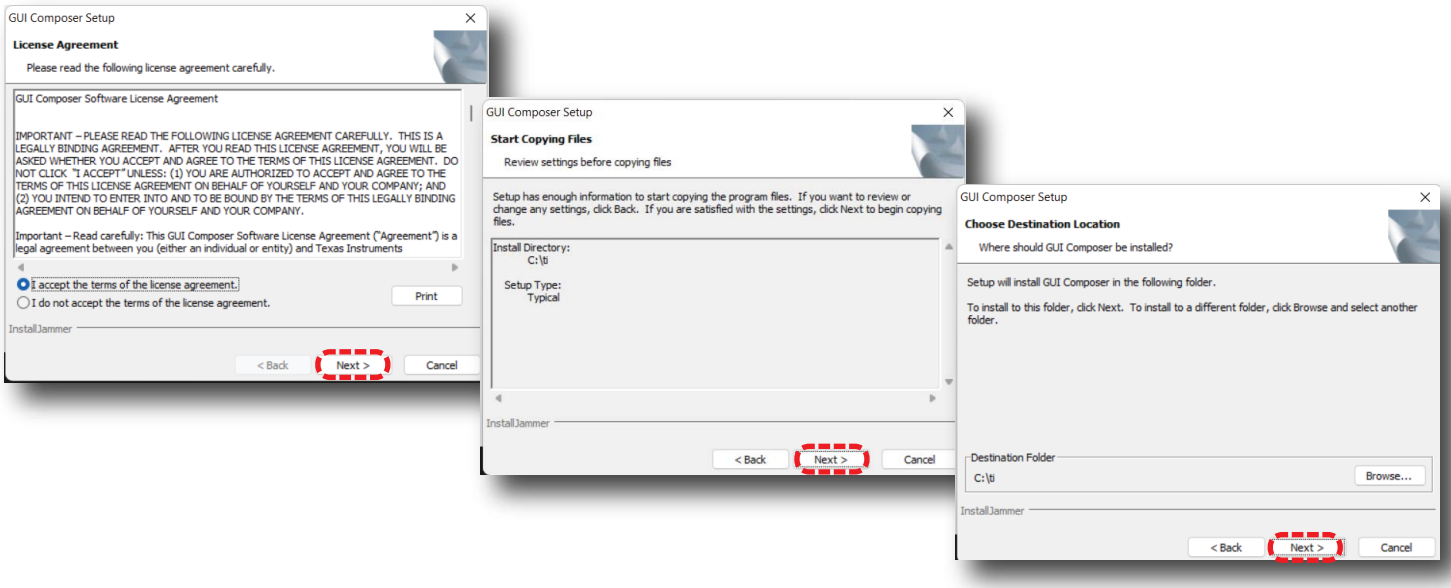
1. Download the universal GUI from the following link: **https://www.ti.com/tool INSTASPINUNIVERSALGUI**
   - Make sure to be logged in with the personal profile on ti.com
   - Make sure to select that the software will be used for civil use



2. Execute the downloaded program **instaspinuniversalgui_v105.exe**

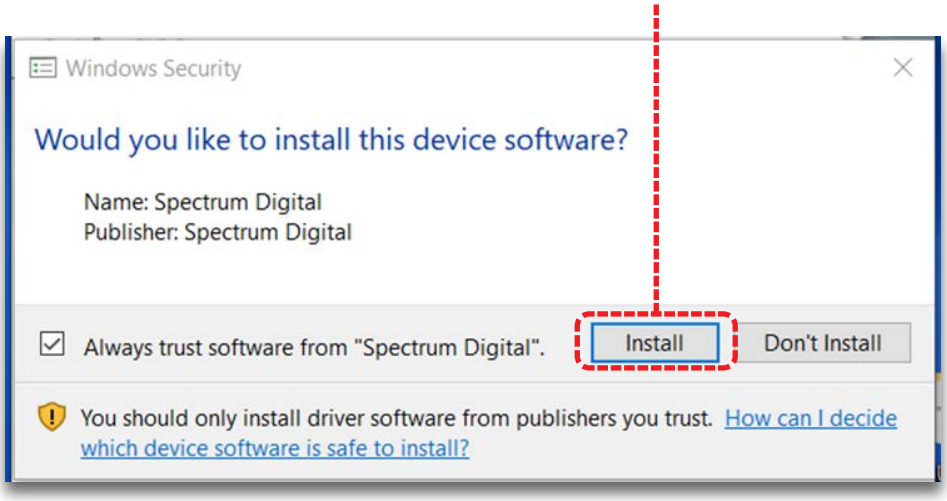


3. Follow all installations steps by accepting default settings.



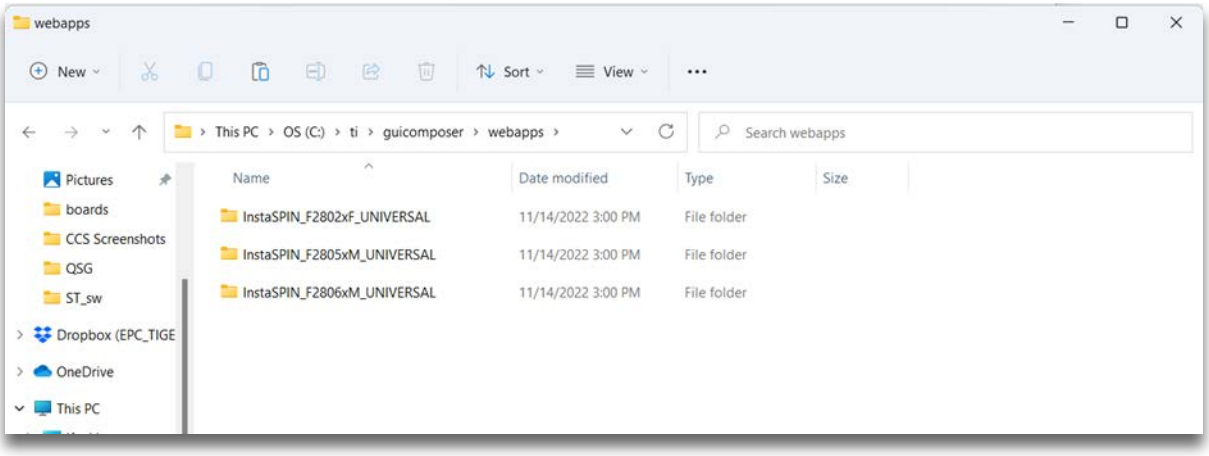
Spectrum Digital Emulator Drivers

During the GUI installation process, it may ask to install the drivers for the Spectrum Digital emulator. Click on Install button.

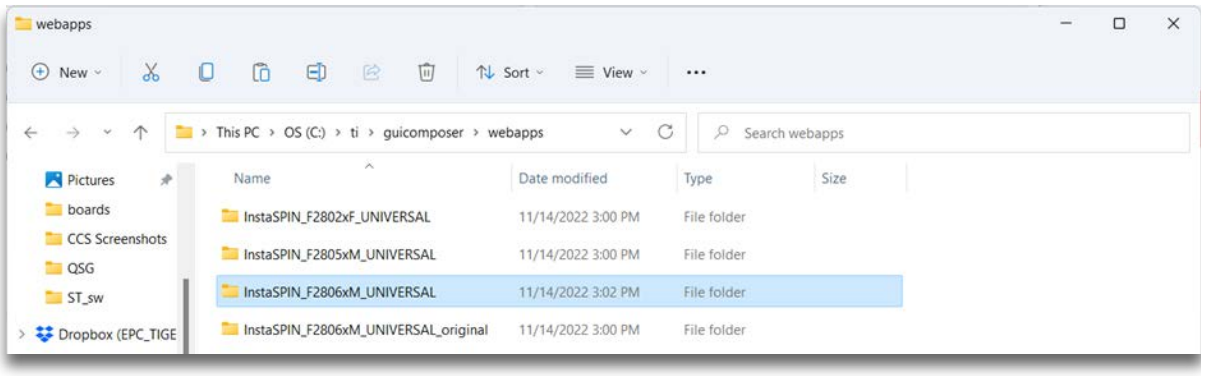


II. EPC 3-phase inverter board dedicated firmware

1. Download the EPC board dedicated files and store them in the correct location by clicking on the "**GitHub EPC Reference Design Firmware**" link on the **EPC9147B web page**.
2. **Install specific EPC directory in GUI software**
3. Navigate to the directory **C:\ti\guicomposer\webapps** and rename the directory **InstaSPIN_F2806xM_UNIVERSAL** by adding _original suffix.

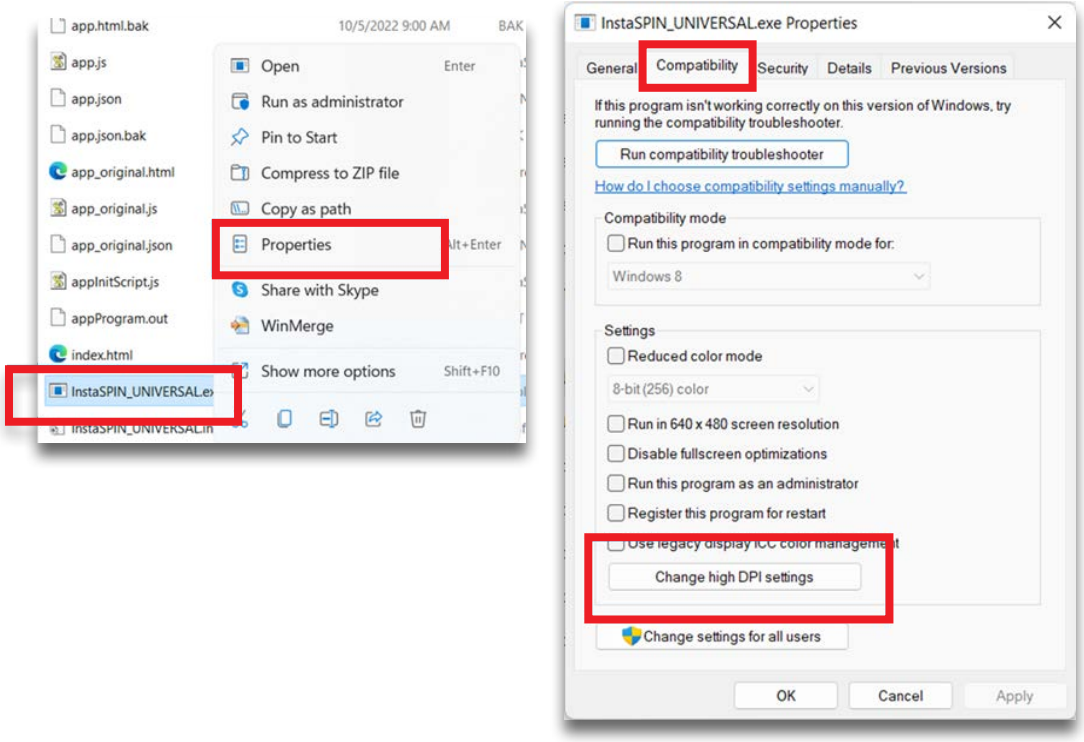


4. Download EPC power board firmware from **"GitHub EPC Reference Design Firmware"** link on the **EPC9147B web page,** then copy the directory **InstaSPIN_F2806xM_UNIVERSAL** supplied by EPC keeping the original name.

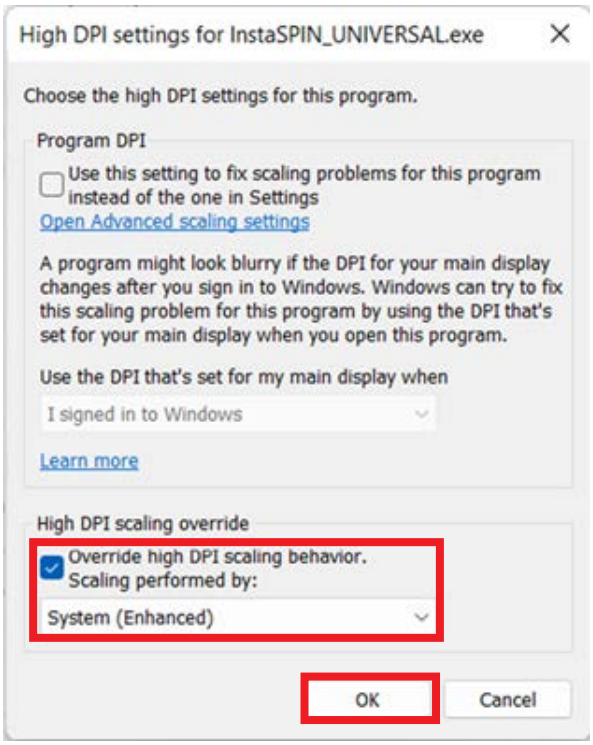


Enhance the Program DPI Resolution

Browse into the copied directory **InstaSPIN_F2806xM_UNIVERSAL** which was copied on the path: **c:\ti\guicomposer\webapps**. Right-click on the **InstaSPIN_UNIVERSAL.exe program**, choose **Properties** on the pop-up menu, then click on **Compatibility** tab and on the **Change high DPI settings** button.



Tick **Override high DPI scaling behavior** and choose **System (Enhanced)** option, then press **OK**.



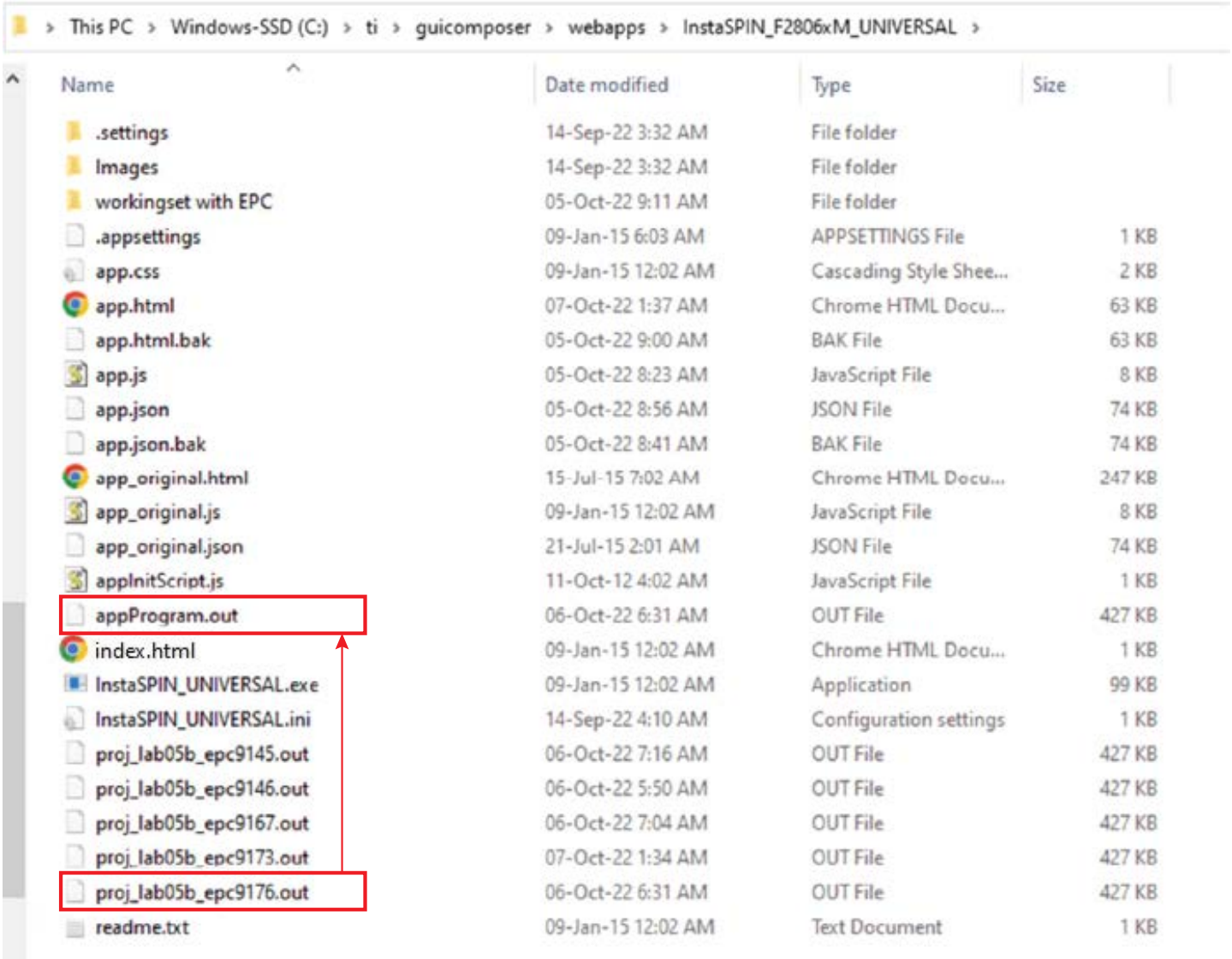
Preparing for the first launch

Each power board is associated with its specific file, but the software always executes the file named appProgram.out; so each time a power board is selected, the specific file associated with it should be copied and renamed appProgram.out. The step-by-step procedure is reported below.

1. Browse to **c:\ti\guicomposer\webapps\instaSPIN_F2806xM_UNIVERSAL**.
2. Inside the indicated directory, one file with **.out** extension for each motor drive reference design board is present.
3. Make sure to make a copy of the desired reference board **.out** file and then rename the copied file as **appProgram.out**.

HARDWARE connection check

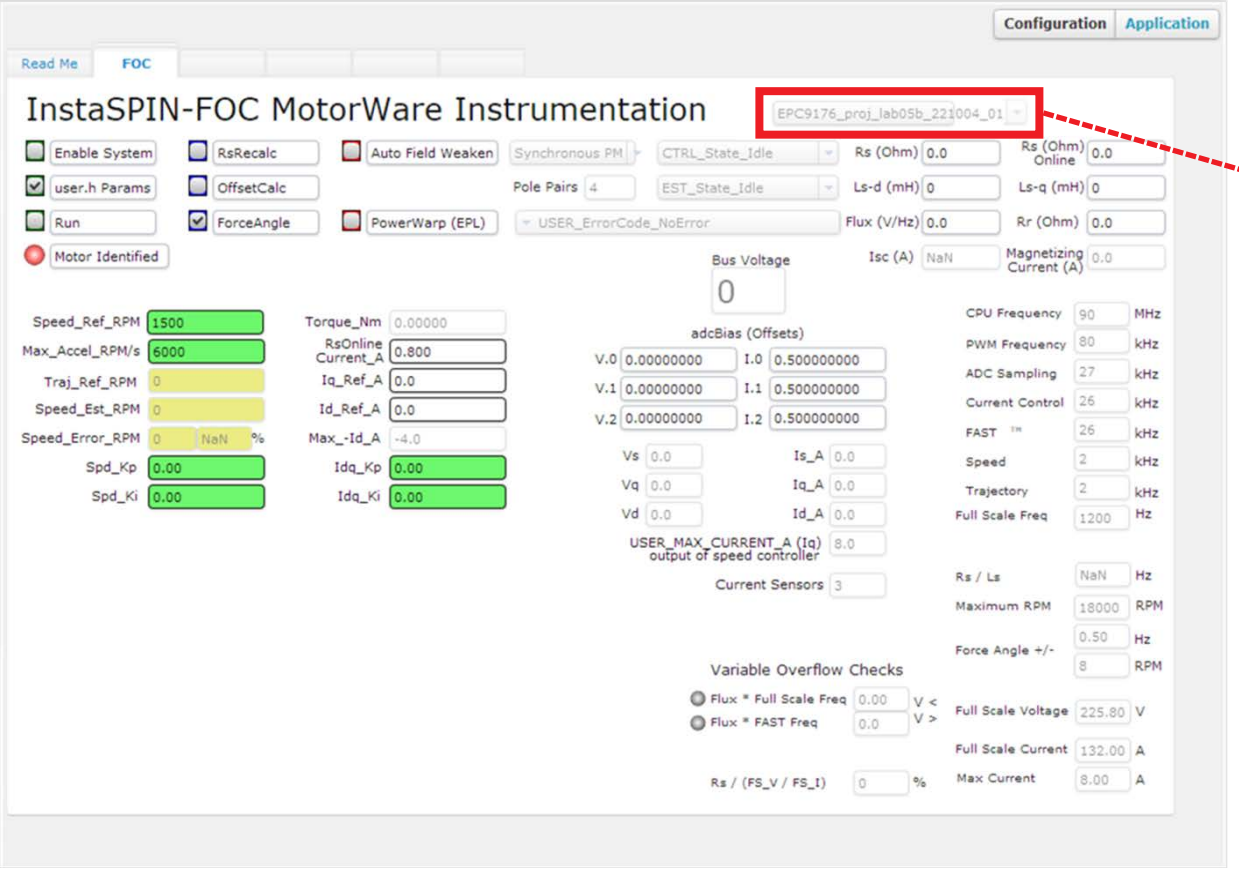
4. Make sure that the EPC9147B + LaunchXL F28069M boards are connected to the USB port of the computer.
5. Launch the **InstaSPIN_UNIVERSAL.exe**
   The **InstaSPIN_UNIVERSAL.exe** program looks for a file called **appProgram.out** and it downloads it on the RAM memory of the F28069M processor. Make sure to chose the proper .out file corresponding to the power board that is going to be used with the EPC9147B and rename the file with the name **appProgram.out**



III. Using InstaSPIN Universal GUI

Setting Up the System

Before operating the board, the user must check that it is the correct reference design. The USB opto-isolator of the LaunchXL board must be enabled to continue.



The reference design name is reflected here

Spinning the Teknic (default) Motor

Please note that this works only with the Teknic motor Teknic_M-3411P-LN-08D

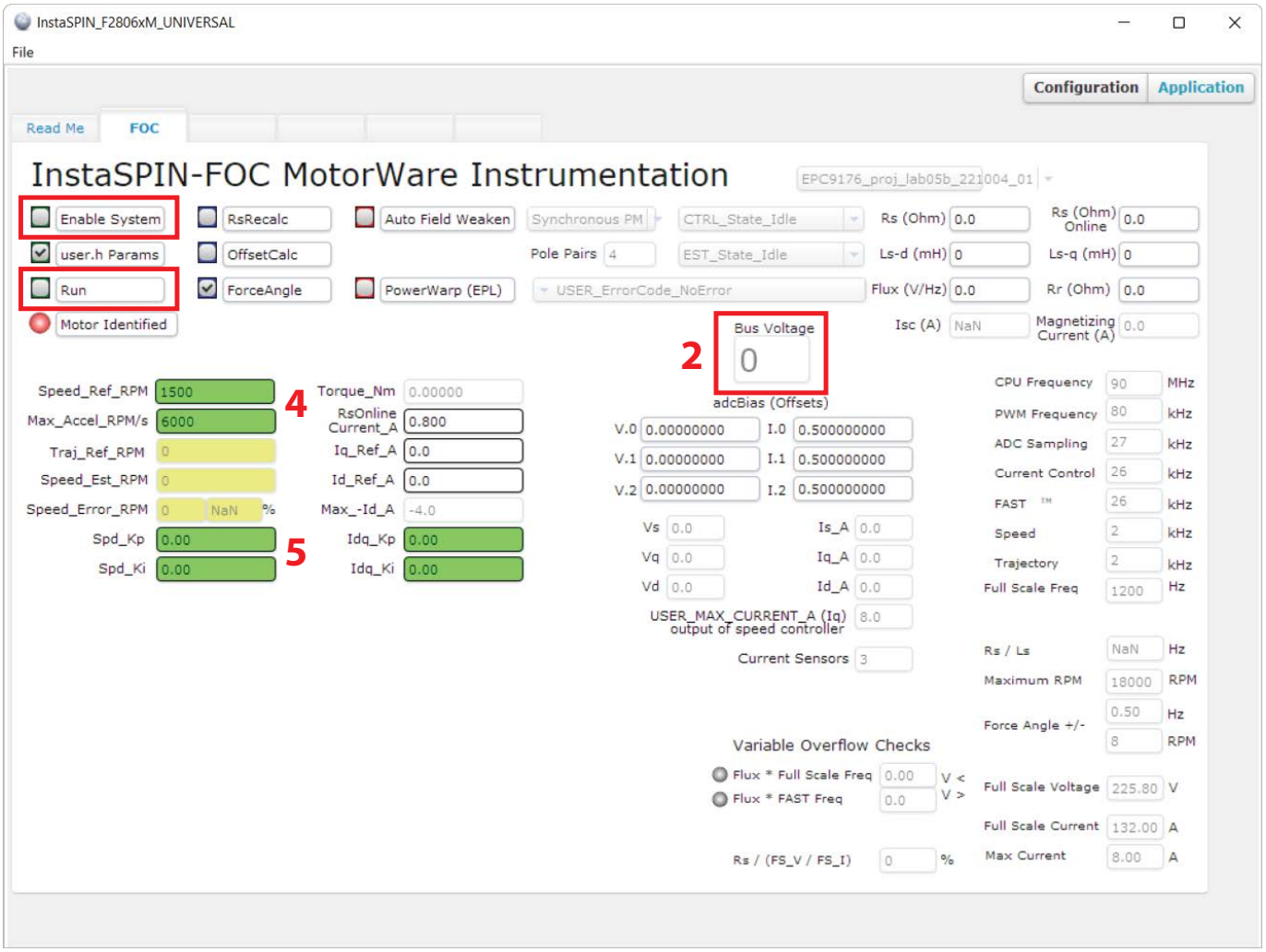
The step-by-step procedure to spin the motor once the hardware connections are made and when the InstaSPIN UNIVERSAL GUI is launched are reported below.

1. Click on **Enable System**
2. Check that the value of the **Bus Voltage** corresponds to the applied DcBus voltage.

   If the voltage is not corresponding, the most common problems are the following:

   - The power supply is not correctly set
   - The wrong **.out** file is used: the read voltage depends on the resistive divider on the power board
3. If the voltage is correct, the motor can be spinned by checking the **Run** box
4. The motor speed can be modified by changing the **Speed_Ref_RPM** value. Swapping the sign of the reference speed will command a change of spinning direction. As an example, if for positive reference speed values the motor spins clockwise, for negative reference speed values the motor spins counterclockwise.
5. The current loop and the speed loop parameters can be adjusted by changing the values indicated on the figure.
6. To stop the motor, uncheck the **Run** box.

Note: LAUNCHXL is not operating from Flash but from RAM so power cycling the board requires it to be reprogrammed.



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