DRV8353Rx-EVM InstaSPIN™ Software Quick Start Guide

This document is a guide to help users evaluate a development kit for the TMS320F28027F Piccolo™ MCU that is enabled with InstaSPIN-FOC™ software and is paired with the DRV8353Rx device. The DRV8353Rx device a three phase smart gate driver evaluation module. The device supports the ISO-F28027F board for InstaSPIN-FOC software which includes on-card XDS100v2 JTAG (isolated), 3-phase inverters, and the DRV8353Rx device.

The document concentrates on setting up the Motorware environment to support the DRV8353Rx-EVM motor driver ICs and finishes with having the source files of the EVM firmware in Code Composer Studio to be modified and analyzed, including the user.h file. The EVM firmware is a modified version of the lab 05b of Instaspin.

To get a more complete idea of how Instaspin works and understand individual parameters, please study the InstaSPIN-FOC™ and InstaSPIN-MOTION™ User's Guide.

To get a complete analysis of how lab 05b and other InstaSPIN labs work, please utilize the InstaSPIN Projects and Labs User's Guide found in the Motorware installation directory below.

If installation is not done, it is instructed in this document.

"Install Directory":\ti\motorware\motorware_1_01_00_15\docs\labs\instaspin_labs.pdf

See the *DRV835x 100-V Three-Phase Smart Gate Driver* data sheet and the *DRV8353Rx-EVM User's Guide* for more information about the DRV8353Rx device.

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1 Hardware and Software Setup

The hardware (HW) and software (SW) tools are required to evaluate the DRV8353Rx devices:

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- DRV8353RH-EVM or DRV8353RS-EVM
- BLDC motor
- Input supply range of 12 to 95-V for the gate driver
- Code Composer Studio™ software V6.3 and newer
  - C2000 Compiler Tools selected during the CCS installation process. Make sure the latest C2000 Compiler Tools are selected during the CCS installation process

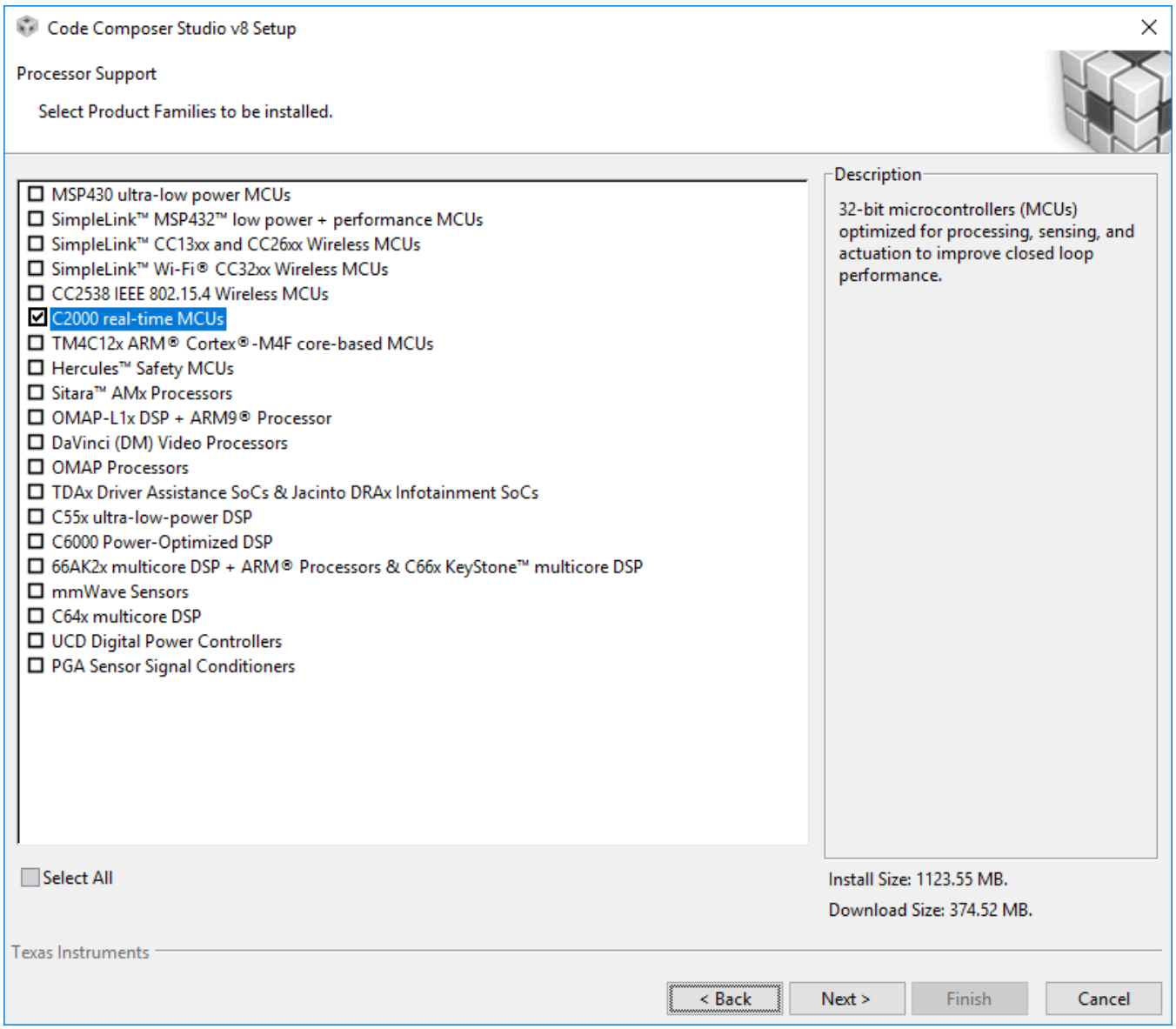

Figure 1. C2000 real-time MCUs Checkbox Checked during CCS Installation

- The latest version of MotorWare™ software from www.ti.com/tool/motorware.

2 MotorWare™ Software Overview and DRV8353Rx Setup

MotorWare™ software is the software and documentation package to develop applications based on InstaSPIN-FOC software and InstaSPIN-MOTION™ software that are for Piccolo F2802x, F2805x, and F2806x series. The software features the InstaSPIN-FOC software which brings powerful sensorless field oriented motor control technology to all skill levels of designers. The InstaSPIN-FOC software auto-identifies, auto-tunes, and fully controls 3-phase motors in minutes. The benefits of utilizing Motorware with this EVM include:

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1. The isolated MCU board (ISO-F28027F) and the DRV8353Rx-EVMs can be integrated MotorWare software.
2. MotorWare contains all of the modules, drivers, example Code Composer Studio software based InstaSPIN software projects, and associated documentation.
3. Motorware can be easily browsed by running MotorWare.exe from the installation directory (see Figure 2).
4. Refer to section 2.2.2 for full integration into Motorware.

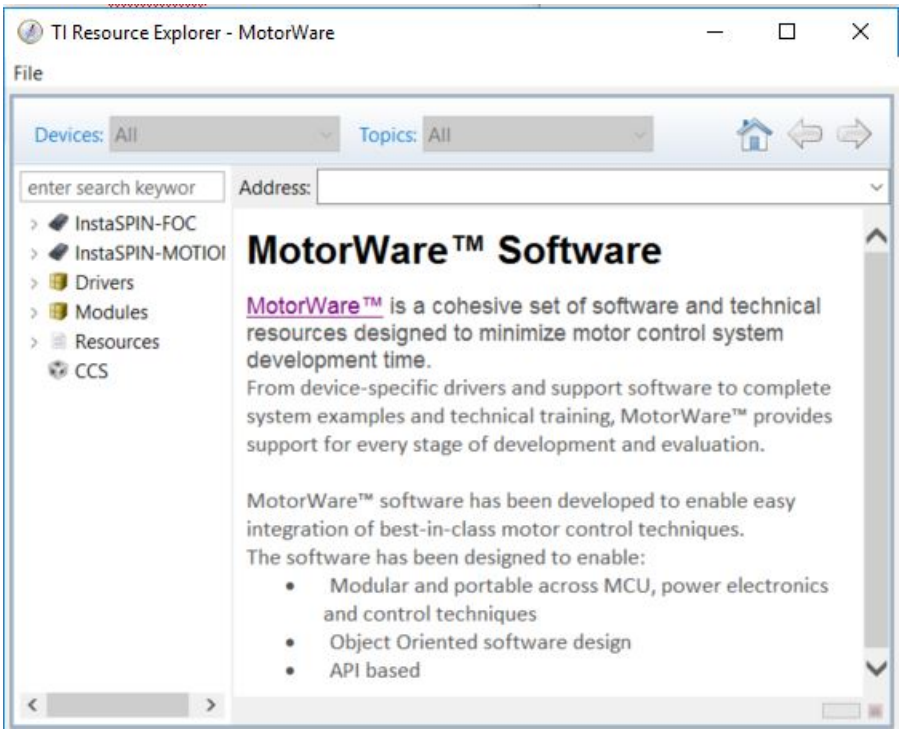

Figure 2. MotorWare™ Software–Overview

5. Set-up the hardware according to documentation (see Figure 3)

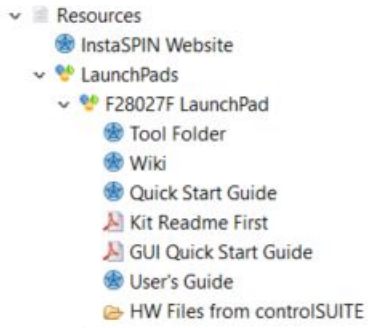

Figure 3. MotorWare™ Software–Hardware Set-Up

2.1 ISO-F28027F Setup

Below is a description of how to setup this isolated MCU board for download and debug purposes:

- First Provide DC bus to the EVM.
- Connect USB from EVM to PC

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2.2 DRV8353RS-EVM and DRV8353RH-EVM Evaluation

DRV8353RS-EVM and DRV8353RH-EVM are compatible with ISO-F28027F. Follow these steps to spin an InstaSPIN-FOC BLDC motor on the DRV8353Rx-EVM.

- Ensure power to the EVM.
- Evaluation of DRV8353Rx device with the InstaSPIN-FOC software can be done in two ways.
  1. The EVM firmware, which is a modified version of Instaspin Proj Lab05b, integrated within DRV8353Rx-EVM GUI Application. To make changes to the user.h file, integrate the firmware software package, which contains the source files for DRV8353Rx-EVM, into Motorware environment and edit the source files in Code Composer Studio. After making changes to the SW, build and put the binary output file in the location in your PC as mentioned in DRV8353Rx EVM GUI Users Guide to use the GUI with the newly updated firmware
  2. The second method is to evaluate the firmware directly within Code Composer Studio after integrating the firmware source files for DRV8353Rx-EVM into Motorware.

2.2.1 Install the DRV8353Rx Software Package

The DRV8353Rx firmware package has source files for the InstaSPIN-FOC software Lab 05b of the MotorWare software. These source files are modified for the DRV8353Rx device and the DRV8353Rx-EVM.

To install the software package follow these steps:

Step 1. Download the "DRV8353RS/H-EVM Firmware" software package. This firmware is common for DRV8353RS and DRV8353RH (see Figure 4).

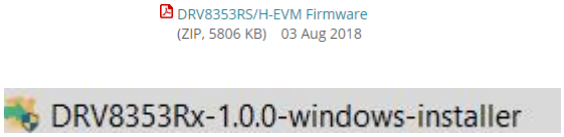

Figure 4. DRV8353Rx Firmware Installer Executable File

Step 1. Follow the prompts to select another language from the default of English (see Figure 5).

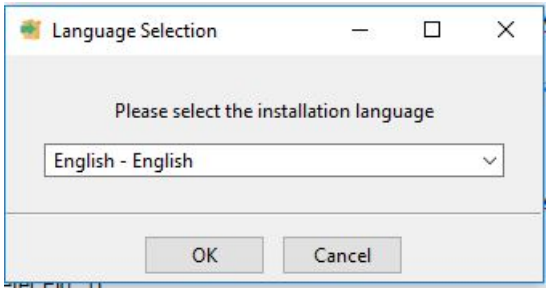

Figure 5. Language Selection

Step 2. Click Next button to setup DRV8353Rx Software package (see Figure 6).

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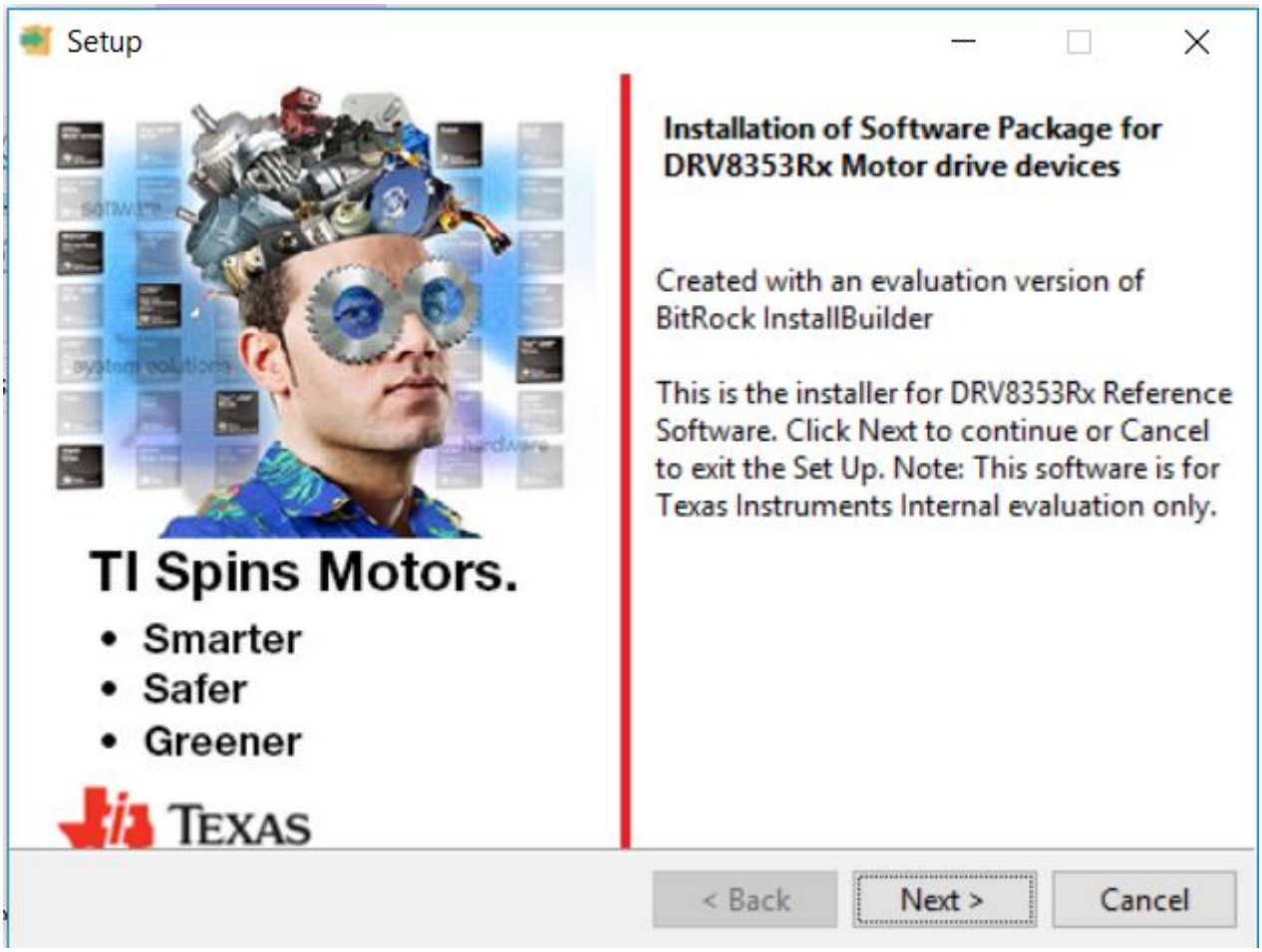

Figure 6. Setup

Step 3. Select the destination location for the software packages (see Figure 7). This destination can be set to any location in the PC.

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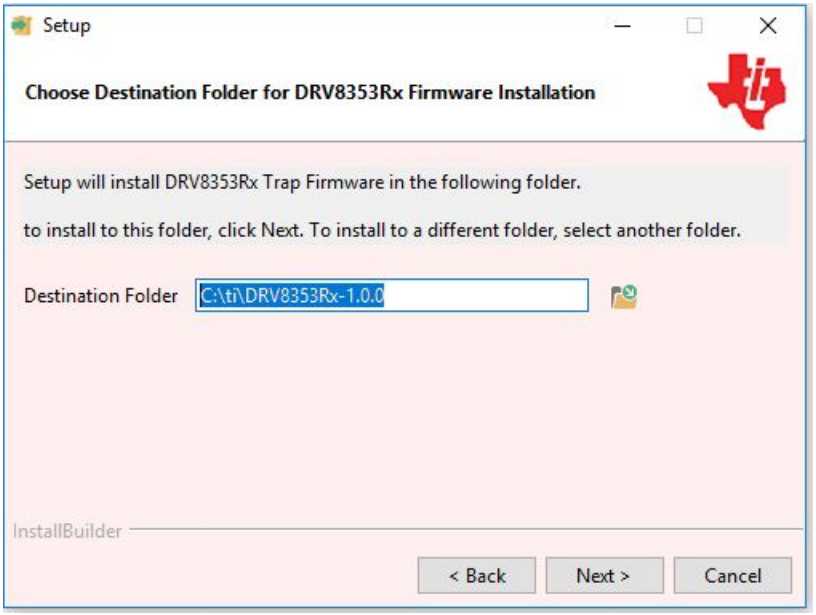

Figure 7. Installation Directory

Step 4. Select the DRV8353Rx components to install (see Figure 8).

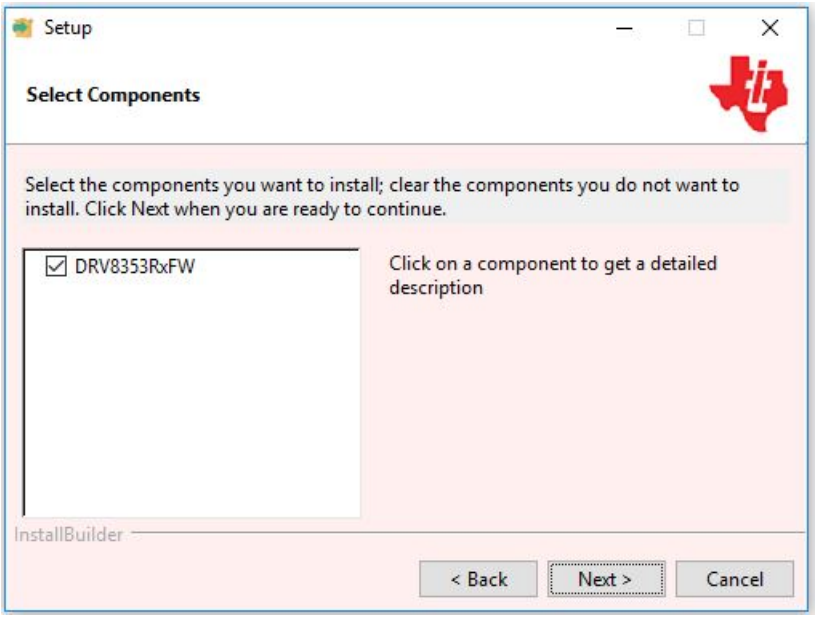

Figure 8. Component Selection

Step 5. Continue with the installation process.

Step 6. Click the Next button to install after reviewing the settings.

Step 7. Click the Finish button when the files are successfully installed in the destination folder (see Figure 9).

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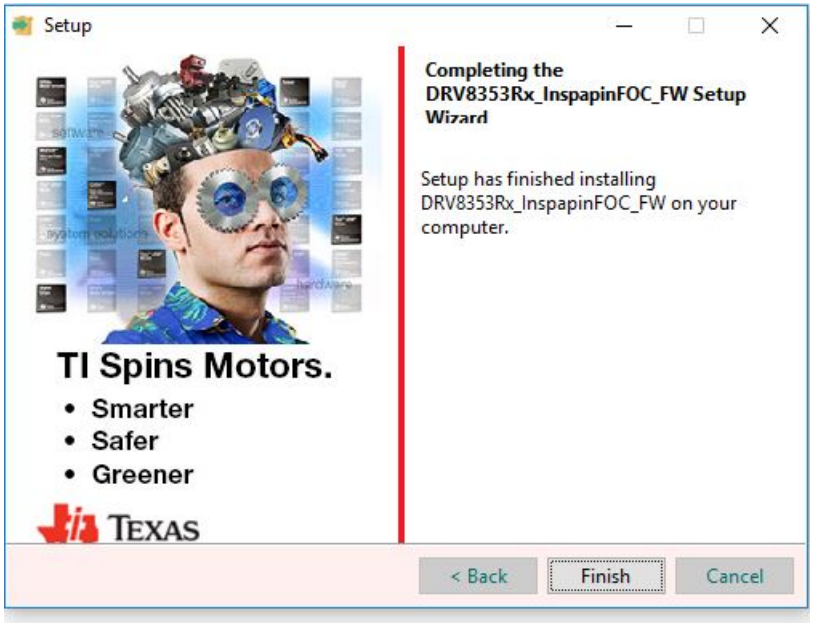

Figure 9. Finish

Step 8. It will contain 3 file directories as shown in Figure 10.

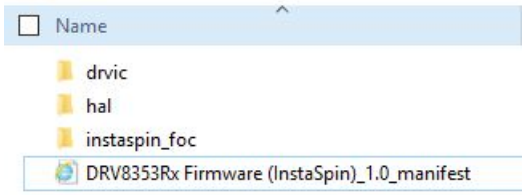

Figure 10. File Directories for DRV8353Rx

Step 9. To integrate DRV8353Rx source files into Motorware

1. Copy folder drv8353 from **"InstallDirectory":\ti\DRV8353Rx-1.0.0\DRV8353Rx_InstaspinFOC_FW\drvic** to **"Install Directory":\ti\motorware\motorware_1_01_00_18\sw\drivers\drvic**
2. Copy folder drv8353 from **"InstallDirectory":\ti\DRV8353Rx-1.0.0\DRV8353Rx_InstaspinFOC_FW\hal\boards** to **"Install Directory":\ti\motorware\motorware_1_01_00_18\sw\modules\hal\boards**
3. Copy folder src from **"InstallDirectory":\ti\DRV8353Rx-1.0.0\DRV8353Rx_InstaspinFOC_FW \instaspin_foc** to **"InstallDirectory":\ti\motorware\motorware_1_01_00_18\sw\modules\hal**
4. Copy folder drv8353 from **"InstallDirectory':\ti\DRV8353Rx-1.0.0\DRV8353Rx_InstaspinFOC_FW\instaspin_foc\boards** to **"InstallDirectory":\ti\motorware\motorware_1_01_00_18\sw\solutions\instaspin_foc\boards**
5. Copy contents of folder src from **"InstallDirectory":\ti\DRV8353Rx-1.0.0\DRV8353Rx_InstaspinFOC_FW\instaspin_foc** to **"InstallDirectory:\ti\motorware\motorware_1_01_00_18\sw\solutions\instaspin_foc\src**

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2.2.2 Importing DRV8353Rx files to MotorWare™ Software

The software package of DRV8353Rx for ISO-F28027F supports InstaSPIN software project Lab05. This project can be opened into CCS. The following steps should be followed to migrate DRV8353Rx related files to project Lab05 of the MotorWare software.

- CCS must be reinstalled if the C2000 Compiler Tools were not selected during the installation process. Please follow this link and select the latest executable of CCS and make sure those Compiler Tools are selected.

http://processors.wiki.ti.com/index.php/Download_CCS

- Follow the next steps to verify import and run the project:
  1. After installing CCS , import the project proj_lab05b using the Project\Import CCS Project... method. In the newly open pop-up menu, paste the following directory into the text box to the right of the Select search directory: (make sure it is bubble-checked): **"InstallDirectory":\ti\motorware\motorware_1_01_00_18\sw\solutions\instaspin_foc\boards\drv8353\f28x\f2802xF\projects**. Then, select the mentioned project and click finish.
  2. Change the drv8353 custom include path in “Project→Properties→Build→C2000 Compiler→Include Options” to the following include **"InstallDirectory":\ti\motorware\motorware_1_01_00_18\sw\modules\hal\boards\drv8353\f28x\f2802x\src**
  3. Clean the project
  4. Build the project.
  5. Now you have imported into CCS the firmware of the DRV8353Rx-EVM, which is a modified version of InstaSPIN Lab 05b.
  6. If you would like to run your own modified version of the firmware with the GUI, modify user.h file with the updatedmotor settings. The *InstaSPIN-FOC™ and InstaSPIN-MOTION™ User's Guide* and the InstaSPIN Projects and Labs User's Guide can help understand each parameter better.
  7. Compile the CCS project.
  8. Copy project_lab05b.out in the directory **"Intall Directory":\Users\"UserId"\guicomposer\gcruntime.v6\DRV8353Rx\target"**.
  9. Rename it to appProgram.out.
  10. Run DRV8353Rx GUI to evaluate FOC on DRV8353Rx.

2.2.3 Graphical User Interface for DRV8353RS and DRV8353RH Evaluation

The DRV8353Rx-EVM GUI along with DRV8353Rx-EVM facilitates control of a BLDC motors and change of various settings. The DRV8353Rx-EVM GUI provides functionality for adjusting the speed of the motor, tuning parameters of the motor-control algorithm and monitoring the device status.

See the *DRV8353Rx-EVM EVM User’s Guide* for more information.

2.3 MotorWare™ Reference Documentation

See the documentation for MotorWare software for more information:

- Texas Instruments, *InstaSPIN-FOC™ and InstaSPIN-MOTION™ User's Guide*
- Texas Instruments, *TMS320F28026F, TMS320F28027F InstaSPIN-FOC™ Software Technical Reference Manual*

3 Software Code for Reference

3.1 Object Definition Codes

Refer project main source file proj_lab05.c. The code is as follows:

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```
#ifdef DRV8353_SPI
// Watch window interface to the DRV8353RS SPI
DRV_SPI_8353_Vars_t gDrvSpi8353Vars;
#endif
```

3.2 Turn On and Initialize DRV8353Rx Driver Interface

The DRV8353Rx device can be enabled or disabled using the APIs that follow:

```
#ifdef DRV8353
  HAL_enableDrv(halHandle);
#endif
#ifdef DRV8353_SPI
  // initialize the DRV8353RS interface
  if(gDeviceVariant)
      HAL_setupDrvSpi(halHandle,&gDrvSpi8353Vars);
#endif
```

3.3 Write or Read DRV8353RS Registers

The DRV8353RS registers can be read and written by the code as follows:

```
#ifdef DRV8353_SPI
        if(gDeviceVariant)
        {
            HAL_writeDrvData(halHandle,&gDrvSpi8353Vars);

            HAL_readDrvData(halHandle,&gDrvSpi8353Vars);
        }
#endif
```


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