

DRV10983 and DRV10975 Evaluation Module

This document provides complete details of DRV10983 and DRV10975 customer evaluation module (EVM) including its hardware implementation, jumper configuration, and operating procedure to run 3-phase BLDC motors. The guide pertains to four EVM configurations: two main configurations are DRV10983 and DRV10975, and depending upon operating mode each of two devices, EVMs are further sub-divided as Standby mode and Sleep mode. This EVM user's guide is intended to be used with the DRV10983 and DRV10975 Tuning Guide ([SLOU395](#)) to optimally tune a user motor.

Contents

1	DRV10983 and DRV10975 EVM Kit Contents.....	3
2	Introduction	3
3	DRV10983 and DRV10975 EVM Board	4
3.1	Power and Motor Connectors P1	4
3.2	Test Point Connector P2.....	4
3.3	Control Input Connectors J3.....	4
3.4	Jumper J1 (Direction)	4
3.5	Jumper J2 (Speed Input)	5
3.6	FG Test Pin.....	5
4	DRV10983 and DRV10975 GUI	6
4.1	Overview	6
4.2	Basic Settings	6
5	Out-of-the-Box Quick Start Guide	10
6	Power-on Sequence and Connection With User-Specific Motor	14
7	Schematic and Bill of Materials.....	15
7.1	Schematic	15
7.2	Bill of Materials (BOM)	16
Appendix A	GUI Installation and Overview	17
Appendix B	GUI to DRV10983 and DRV10975 Register Cross Reference.....	39

List of Figures

1	DRV10983 EVM with Standby Device	3
2	DRV10983 GUI Basic Settings	6
3	DRV10983 GUI Advanced Settings	8
4	DRV10983 GUI Display Settings	9
5	Initial GUI Screen	11
6	GUI in Simulation Mode	12
7	Enable Configure.....	13
8	Disable Sleep Mode	14
9	DRV10983 and DRV10975 Schematic.....	15
10	Setup.exe from the Volume Folder	17
11	GUI Installation Initialization	18
12	GUI Destination Directory	18
13	GUI License Agreement.....	19
14	GUI Start Installation.....	19
15	GUI Installation in Progress.....	20

16	GUI Installation Complete	20
17	Python Installation Complete	21
18	USB2ANY Installation Initialization	21
19	USB2ANY License Agreement	22
20	USB2ANY Destination Directory	22
21	USB2ANY Start Installation	23
22	USB2ANY Installation Progress	23
23	USB2ANY Installation Complete	24
24	LabVIEW RTE Installation Initialization	25
25	LabVIEW RTE Select Features	26
26	LabVIEW RTE License Agreement	26
27	LabVIEW RTE Start Installation	27
28	LabVIEW RTE Installation in Progress	27
29	LabVIEW RTE Installation Complete	28
30	Basic Settings Page	29
31	Confirmation on Voltage Level	30
32	Help Icon	31
33	Advanced Settings	31
34	Display	32
35	About Page.....	33
36	File Menu.....	33
37	Script Menu	34
38	Launch Macro.....	34
39	Start Recording	35
40	Stop Recording	36
41	Run Macro	37
42	Debug Menu	38

List of Tables

1	DRV10983 and DRV10975 Bill of Materials	16
2	GUI to DRV10983 and DRV10975 Register Cross Reference.....	39

Trademarks

Microsoft, Windows are registered trademarks of Microsoft Corporation.
All other trademarks are the property of their respective owners.

1 DRV10983 and DRV10975 EVM Kit Contents

The DRV10983 and DRV10975 evaluation kit contains following:

1. DRV10983 and DRV10975 EVM board
2. USB2ANY communication board for I2C GUI interaction
3. USB cable
4. 10-pin ribbon cable to connect USB2ANY and DRV10983 and DRV10975 EVM
5. DRV10983 and DRV10975 EVM GUI

The DRV10983 and DRV10975 EVM boards and GUI are designed to work together to evaluate the device features.

2 Introduction

The DRV10983 and DRV10975 EVM is a complete solution for evaluating the DRV10983 24-V and DRV10975 12-V, Three-Phase Sensorless BLDC motor drivers. Device evaluation and configuration for specific applications is possible with the provided DRV10983 and DRV10975 EVM GUI. This document describes the kit details and explains the functions and locations of test points, jumpers, and connectors present on the kit. This document is also a quick start guide for using the GUI to tune a motor for application. There are four identifications marks on EVM⁽¹⁾ to help the user easily identify the right configuration. For example, [Figure 1](#) shows the EVM using the DRV10983 standby device. For detailed information about operating modes of the DRV10983 and DRV10975 devices, refer to their data sheets ([SLVSCP6](#)) and ([SLVSCP2](#)), respectively.

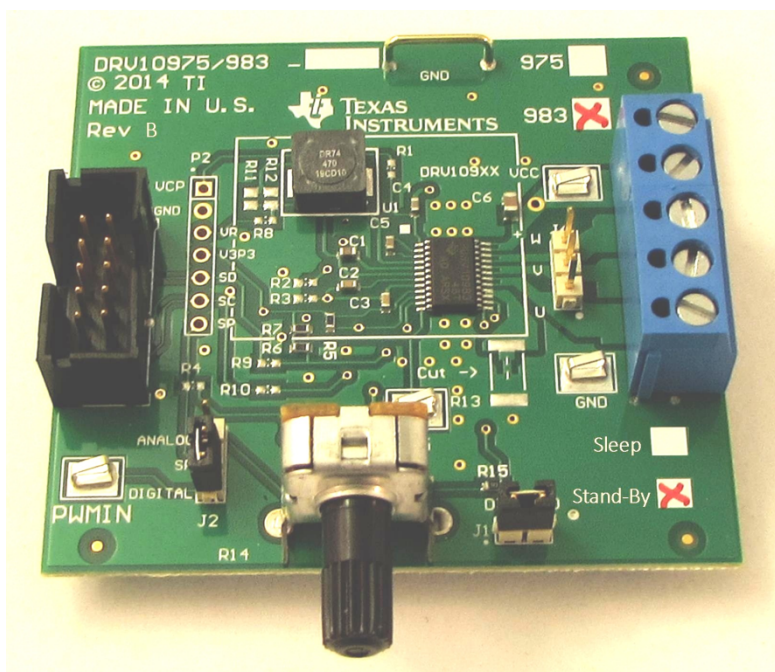


Figure 1. DRV10983 EVM with Standby Device

⁽¹⁾ There are two revisions of the DRV10983 and DRV10975 EVM. The REV-A board uses only two identification marks to distinguish between DRV10983 and DRV10975. The latest REV-B board uses two additional identifications marks to distinguish between Standby and Sleep mode parts.

3 DRV10983 and DRV10975 EVM Board

3.1 Power and Motor Connectors P1

The DRV10983 and DRV10975 EVM shares terminal P1 for power supply and motor phase output. To operate the EVM, a single power supply rail between 8 to 28 V for DRV10983 EVM and 6.5 to 18 V for DRV10975 EVM (depending on the motor requirements) is necessary. For DRV10975 EVM, nominal voltage is 12 V, and for DRV10983, nominal voltage is 24 V. The pin assignment of terminal P1 is as follows:

Pin	Description
1	VCC
2	W
3	V
4	U
5	GND

3.2 Test Point Connector P2

Connector P2 can be used to measure signals from the DRV10983 and DRV10975. P2 is not populated. The pin assignment is as follows:

Pin	Description
1	VCP, charge pump output
2	GND
3	VR, VREG output
4	V3P3
5	SD from J3 (connects to SDA of device)
6	SC from J3 (connects to SCL of device)
7	SP, SPEED input from PWMIN or R14

3.3 Control Input Connectors J3

The connector J3 is used for the I2C interconnection with the GUI. The pin assignment is as follows:

Pin	Description
6	GND
9	SD (connects to SDA of device)
10	SC (connects to SCL of device)

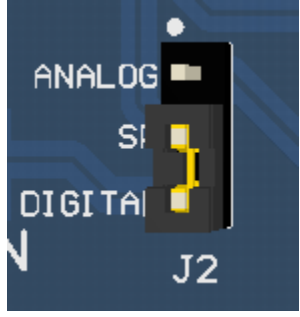
3.4 Jumper J1 (Direction)

In order to control the spin direction of the motor, the DRV10983 and DRV10975 EVM is equipped with a direction jumper. Depending if 3V3 or GND is supplied to the DRV10983 and DRV10975 direction input, the motor spins either in forward or reverse direction.

	J1 Connection	Description
	unconnected	DIR is set to 3.3V
	connected	DIR is set to GND (shown)

3.5 Jumper J2 (Speed Input)

The motor speed input source is configured with J2. If J2, pins 2-3 is populated, supply a PWM to the PWMIN test pin to control the motor speed. If J2, pins 1-2 is populated, the motor speed is controlled with the analog potentiometer R14 equipped on the EVM.

	J2 Connection	Description
	1 – 2	Analog Pot R14
	2 – 3	PWMIN digital input (shown)

NOTE: The motor operation may be unpredictable if the DRV10983 and DRV10975 internal register setting does not match the J2 selection.

3.6 FG Test Pin

The FG test pin outputs the motor speed, depending on the internal DRV10983 and DRV10975 divider setting and the number of motor poles.

4 DRV10983 and DRV10975 GUI

4.1 Overview

The DRV10983 and DRV10975 EVM is provided with a GUI to configure the device and tune the application. Refer to [Appendix A](#) to download and install GUI application. The GUI is structured into three tabs (Basic Settings, Advanced Settings, and Display) allowing configuration of the register settings and tuning of the device parameters for the target application. For details about the settings, refer to the DRV10983 datasheet ([SLVSCP6](#)) and DRV10975 datasheet ([SLVSCP2](#)).

In following sections, DRV10983 GUI images are shown to explain the various features of GUI. The same applies for DRV10975 devices unless otherwise specified.

4.2 Basic Settings

The Basic Settings tab is the landing screen after launching the GUI on the computer. The tab sets the motor parameters, startup parameters, initial speed detection prior to startup, and current limits. This tab can also load and save motor parameters and program the EEPROM with optimized settings.

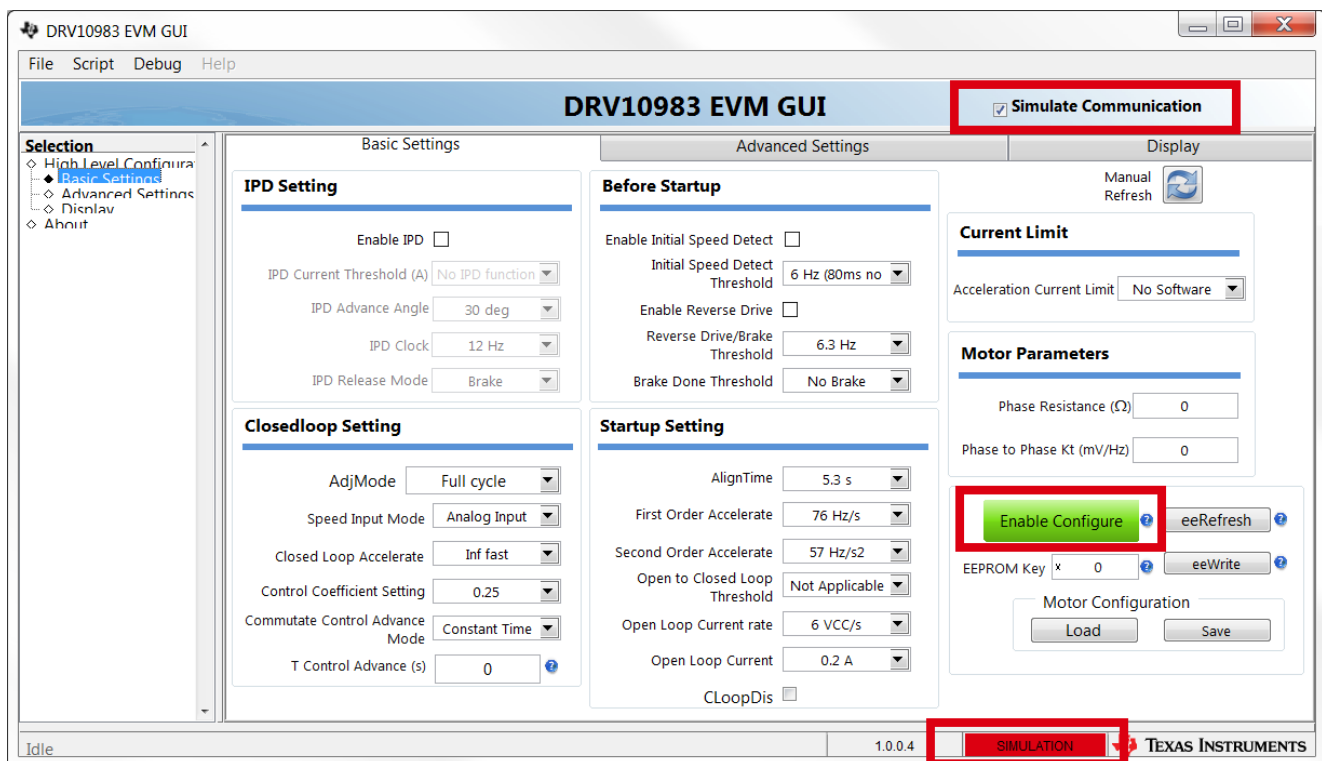


Figure 2. DRV10983 GUI Basic Settings

4.2.1 Communication

The GUI is designed to work with and without the hardware connected, allowing evaluation of the available settings. Select *Simulate Communication* on the top right to work offline. When the EVM is connected to the GUI, this box should be unchecked and the bar at the bottom shows *Connected*. If the GUI cannot connect to the hardware, check that the hardware is powered and the I2C communication is correctly established.

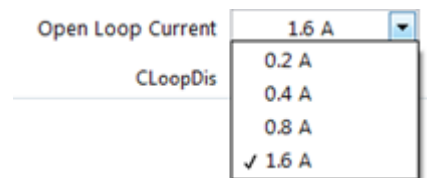
4.2.2 Register Access – Enable Configure

To access the register settings, left click the Enable Configure button. Refer to [Figure 2](#). Once selected, the button changes to green and the settings can change.

4.2.3 Changing Register Settings

The GUI supports three different input types to set the register values:

1. Dropdown list to select a predefined setting. An example is shown to the right.



2. Checkbox to set single bit values. An example with the selection enabled is shown to the right.

IPD Setting

Enable IPD ☒

3. Text boxes (user input data might be changed by the device due to data type conversions). 1.5 was entered, 1.54 is the nearest value and was selected.

Motor Parameters

Phase Resistance (Ω)

4.2.4 Work with EEPROM

The settings are saved and loaded using the Save and Load buttons on the Basic tab. When saved, the file is written as a .csv file that can be loaded at a later time.

To program the DRV10983 and DRV10975 devices and change the default EEPROM settings, follow the instructions of the DRV10983 datasheet ([SLVSCP6](#)) and DRV10975 datasheet ([SLVSCP2](#)).

4.2.4.1 Advanced Settings

The Advance settings tab controls functions such as lock detection, anti-voltage surge function, dead time, PWM frequency, and the Buck Regulator output voltage.

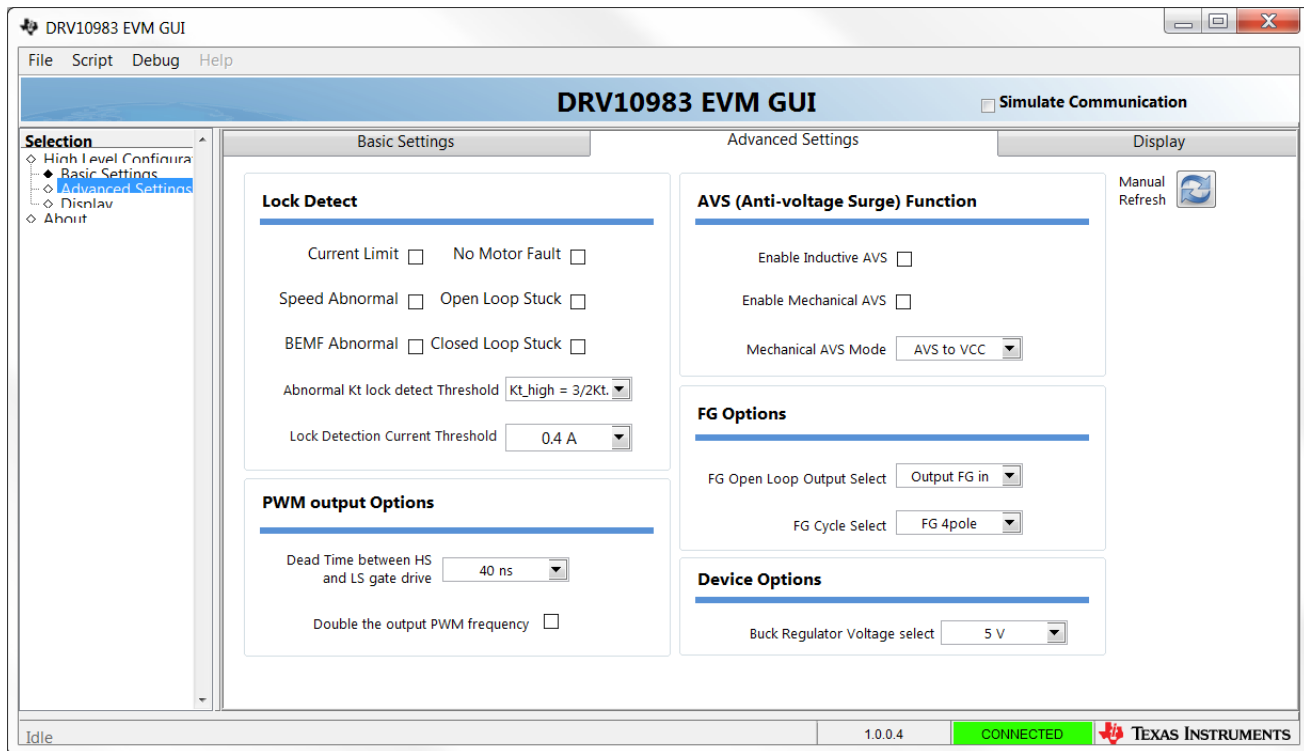


Figure 3. DRV10983 GUI Advanced Settings

4.2.4.2 Display

The Display tab monitors the device status and motor parameters.

The left side shows all motor parameters. The parameters can be refreshed manually, or automatically every second.

NOTE: Auto refresh may slow communication with the device.

The right side shows the device status. An active fault condition lights the red indication.

Control the motor speed from the GUI with the speed control in the bottom right. To control the motor speed using the GUI, check the OverRide bit and set the motor speed from 0 to 511 decimal.

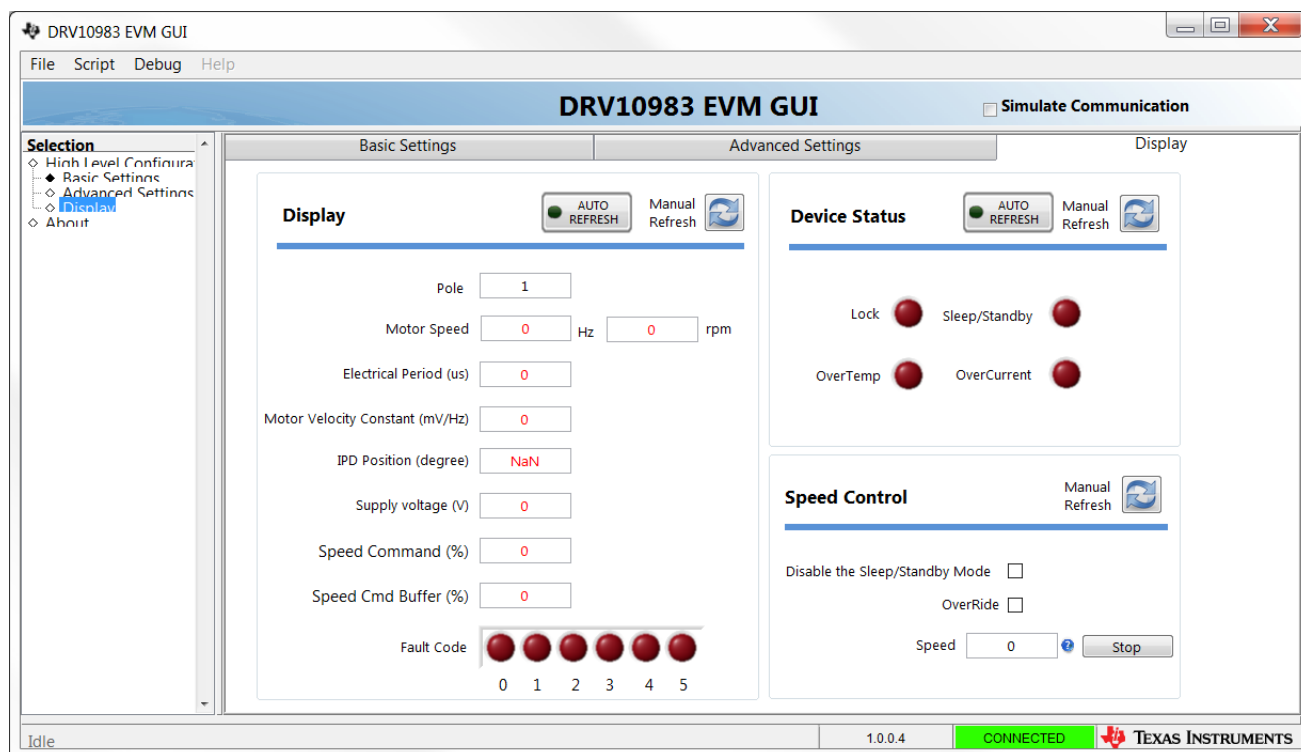


Figure 4. DRV10983 GUI Display Settings

5 Out-of-the-Box Quick Start Guide

This section assumes that the user has a 3-phase BLDC motor and has already downloaded the DRV10983 and DRV10975 application GUI, as mentioned in [Appendix A](#).

Perform the following procedure to confirm proper operation of the EVM kit:

1. Do not connect the motor phases and ensure that jumper J2 is set to analog.
2. For DRV10983 and DRV10975 Standby mode devices, set the speed input to 0 by rotating the potentiometer R14 fully counterclockwise. For DRV10983 and DRV10975 Sleep mode devices, set the speed input to maximum by rotating the potentiometer R14 fully clockwise.
3. Only with DRV10983 and DRV10975 EVMs with Standby mode devices, connect the motor phases of the user motor to connector P1. Phase sequence is not important as it only determines the direction of rotation.

CAUTION

Do not connect the motor phases for EVMs with sleep mode devices.

4. Connect the USB2Any board to your computer using the supplied USB cable. Then connect the 10-pin ribbon cable header to J4 on the USB2Any board and J3 on the DRV10983 and DRV10975 EVMs.
5. Connect a power supply to VCC (pin1) and GND (pin 5) of connector P1. Power on EVM with VCC: For the DRV10975 EVM apply 12 V, and for the DRV10983 EVM apply 24 V.

CAUTION

With VCC, never exceed 18 V on DRV10975 EVMs and 28 V on the DRV10983 EVMs during motor operation.

6. Launch the DRV10983-75.exe application on the computer. Select the appropriate device configuration as shown in [Figure 5](#) and press OK.

The following GUI images will appear for DRV10983 EVMs only, but the same images and operating steps are applicable for DRV10975 EVMs.

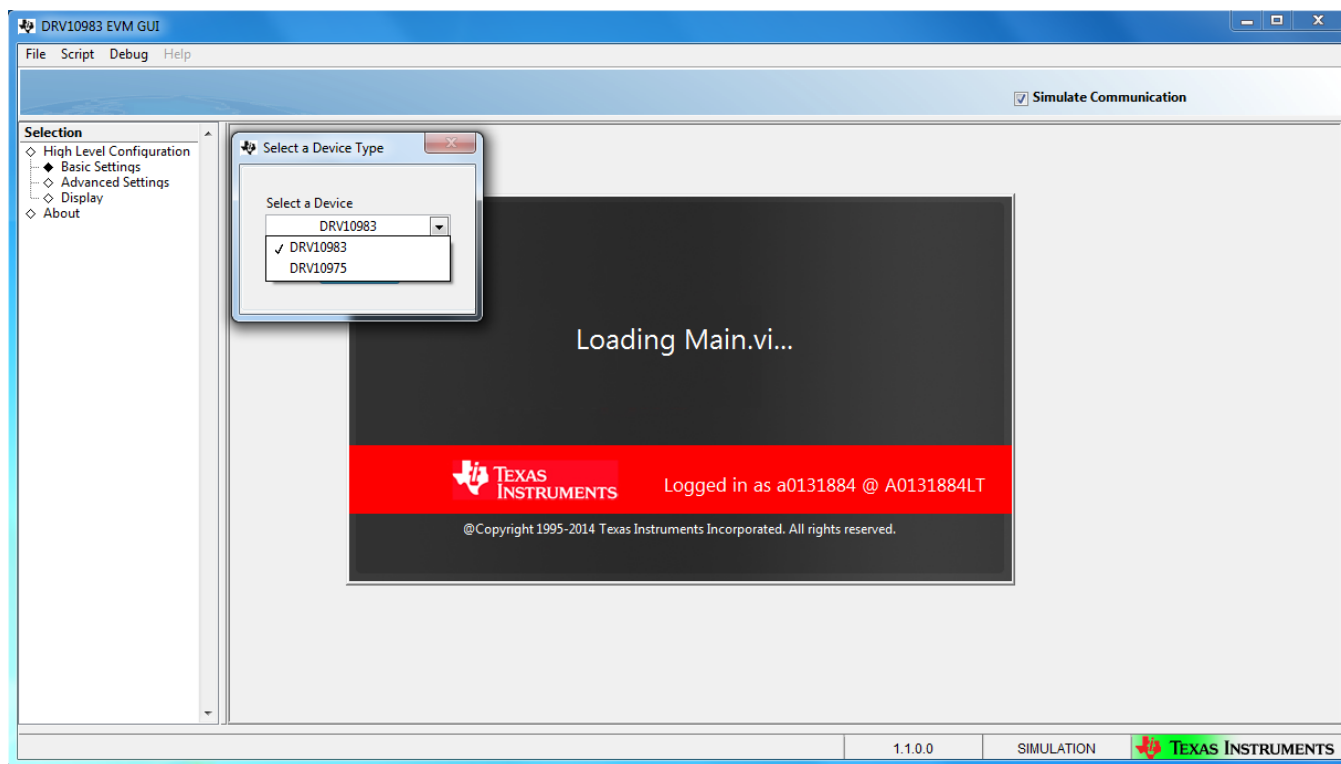


Figure 5. Initial GUI Screen

7. If Simulate Communication was enabled previously, the following GUI screen image would appear as shown in Figure 6. Uncheck the Simulate Communication box to go to next step. Otherwise, the GUI screen image shown in Step 8 will appear directly, after Step 6.

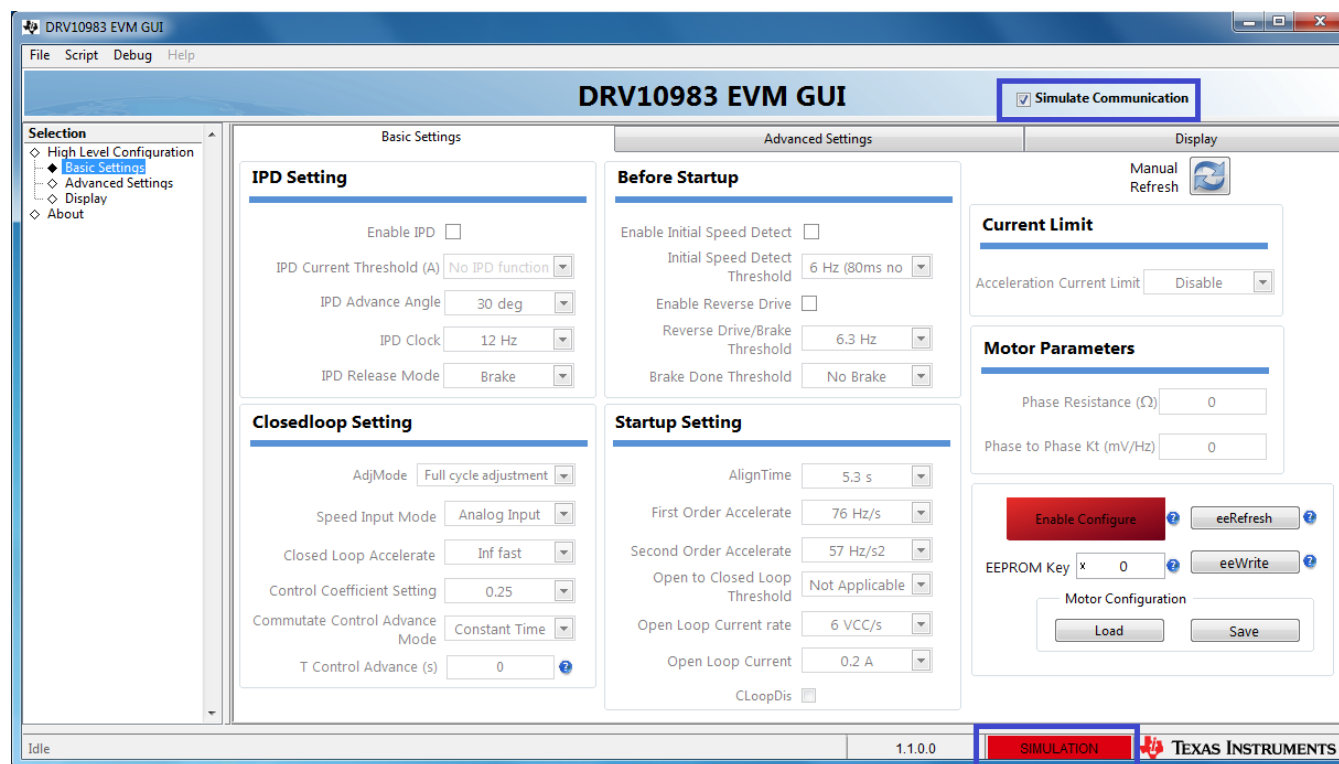


Figure 6. GUI in Simulation Mode

8. CONNECTED should turn green, indicating that the GUI is communicating with the device. Select Enable Configure to turn the button to green as well (see Figure 7).

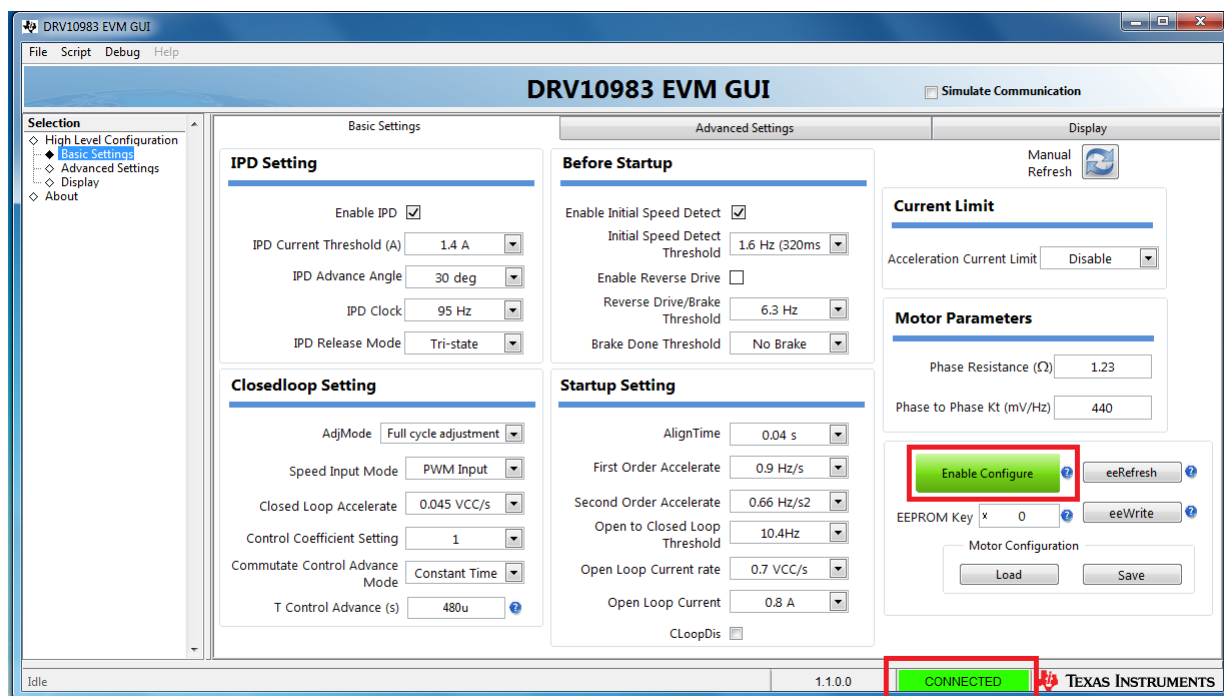


Figure 7. Enable Configure

9. In the Display tab, disable Sleep mode as shown in Figure 8

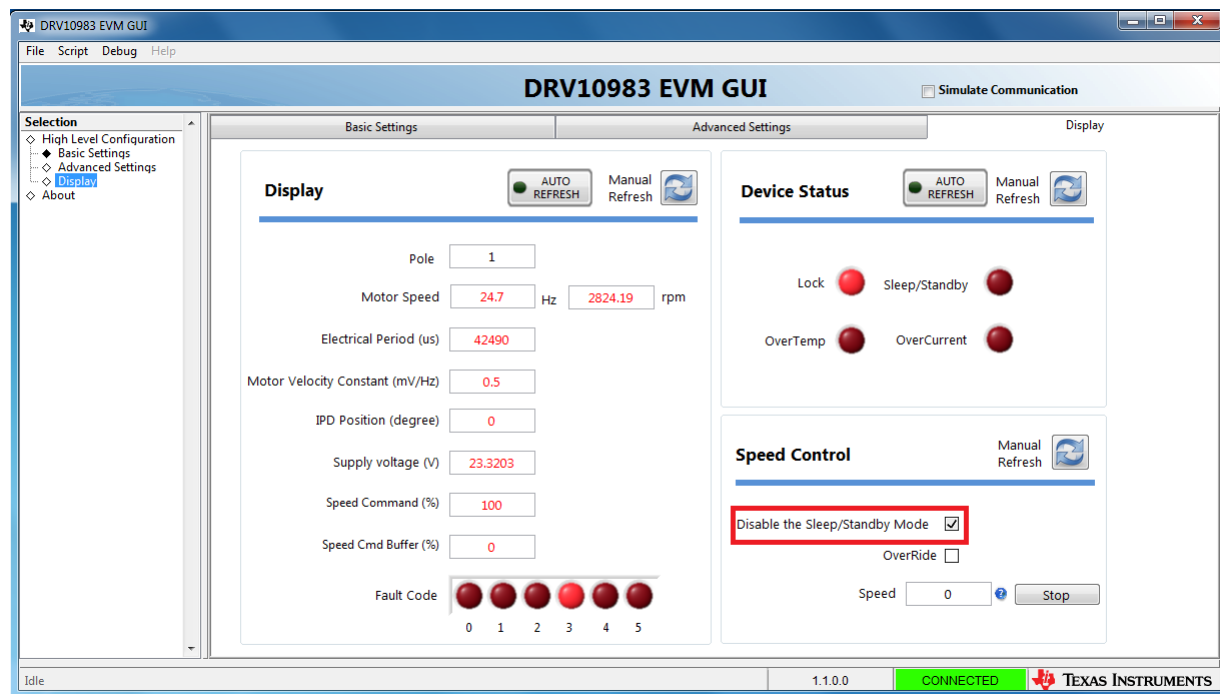


Figure 8. Disable Sleep Mode

For DRV10983 and DRV10975 EVMs with Sleep mode devices, Potentiometer R14 can be brought back to zero by rotating counterclockwise because Sleep mode is disabled and it will not cause issue with the GUI. Now motor can be connected at P1 to Sleep mode EVMs.

CAUTION

Do not short motor phases to VCC at connector P1, specifically P1-2 (Wphase) to P1-1(VCC) because EVM is in power-on condition.

6 Power-on Sequence and Connection With User-Specific Motor

The DRV10983 and DRV10975 EVMs are shipped with default EEPROM settings for all registers, which may or may not be suitable to operate the target motor. To connect the user motor to the EVM, follow the steps mentioned in Section 5 to avoid any damage to EVM.

In order to successfully tune user motor, refer to the DRV10983 and DRV10975 Tuning Guide (SLOU395).

7 Schematic and Bill of Materials

This section contains the DRV10983 and DRV10975 schematic and bill of materials (BOM).

7.1 Schematic

Figure 9 shows the DRV10983 and DRV10975 schematic.

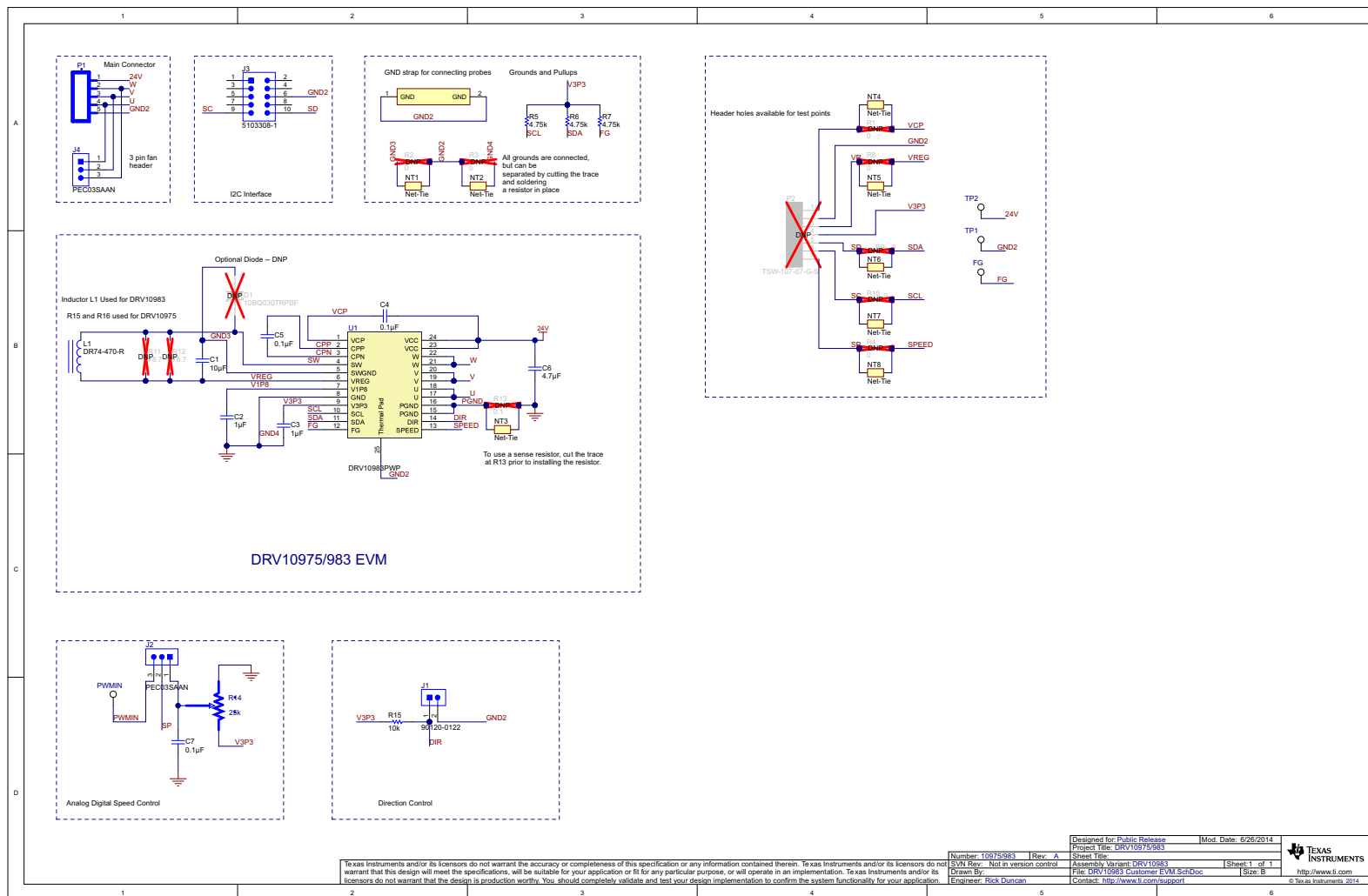


Figure 9. DRV10983 and DRV10975 Schematic

7.2 Bill of Materials (BOM)

Table 1 lists the DRV10983 and DRV10975 EVM bill of materials.

Table 1. DRV10983 and DRV10975 Bill of Materials

Designator	Description	Manufacturer	PartNumber	Quantity
IPCB	Printed Circuit Board	Any	10975/983	1
C1	CAP, CERM, 10 uF, 10 V, +/-20%, X5R, 0603	TDK	C1608X5R1A106M	1
C2, C3	CAP, CERM, 1 uF, 25 V, +/-10%, X5R, 0603	TDK	C1608X5R1E105K080AC	2
C4, C5, C7	CAP, CERM, 0.1 uF, 50 V, +/-10%, X7R, 0603	AVX	06035C104KAT2A	3
C6	CAP, CERM, 4.7 uF, 50 V, +/-10%, X5R, 0805	TDK	C2012X5R1H475K125AB	1
FG, PWMIN, TP1, TP2	Test Point, Compact, SMT	Keystone	5016	4
GND2	Shorting Plug, 1MM uninsulated	Harwin Inc	D3082-05	1
H9, H10, H11, H12	Bumpon, Hemisphere, 0.44 X 0.20, Clear	3M	SJ-5303 (CLEAR)	4
J1	Header, 100mil, 2x1, Tin plated, TH	Molex	90120-0122	1
J2, J4	Header, 100mil, 3x1, Tin plated, TH	Sullins Connector Solutions	PEC03SAAN	2
J3	Header (shrouded), 100mil, 5x2, Gold, TH	TE Connectivity	5103308-1	1
L1	Inductor, Shielded Drum Core, Ferrite, 47 uH, 1.15 A, 0.216 ohm, SMD	Coiltronics	DR74-470-R	1
P1	Terminal Block, 5-pin, 15-A, 5.1mm	OST	D120/5DS	1
R5, R6, R7	RES, 4.75k ohm, 1%, 0.1 W, 0603	Vishay-Dale	CRCW06034K75FKEA	3
R14	Potentiometer, Carbon, 1/8W, Horiz. Adjust	CTS	296XD253B1N	1
R15	RES, 10k ohm, 5%, 0.1W, 0603	Vishay-Dale	CRCW060310K0JNEA	1
SH-J1, SH-J2	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA	2
U1	IC, Motor Driver 3 Phase	Texas Instruments	DRV10983 and DRV10975 ⁽¹⁾	1

⁽¹⁾ U1 part number can be any of the following depending on the EVM:

1. For Standby mode EVM: DRV10975PWP or DRV10983PWP
2. For Sleep mode EVM: DRV10975Z or DRV10983Z

GUI Installation and Overview

The following section explains the location and the procedure for installing the software.

NOTE: Ensure that no USB connections are made to the EVM until the installation is completed.

A.1 System Requirements

- Supported OS – Microsoft® Windows® XP, Windows 7 (32 bit,64 bit)
- Recommended RAM memory - 4GB or higher
- Recommended CPU operating speed – 3.3 GHz or higher

A.2 Installation Procedure

The following procedure describes how to install the DRV10983/75 GUI. The installer also installs Python 2.7, USB2ANY SDK along with the GUI installation.

1. Double click on setup.exe from the Volume folder as shown in [Figure 10](#).

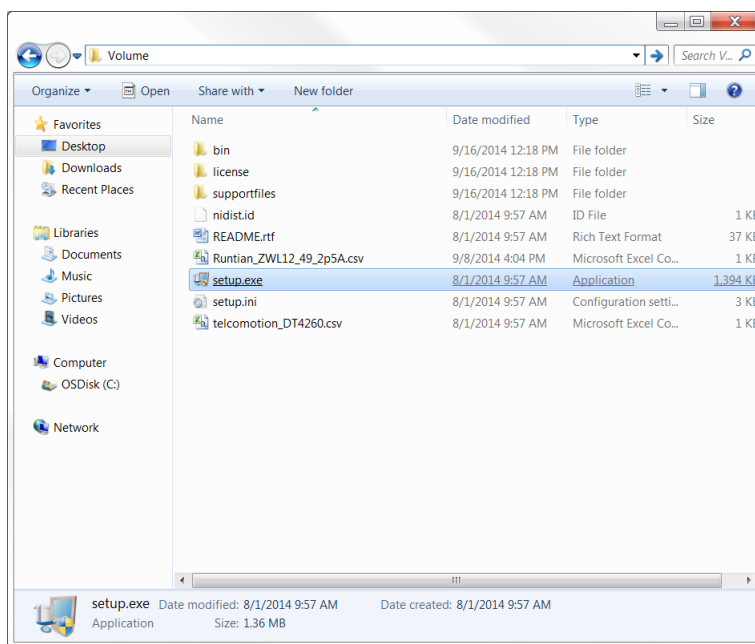


Figure 10. Setup.exe from the Volume Folder

2. A screen shown in [Figure 11](#) appears. Press the *Next >>* button.

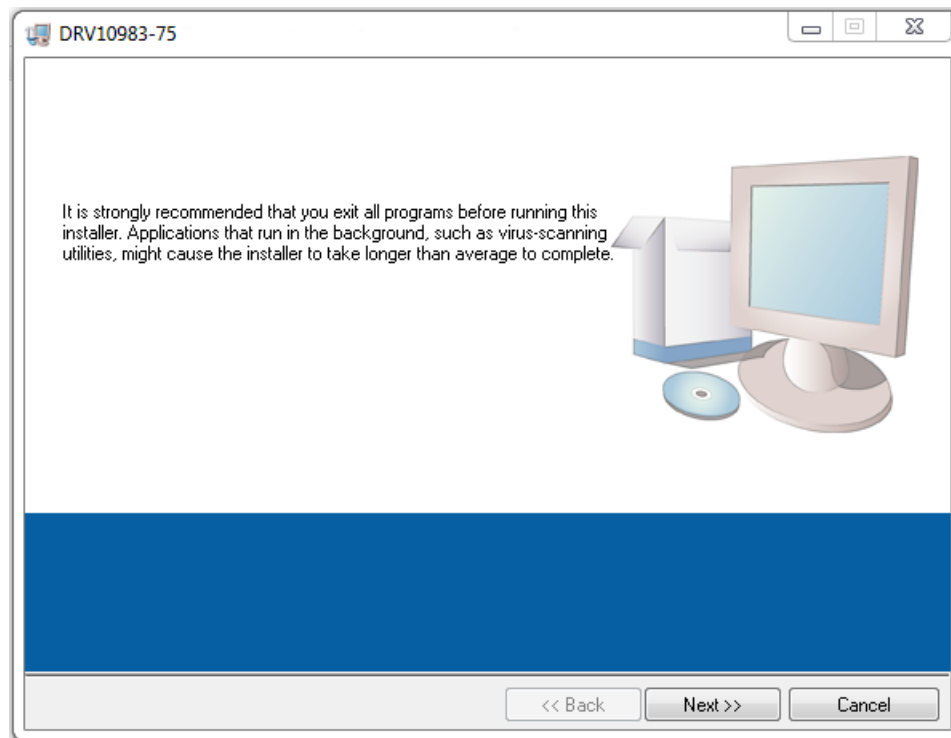


Figure 11. GUI Installation Initialization

3. Set the destination directories for the GUI installation and press the *Next >>* button as shown in [Figure 12](#). It is recommended to keep the default values as provided in the installer.

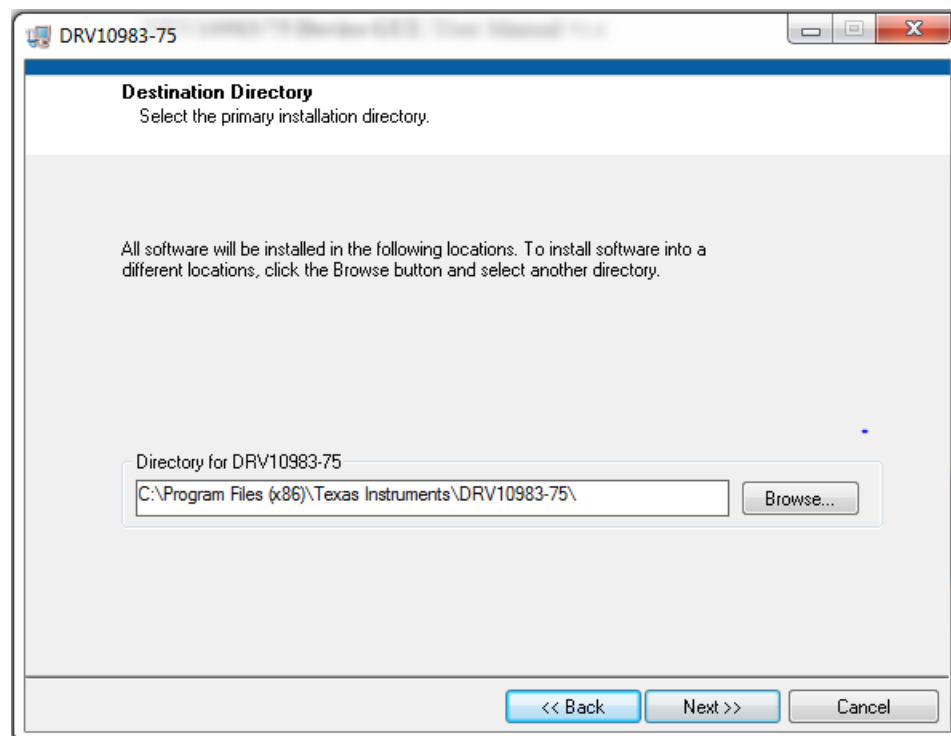


Figure 12. GUI Destination Directory

4. The *License Agreement* screen appears as shown in [Figure 13](#). Read through the agreement carefully and enable the “I Accept the License Agreement” radio button, then press the *Next>>* button.

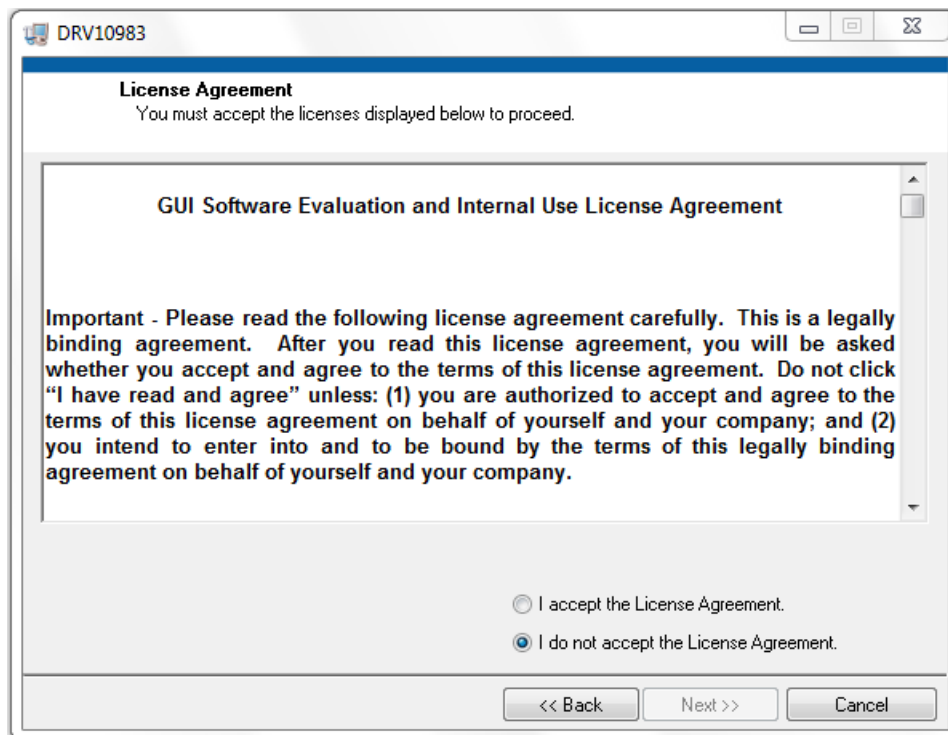


Figure 13. GUI License Agreement

5. The screen shown in [Figure 14](#) appears. Click *Next >>* to begin installation.

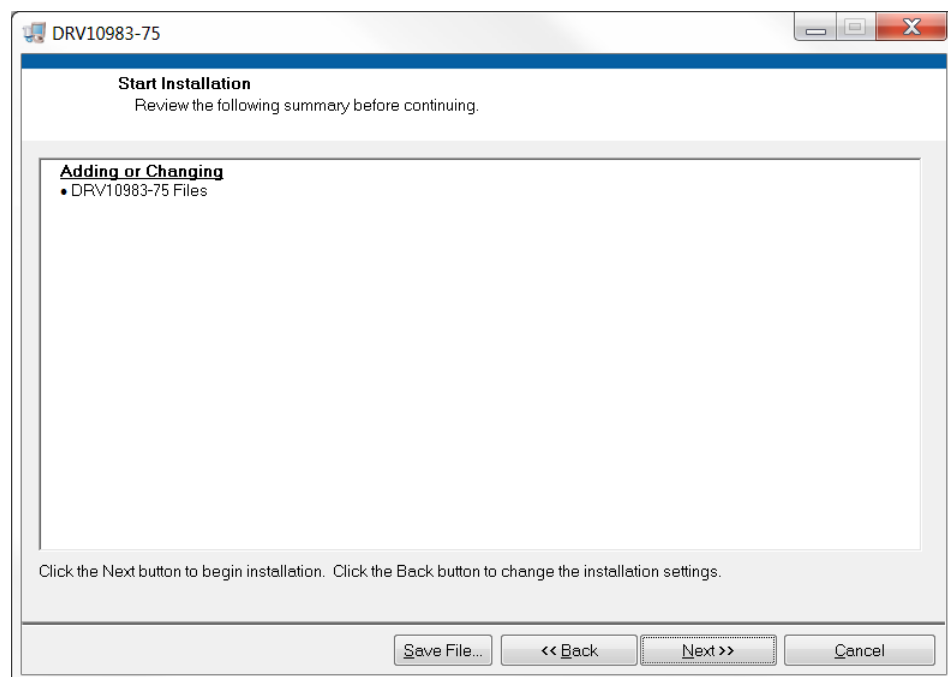


Figure 14. GUI Start Installation

6. The installer begins self-extraction and proceeds with the installation as shown in [Figure 15](#).

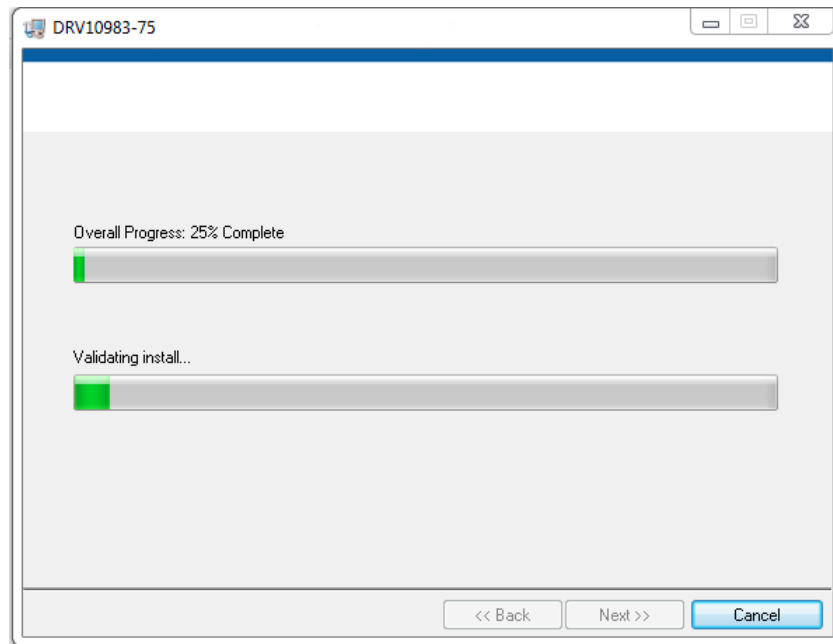


Figure 15. GUI Installation in Progress

7. The *Installation Complete* screen ([Figure 16](#)) appears, providing the link for LabVIEW Runtime Engine. This denotes the completion of DRV10983/75 GUI Installation.

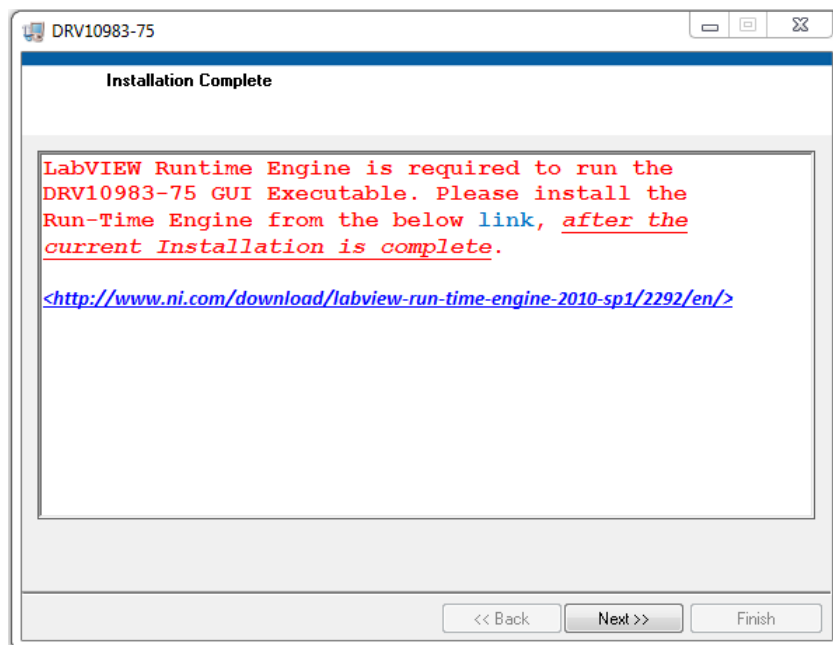


Figure 16. GUI Installation Complete

8. After the installation of the GUI, Python installation initiates. Once python is installed, a screen as shown in [Figure 17](#) appears. Click the **OK** button to proceed with USB2ANY installation.

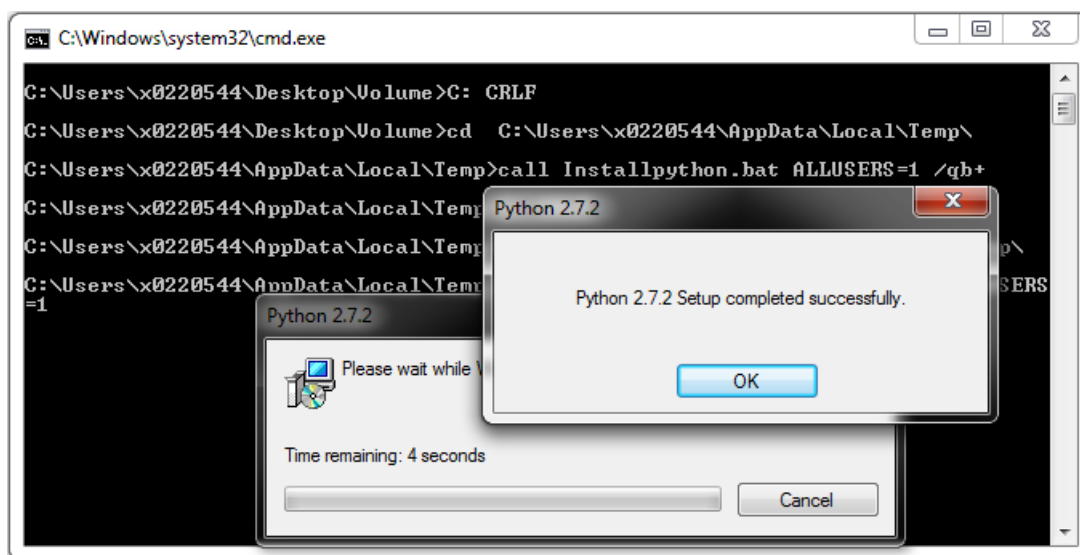


Figure 17. Python Installation Complete

9. A screen as shown in [Figure 18](#) appears, click the **Next >** button to proceed.

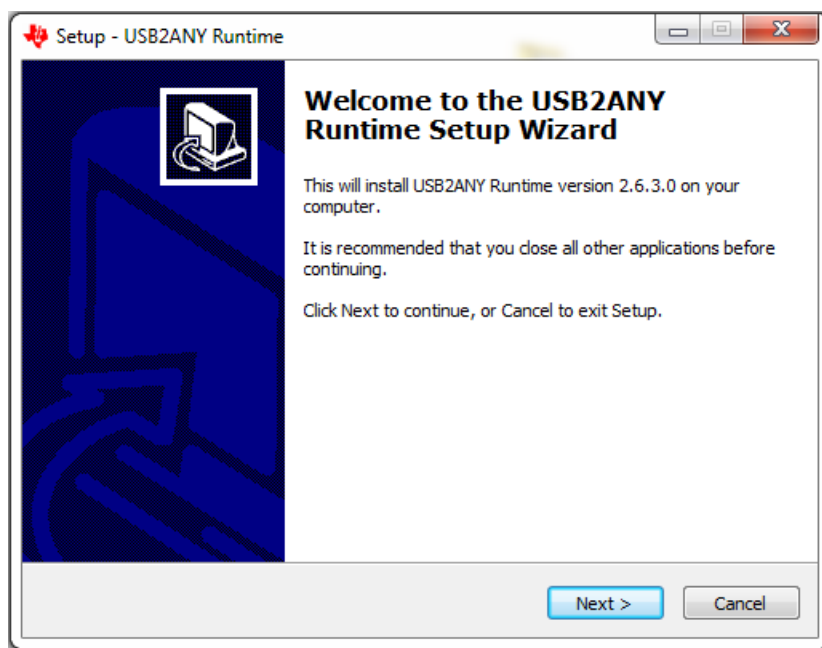


Figure 18. USB2ANY Installation Initialization

10. The *License Agreement* appears, as shown in [Figure 19](#). Read through the agreement carefully and enable the *I Accept the License Agreement* radio button, then press the *Next >* button.

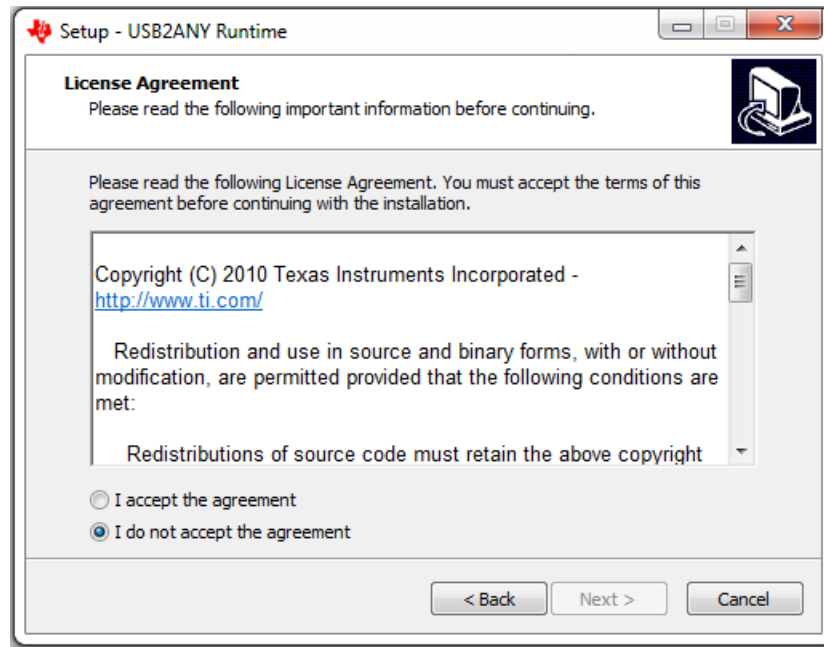


Figure 19. USB2ANY License Agreement

11. Set the destination directories for the USB2ANY installation and press the *Next >* button as shown in [Figure 20](#).

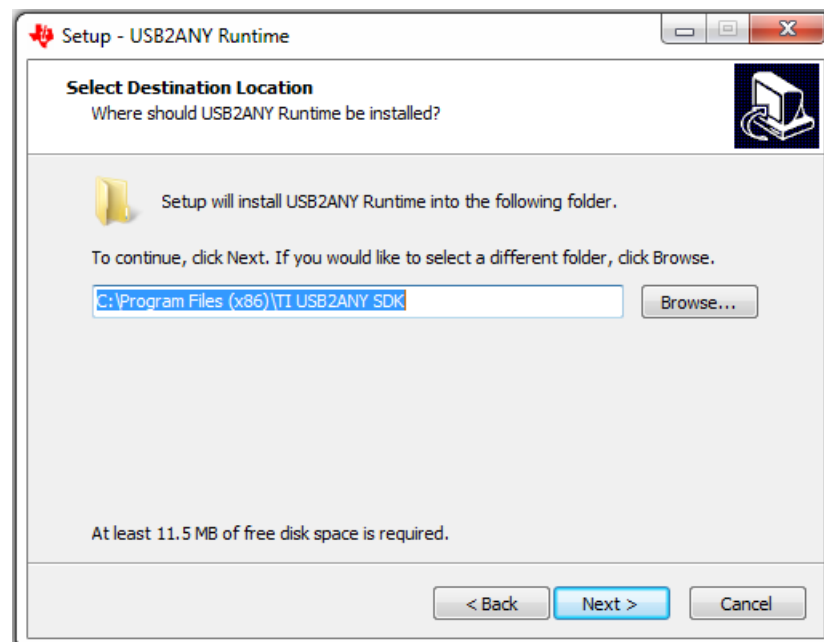


Figure 20. USB2ANY Destination Directory

12. The screen shown in [Figure 21](#) appears. Click the *Install* button to begin the USB2ANY installation.

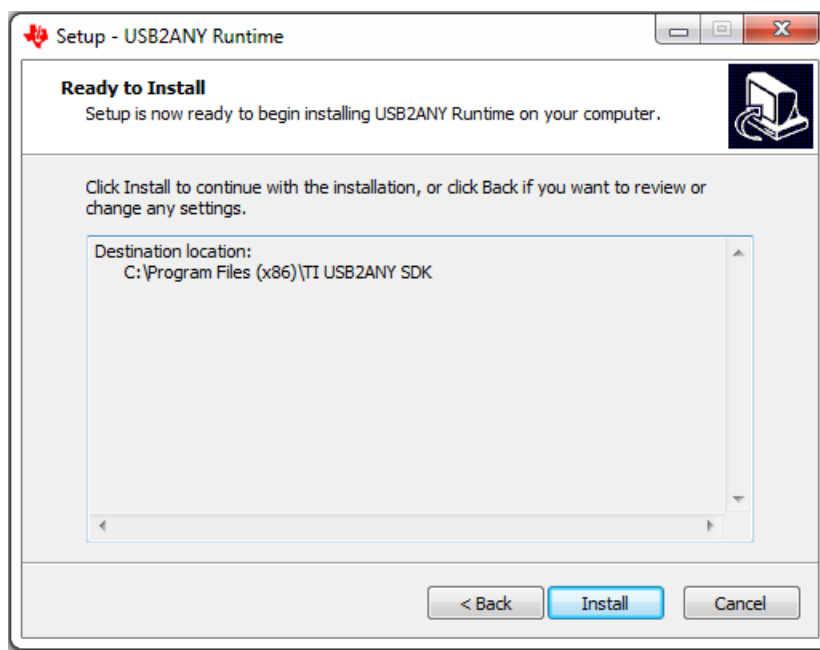


Figure 21. USB2ANY Start Installation

13. The installer begins self-extraction and proceeds with the installation as shown in [Figure 22](#).

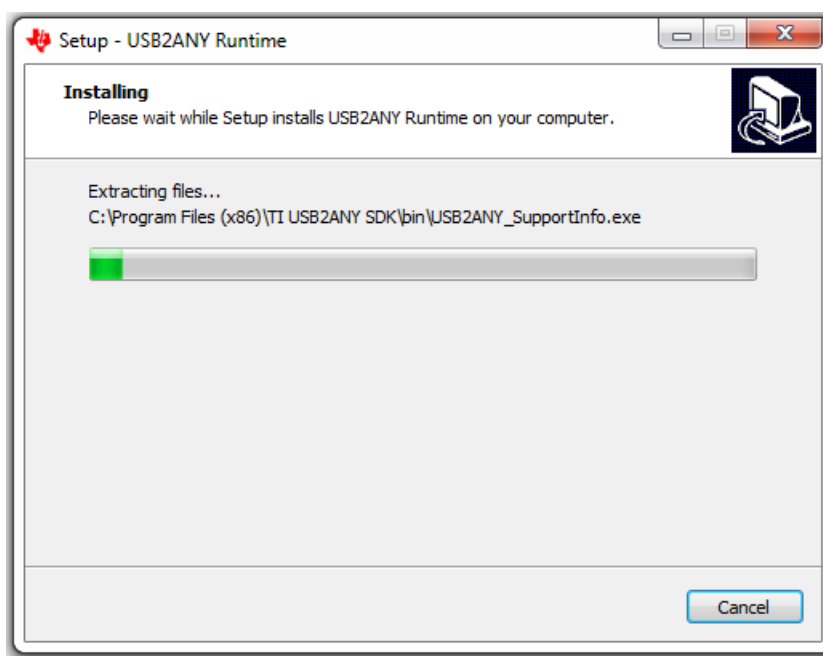


Figure 22. USB2ANY Installation Progress

14. The *USB2ANY Installation Complete* window (Figure 23) appears, indicating the completion of the USB2ANY installation. Click the *Finish* button.

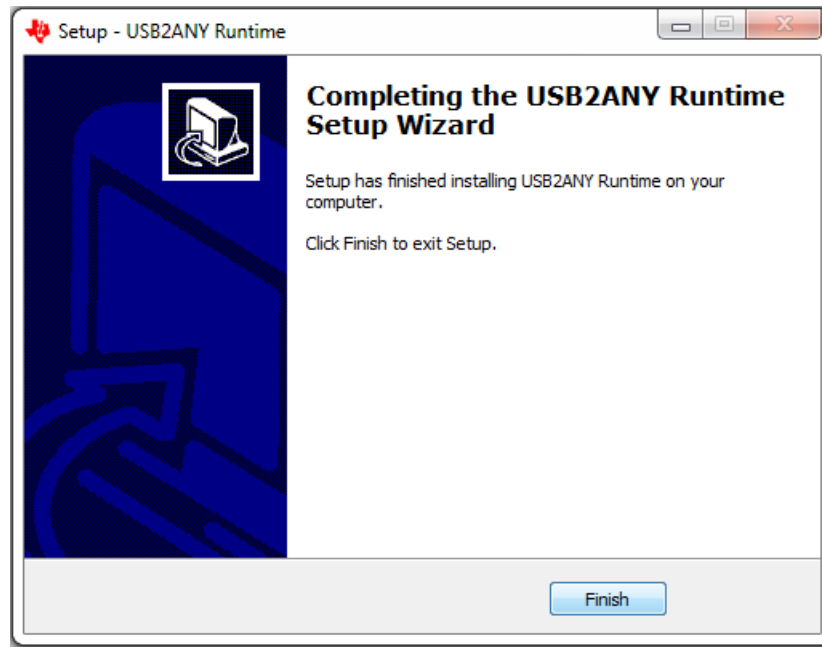


Figure 23. USB2ANY Installation Complete

NOTE: The DRV10983/75 GUI requires the LabVIEW Run-Time Engine 2010 to be installed before the GUI is executed.

The DRV10983 and DRV10975 GUI Installer does not include the LabVIEW Run-time-engine. Download the National Instruments LabVIEW Run-Time Engine 2010 from <http://www.ni.com/download/labview-run-time-engine-2010-sp1/2292/en/>.

The DRV10983 and DRV10975 GUI executable was built in the LabVIEW 2010 (32-Bit) version and expects the LabVIEW Run-Time Engine (32-Bit) version.

A.3 LabVIEW Run-Time-Engine Installation Procedure

The following procedure describes how to install the LabVIEW 2010 Run-Time-Engine.

1. Download the LabVIEW 2010 RTE from the link provided earlier.
2. Double click on the downloaded LVRTE2010std.exe file. The screen shown in [Figure 24](#) appears. Press the *Next >* button.

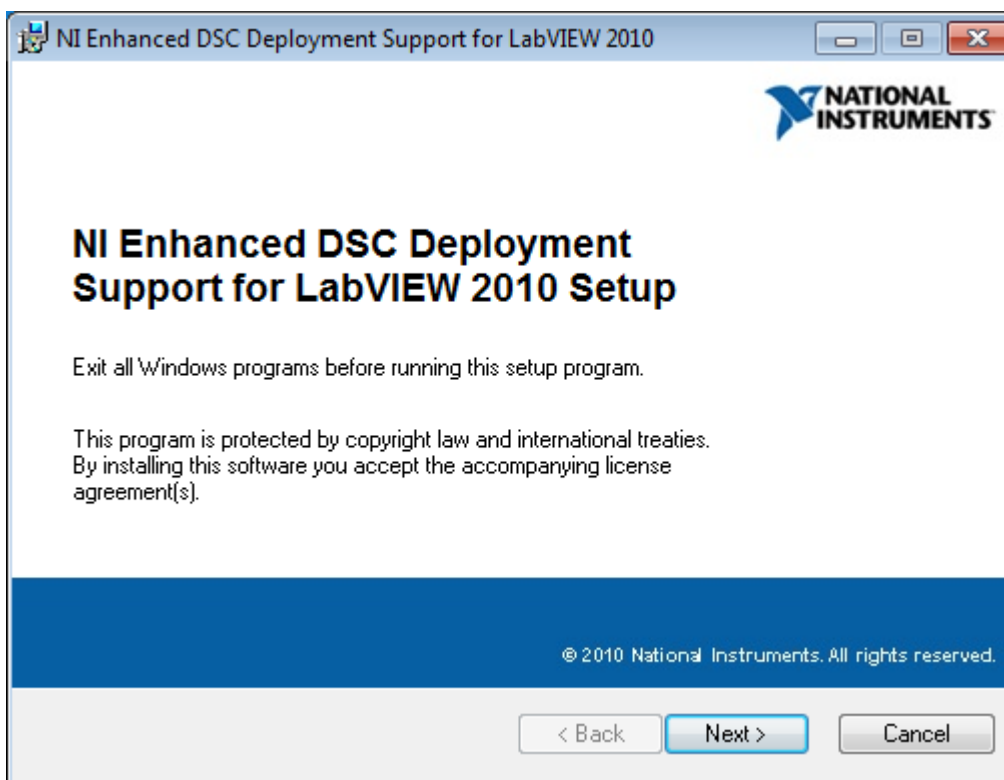


Figure 24. LabVIEW RTE Installation Initialization

3. A window as shown in [Figure 25](#) appears. Select the desired features in Run-Time Engine, then click the *Next >* button to continue. TI recommends keeping the default values as provided in the installer.

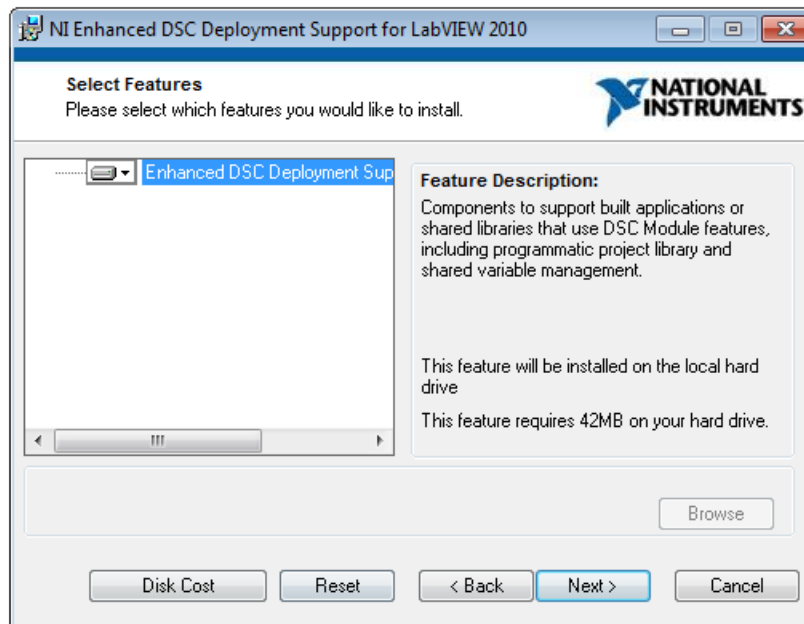


Figure 25. LabVIEW RTE Select Features

4. The License Agreement appears as shown in [Figure 26](#). Read through the agreement carefully and enable the "I Accept the License Agreement" radio button, then press the *Next >* button.

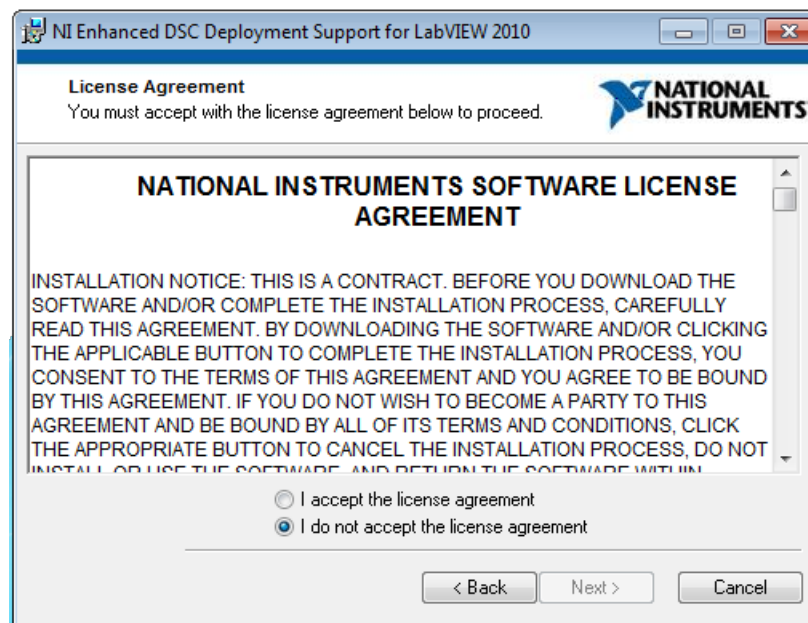


Figure 26. LabVIEW RTE License Agreement

5. The *LabVIEW RTE Start Installation* window (Figure 27) appears, click the *Next >* button to begin installation.

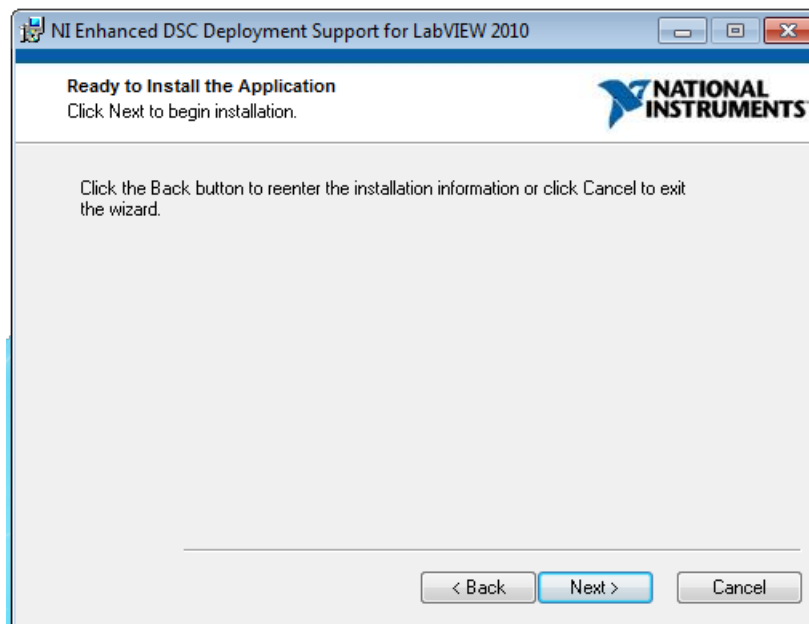


Figure 27. LabVIEW RTE Start Installation

6. The installer begins self-extraction and proceeds with the installation as shown in Figure 28.

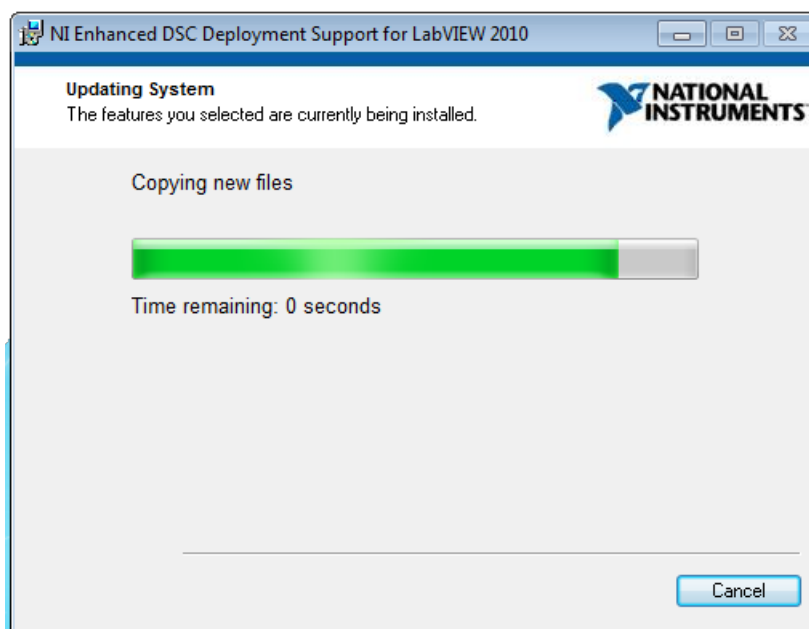


Figure 28. LabVIEW RTE Installation in Progress

7. The *LabVIEW RTE Installation Complete* window (Figure 29) appears, indicating the completion of the LabVIEW 2010 RTE installation. Click the *Finish* button.

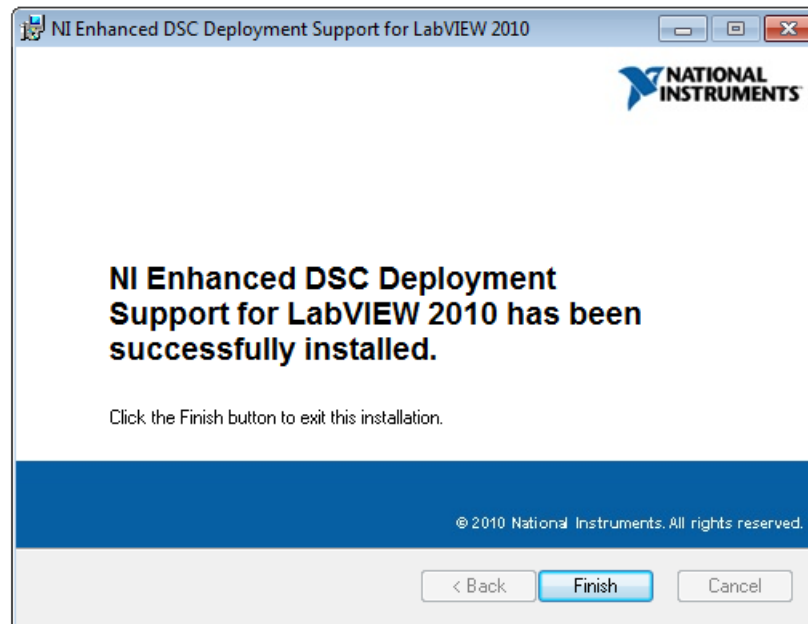


Figure 29. LabVIEW RTE Installation Complete

A.4 GUI Overview

The DRV10983 and DRV10975 GUI was developed to communicate with the part to configure different registers within the device, and to understand the response based on the configurations. The following sections describe some of the specific features of the GUI, but does not explain the configurations of the controls and indicators.

In following sections, DRV10983 GUI images are shown to explain the various features of GUI. The same images apply for DRV10975 devices unless otherwise specified.

A.4.1 Components of the GUI

The device GUI contains four pages:

- Basic Settings
- Advanced Settings
- Display
- About

A.4.1.1 Basic Settings

Figure 30 illustrates the *Basic Settings Page* of the GUI.

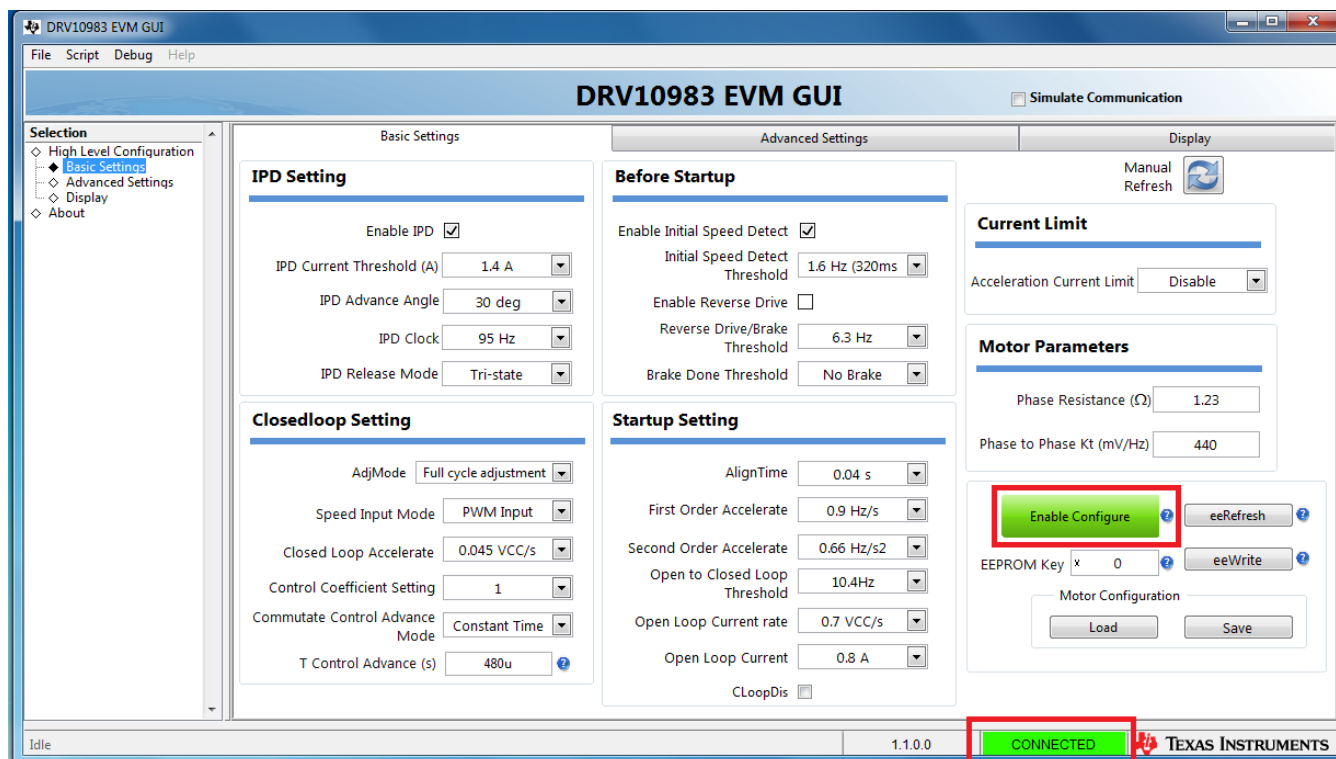


Figure 30. Basic Settings Page

A.4.1.1.1 Enable Configure

The controls in the Basic Settings page and Advanced Settings page are only enabled if Enable Configure is selected. Enable Configure specifies the data use between the registers and EEPROM. Click on the control to select the data use. If Enable configure is enabled (the control turns green in color), the register data is used, or else (the control turns red) the EEPROM data is used.

A.4.1.1.2 Enable IPD

This control enables and disables the controls related to IPD settings. If the control is disabled, a value 0 is written to the IPD current threshold. If the control is enabled, a value 1 is written to IPD current threshold field.

A.4.1.1.3 eeWrite

eeWrite programs to the EEPROM. When this control is clicked, a prompt message asks for confirmation of the voltage level (Figure 31). The eeWrite field is written only if the EEPROM Key is set to B6, and the the power supply voltage level is confirmed.

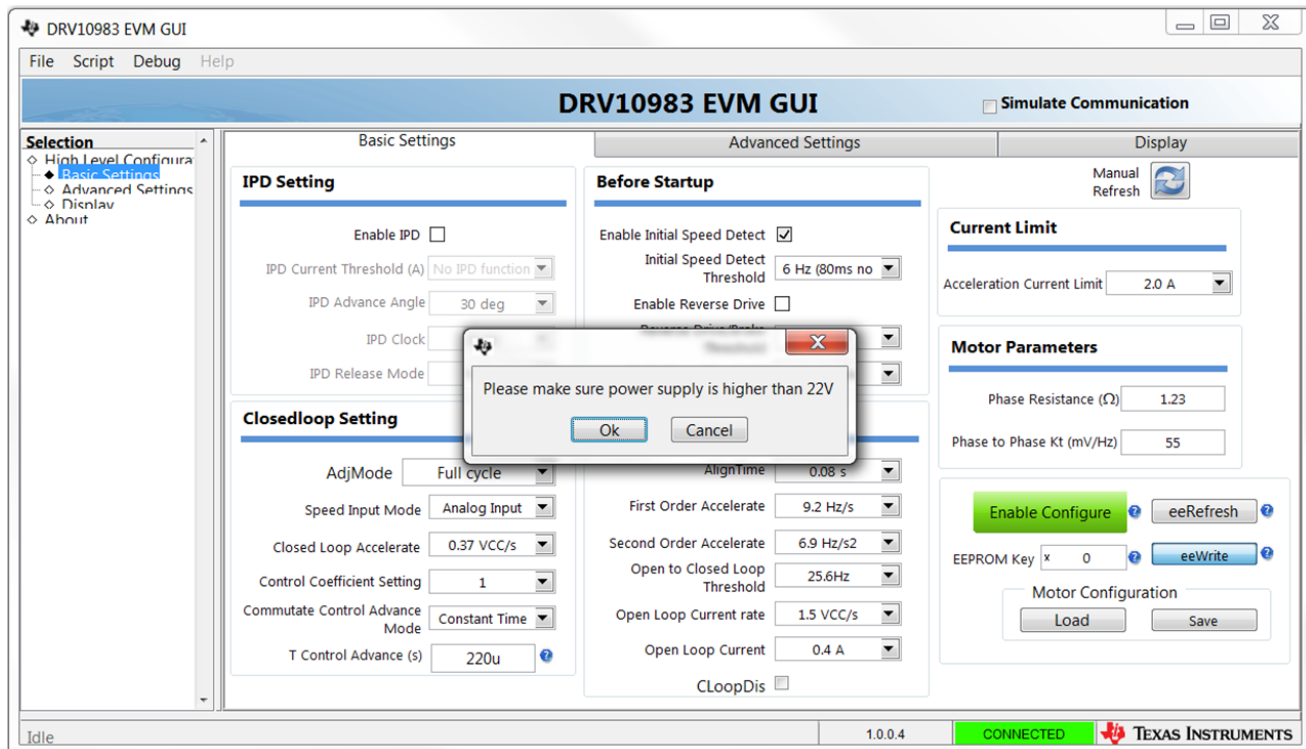


Figure 31. Confirmation on Voltage Level

A.4.1.1.4 eeRefresh

The eeRefresh Button refreshes the controls in the Basic Settings page, which reads the latest value of the corresponding fields from the registers and updates the controls.

A.4.1.1.5 Manual Refresh

The Manual Refresh Button refreshes the controls of the Motor Parameters, which reads the latest value of the corresponding fields from the registers and updates the controls. The function of this button is same in every section.

A.4.1.1.6 Save Motor Configuration

This button saves the current motor configuration into a file that is later loaded into the GUI using the Load option. The button saves the Last Read values for the registers. Perform a Manual Refresh operation before saving the configurations into a file.

A.4.1.1.7 Load Motor Configuration

This button loads the configuration file saved earlier, to bring the device to a known state.

A.4.1.1.8 Help Icon

Move the mouse over the help icon to display a brief description for the control, as shown in [Figure 32](#).

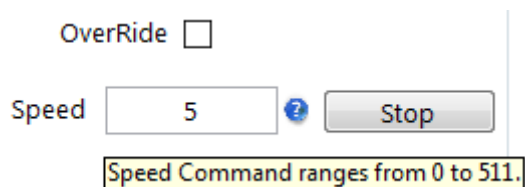


Figure 32. Help Icon

A.4.1.2 Advanced Settings

The Advanced Settings page contains controls to handle the frequency overflow, Buck regulator voltage, Hardware Current Limit, FG motor pole option, and so forth.

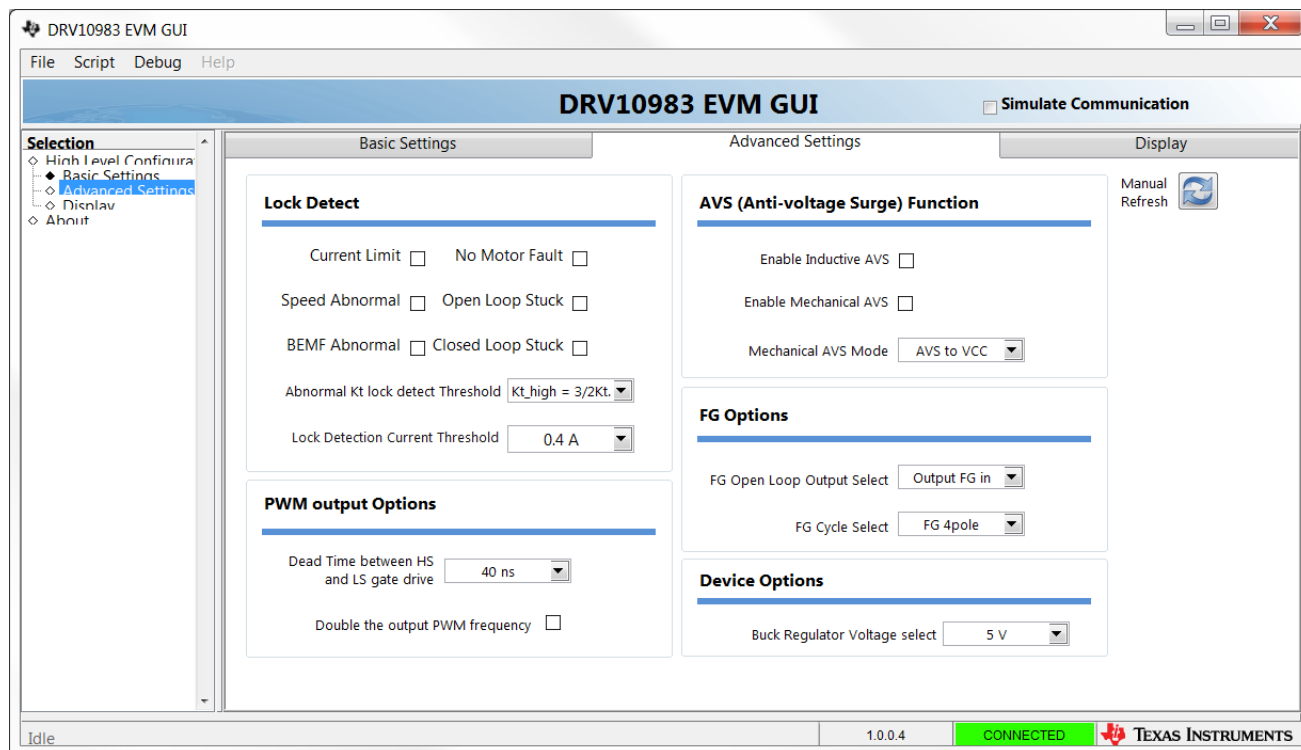


Figure 33. Advanced Settings

A.4.1.3 Display

The Display page (Figure 34) contains controls to handle the motor speed, indicates the status of the device, and displays the value of motor attributes such as motor speed, current, and IPD position.

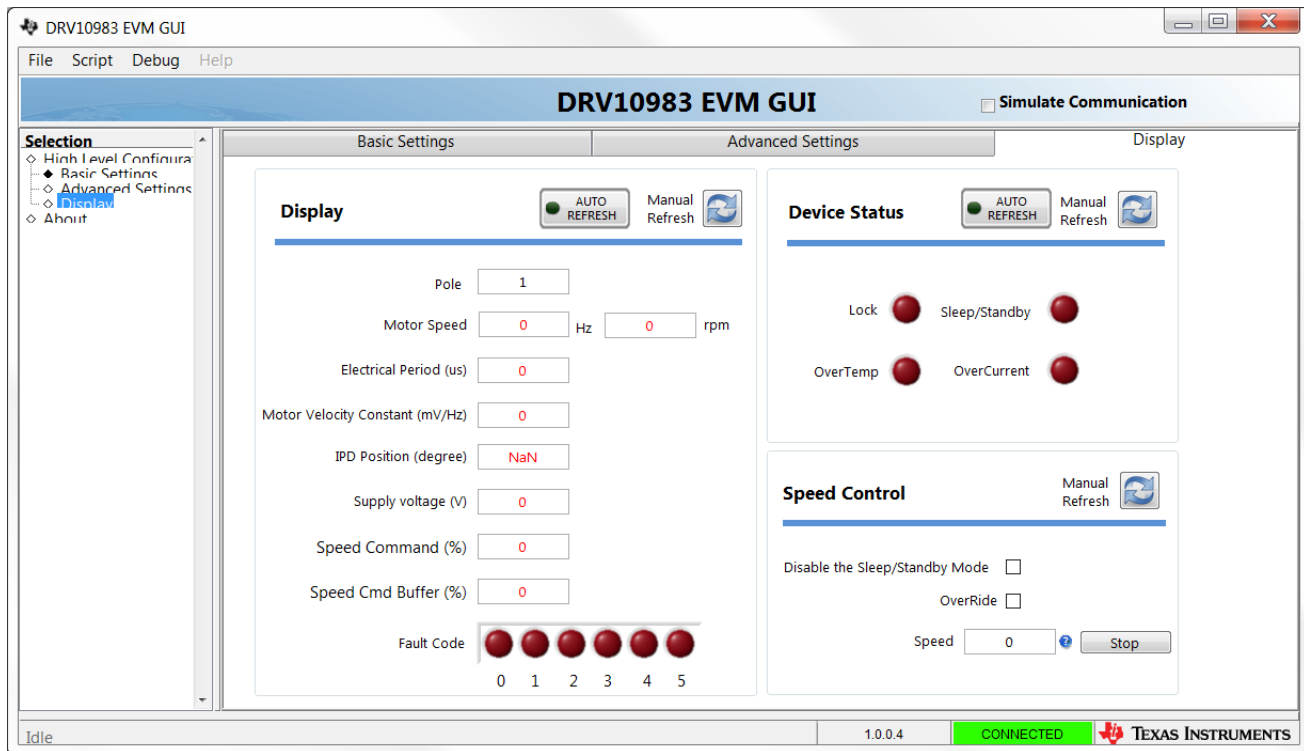


Figure 34. Display

A.4.1.3.1 Auto Refresh

The Auto Refresh Button periodically refreshes the controls of the motor parameters, which read the latest value of the corresponding fields from the registers and update the controls. The rate of auto refresh is specified in the configuration file found parallel to the application. The function of this button is same in every section.

A.4.1.3.2 Pole

This control calculates the RPM in the Display section, given by the formula:

- If motor speed (Hz) ≥ 2 , motor speed (rpm) = $(1000000/\text{electrical period(us)}) \times 120/\text{pole}$. Else, motor speed (rpm) = motor speed (Hz) $\times 120/\text{pole}$. The default value of this control is 1.

A.4.1.3.3 Stop

This control writes the speed control with a value of 0.

A.4.1.3.4 About

The About Page provides the details like the GUI version, supported OS, and the firmware version of the USB2ANY.

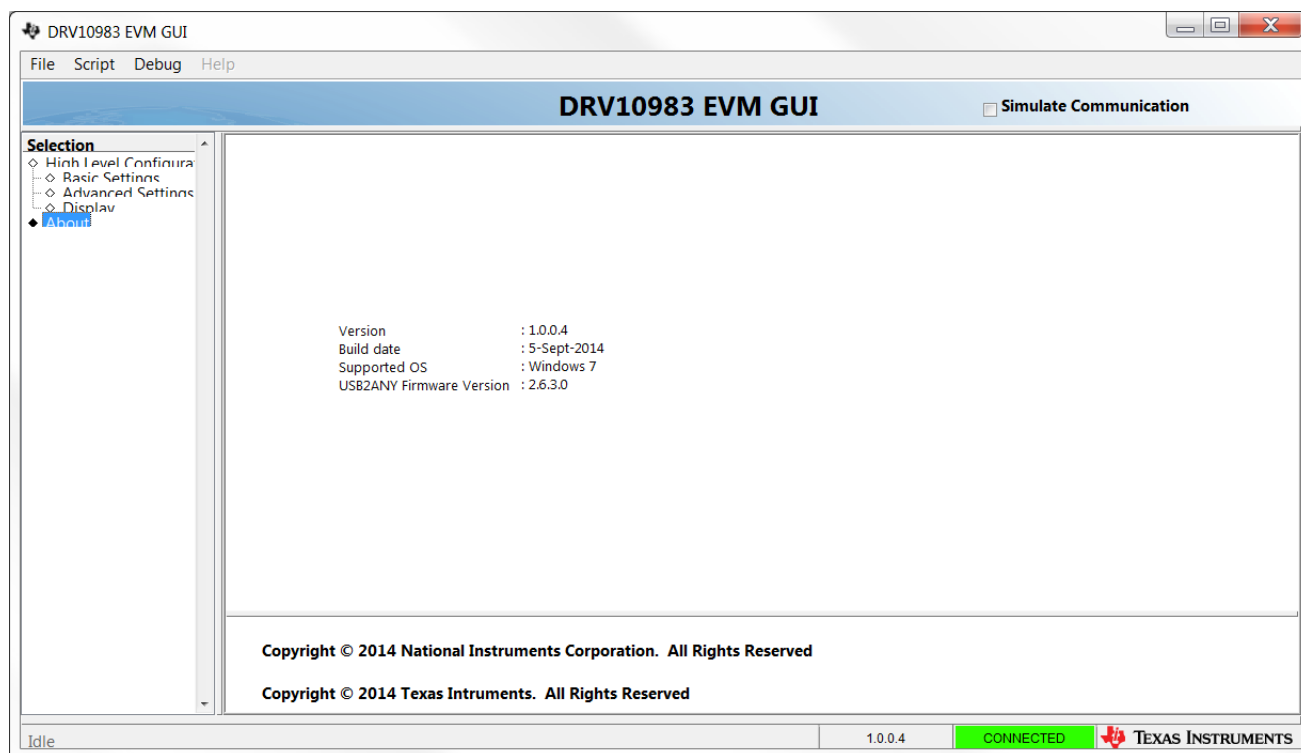


Figure 35. About Page

A.4.2 Menu Options

A.4.2.1 File

The File menu contains the Exit option as shown in [Figure 36](#). The Exit option stops the execution of the DRV10983 and DRV10975 GUI.

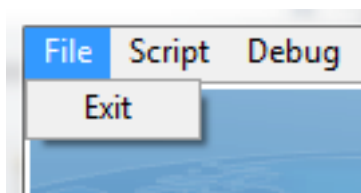


Figure 36. File Menu

A.4.2.2 Script

- Scripting automates the device operations and reduces the time consumption in repeating similar operations.
- Scripting is helpful in situations where performing a particular device function requires setting 10 to 15 registers on the device to a particular value. In these circumstances, scripts can be recorded and run whenever needed.
- In DRV10983 and DRV10975 GUI, the scripting is done using Python.

A.4.2.2.1 Recording and Running Scripts

1. Start recording by going to Scripts → Launch Window in the DRV10983 and DRV10975 GUI.

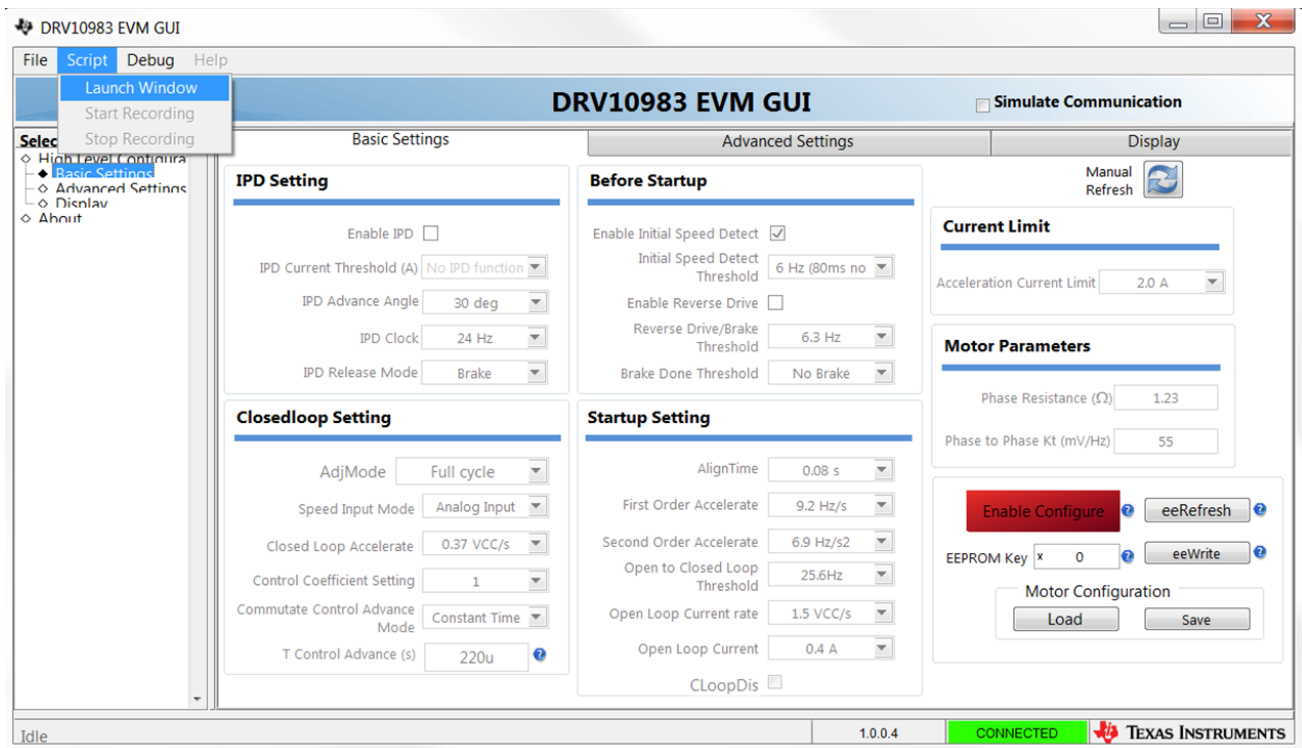


Figure 37. Script Menu

2. This opens an untitled, empty Python window in IDLE IDE.

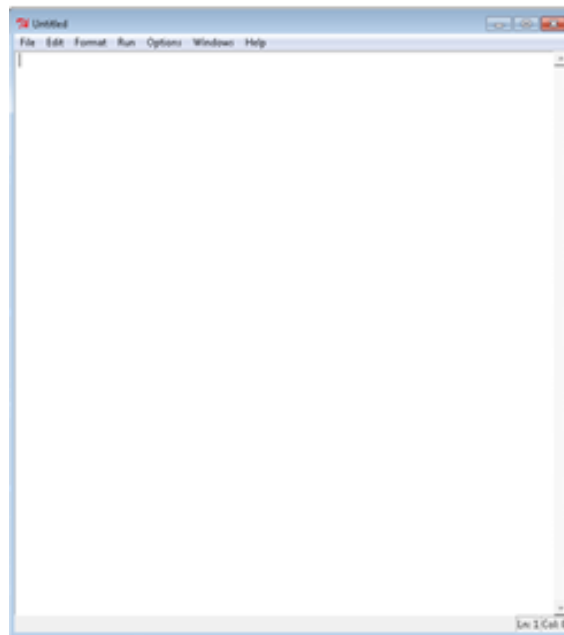


Figure 38. Launch Macro

- Once the python window launches, the Start Recording option is enabled in the same Script menu, in the GUI window. Selecting the Launch Window again opens another untitled window, and the last opened window is active.
- In the GUI window, traverse to the Scripts → Start Recording option in the menu.

All actions performed on the GUI are recorded in the Python window. The recording function is indicated by the window blinking in green, while the window is recording as shown in [Figure 39](#).

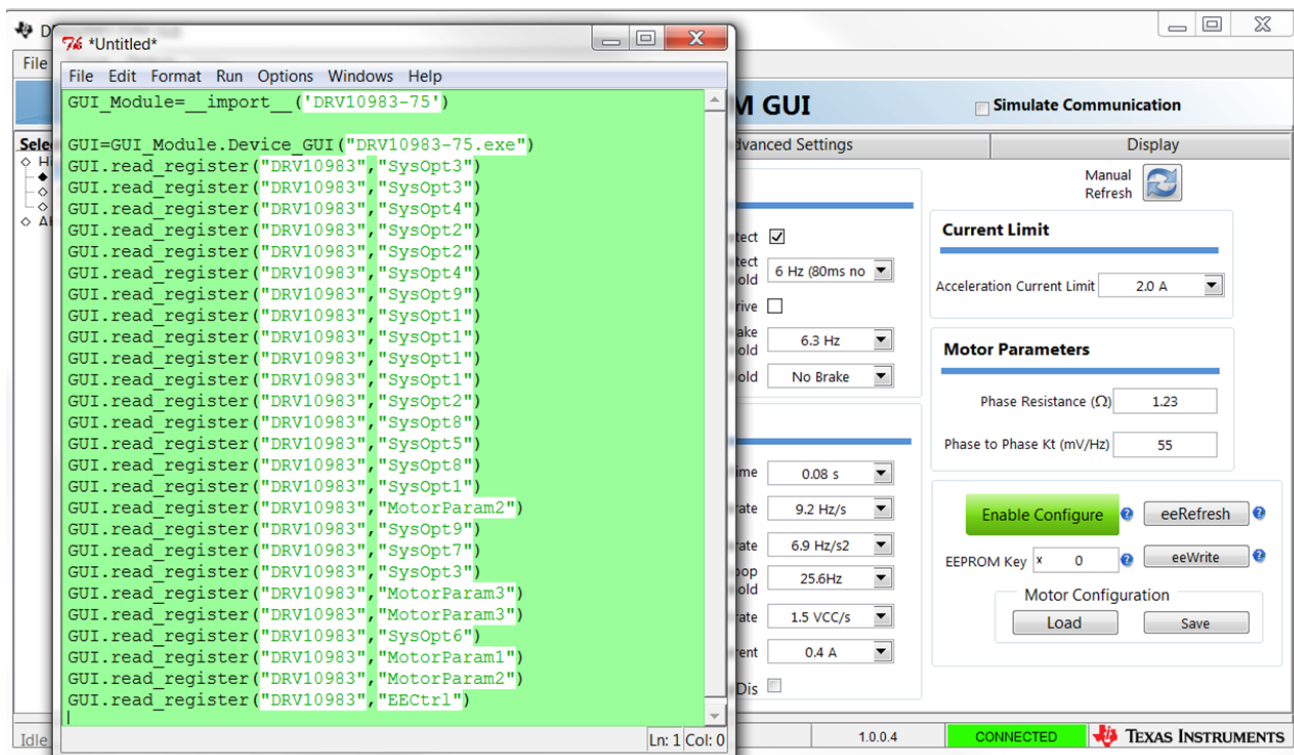


Figure 39. Start Recording

The Python window captures predefined actions only. While recording, no action such as moving the cursor or entering data has to be performed on the Python window.

- Stop Recording. To stop recording, traverse to the Scripts → Stop Recording option in the GUI window menu.

- The Launch Window remains after the recording has been stopped, as shown in Figure 40. It can be closed with or without saving.

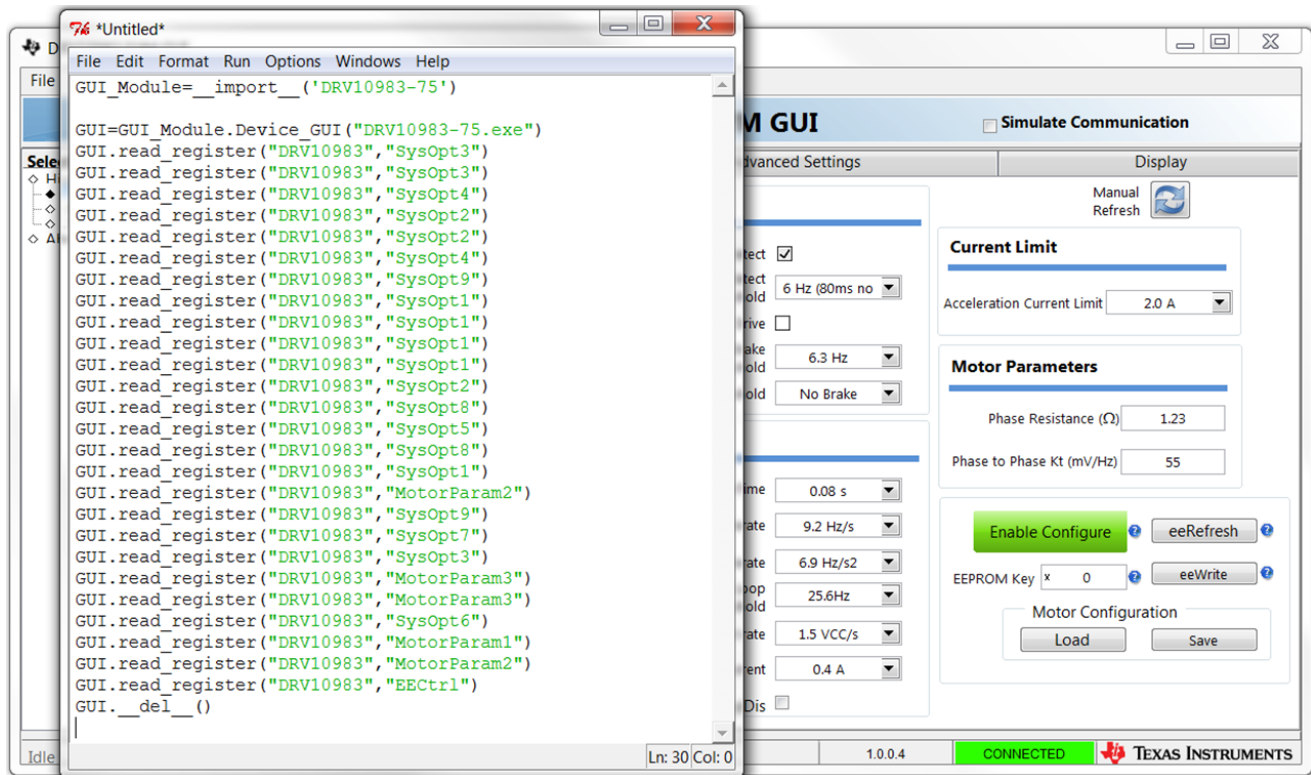


Figure 40. Stop Recording

- While saving, the window must be saved with extension .py under the script folder.

4. Run Script. To run the script, in the IDLE IDE menu bar, go to Run → Run Module as shown in Figure 41.

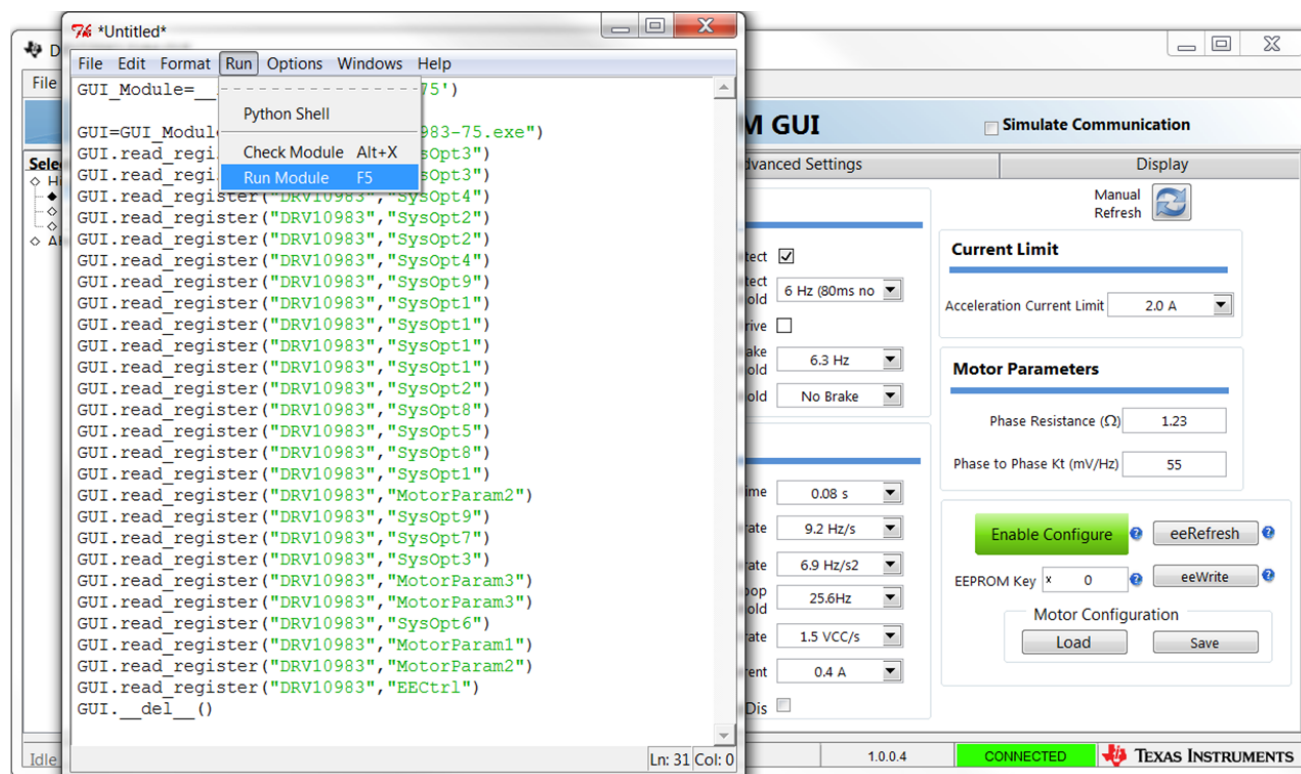


Figure 41. Run Macro

5. The script runs and displays the message "Script completed successfully" in the Python window.
6. To run an already saved script, go to File → Open in the IDLE IDE window, and choose the file from the browser.

A.4.2.2.2 Debug

The Debug option is used for the following operations:

- **Simulation** – By selecting the simulation submenu, the GUI runs in simulation mode. By unselecting it, the GUI runs in connected mode.
- **File Logging** – The log to file submenu logs the GUI activities to a specified log file.
- **Debugging** – The Debug log option logs all user activities. If not selected, only the high-level operations are logged.

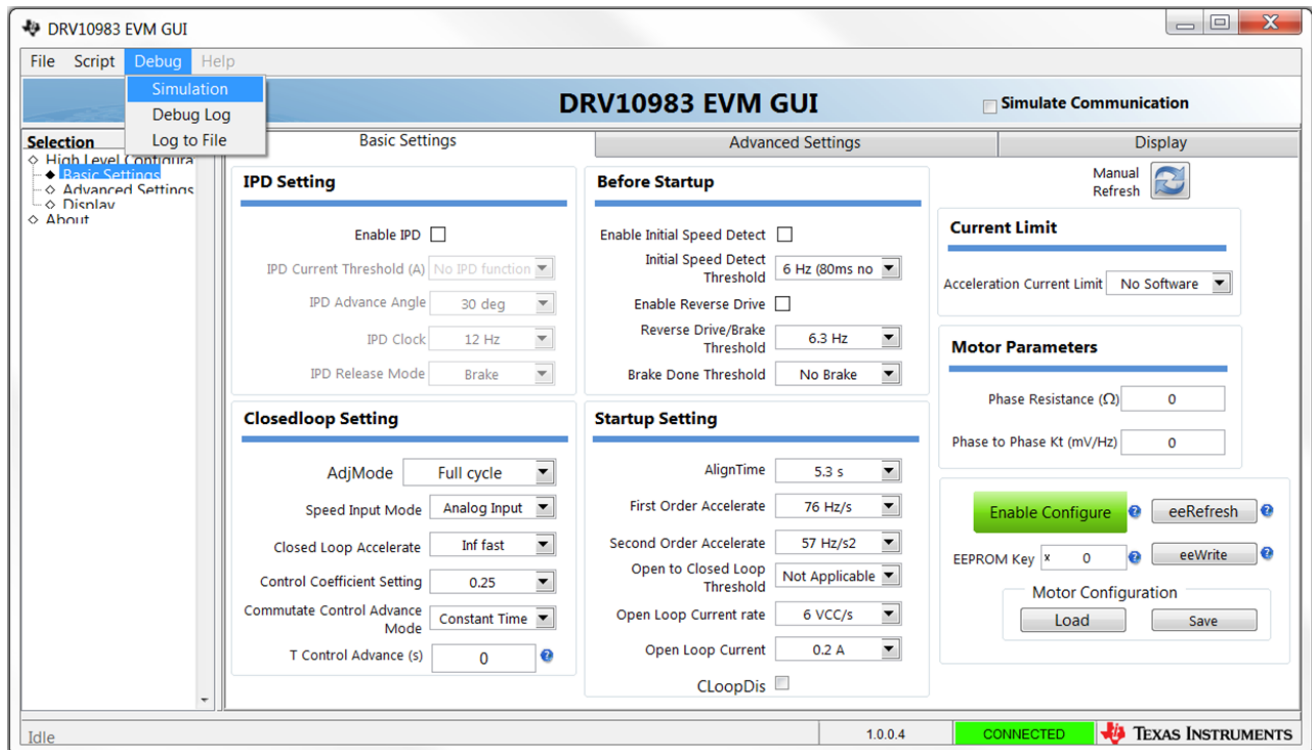


Figure 42. Debug Menu

GUI to DRV10983 and DRV10975 Register Cross Reference

The DRV10983 and DRV10975 register names and GUI names do not always match. [Table 2](#) provides a cross reference between the two. The Tab and Section location of the register values in the GUI is also provided.

Table 2. GUI to DRV10983 and DRV10975 Register Cross Reference

Registers			GUI		
Register Name	Addr	Register Map	Tab	Section	GUI Name
SpeedCtrl1	0x00	SpdCtrl[7:0]	Display	Speed control	Speed
SpeedCtrl2	0x01	OverRide	Display	Speed control	OverRide
		SpdCtrl[8]	Display	Speed control	Speed
DevCtrl	0x02	enProgKey[7:0]	Basic	Motor parameters	EEPROM KEY
EECtrl	0x03	sleepDis	Display	Speed control	Disable Sleep/Standby mode
		Slidata	Basic	Motor parameters	Enable Configure
		eeRefresh	Basic	Motor parameters	eeRefresh
		eeWrite	Basic	Motor parameters	eeWrite
Status	0x10	OverTemp	Display	Device status	OverTemp
		Slp_Stdbby	Display	Device status	Sleep/Standby
		OverCurr	Display	Device status	Overcurrent
		MtrLck	Display	Device status	Lock
MotorSpeed1	0x11	MotorSpeed[15:8]	Display	Display	Motor speed (rpm)
MotorSpeed2	0x12	MotorSpeed[7:0]	Display	Display	Motor speed (rpm)
MotorPeriod1	0x13	MotorPeriod[15:8]	Display	Display	Electrical period (μs)
MotorPeriod2	0x14	MotorPeriod[7:0]	Display	Display	Electrical period (μs)
MotorKt1	0x15	MotorKt[15:8]	Display	Display	Motor velocity constant (mV/Hz)
MotorKt2	0x16	MotorKt[7:0]	Display	Display	Motor velocity constant (mV/Hz)
IPDPosition	0x19	IPDPosition[7:0]	Display	Display	IPD position (degree)
SupplyVoltage	0x1A	SupplyVoltage [7:0]	Display	Display	Supply voltage (V)
SpeedCmd	0x1B	SpeedCmd [7:0]	Display	Display	Speed command (%)
spdCmdBuffer	0x1C	spdCmdBuffer[7:0]	Display	Display	Speed cmd buffer (%)
FaultCode	0x1E	Lock5	Display	Display	Fault code 5
		Lock4	Display	Display	Fault code 4
		Fault3	Display	Display	Fault code 3
		Lock2	Display	Display	Fault code 2
		Lock1	Display	Display	Fault code 1
		Lock0	Display	Display	Fault code 0
MotorParam1	0x20	DoubleFreq	Advanced	PWM output options	Double the output PWM frequency
		Rm[6:0]	Basic	Motor parameters	Phase resistance (Ohms)
MotorParam2	0x21	AdjMode	Basic	Closedloop setting	AdjMode
		Kt[6:0]	Basic	Motor parameters	Phase to phase Kt (mV/Hz)
MotorParam3	0x22	CtrlAdvMd	Basic	Closedloop setting	Commutate control advance mode
		TCtrlAdv[6:0]	Basic	Closedloop setting	T control advance (s)
SysOpt1	0x23	ISDThr[1:0]	Basic	Before startup	Initial speed detect threshold

Table 2. GUI to DRV10983 and DRV10975 Register Cross Reference (continued)

Registers			GUI		
Register Name	Addr	Register Map	Tab	Section	GUI Name
		IPDAdvAg[1:0]	Basic	IPD setting	IPD advance angle
		ISDen	Basic	Before startup	Enable initial speed detect
		RvsDrEn	Basic	Before startup	Enable reverse drive
		RvsDrThr[1:0]	Basic	Before startup	Reverse drive/brake threshold
SysOpt2	0x24	OpenLCurr[1:0]	Basic	Startup setting	Open loop current
		OpLCurrRt[2:0]	Basic	Startup setting	Open loop current rate
		BrkDoneThr[2:0]	Basic	Before startup	Brake done threshold
SysOpt3	0x25	CtrlCoeff[1:0]	Basic	Closedloop setting	Control coefficient setting
		StAccel2[2:0]	Basic	Startup setting	Second order accelerate
		StAccel[2:0]	Basic	Startup setting	First order accelerate
SysOpt4	0x26	Op2ClsThr[4:0]	Basic	Startup setting	Open to closed loop threshold
		AlignTime[2:0]	Basic	Startup setting	Align time
SysOpt5	0x27	LockEn[3]	Advanced	Lock detect	No motor fault
		LockEn[2]	Advanced	Lock detect	BEMF abnormal
		LockEn[1]	Advanced	Lock detect	Speed abnormal
		LockEn[0]	Advanced	Lock detect	Current limit
		AVSIndEn	Advanced	AVS (Anti-voltage surge) function	Enable inductive AVS
		AVSMEn	Advanced	AVS (Anti-voltage surge) function	Enable mechanical AVS
		AVSMMd	Advanced	AVS (Anti-voltage surge) function	Mechanical AVS mode
		IPDRIsMd	Basic	IPD setting	IPD release mode
SysOpt6	0x28	SWiLimitThr[3:0]	Basic	Current limit	Acceleration Current Limit
		HWiLimitThr[2:0]	Advanced	Current limit	Lock Detection Current Threshold
SysOpt7	0x29	LockEn5	Advanced	Lock detect	Closed loop stuck
		ClslpAccel[2:0]	Basic	Closedloop setting	Closed loop accelerate
		Deadtime[3:0]	Advanced	PWM output options	Dead time between HS and LS gate drive
SysOpt8	0x2A	IPDCurrThr[3:0]	Basic	IPD setting	IPD current threshold
		LockEn4	Advanced	Lock detect	Open loop stuck
		VregSel	Advanced	Device options	Buck regulator voltage select
		IPDClk[1:0]	Basic	IPD setting	IPD clock
SysOpt9	0x2B	FGOLSet[1:0]	Advance	FG options	FG open loop output select
		FGcycle[1:0]	Advance	FG options	FG cycle select
		KtLckThr[1:0]	Advance	Lock detect	Abnormal Kt lock detect threshold
		SpdCtrlMd	Basic	Closedloop setting	Speed input mode
		CLoopDis	Basic	Startup setting	CLoopDis

Revision A History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (July 2014) to A Revision	Page
• Changed TelcoMotion DT4260-24-055--4H-TI to Runtian ZWL12_22_2.5A in the <i>DRV10983 EVM Kit Contents</i> list	3
• Added EVM motor images.	14
• Changed TelcoMotion DT4260-24-055--4H-TI to Runtian ZWL12_22_2.5A in the <i>DRV10983 Bill of Materials</i> list.....	16
• Changed <i>Setup.exe</i> from <i>Volume Folder</i> image in the <i>Installation Procedure</i> section.	17
• Changed <i>GUI Start Installation</i> image in the <i>Installation Procedure</i> section.	19
• Changed GUI content in <i>SysOpt6</i> row of the <i>GUI to DRV10983 Register Cross Reference</i> table.	40

Revision B History

Changes from A Revision (October 2014) to B Revision	Page
• Added DRV10975 throughout the guide, Changed all mentions of DRV10983 EVM to DRV109xx family	1
• Added <i>Initial GUI Screen</i> image	11
• Added <i>GUI in Simulation Mode</i> image	12
• Added <i>Disable Sleep Mode</i> image	14
• Added <i>Power-on Sequence and Connection With User-Specific Motor</i> section	14
• Changed U1 PartNumber.....	16

Revision C History

Changes from B Revision (January 2015) to C Revision	Page
• Changed all DRV109xx uses to DRV10983 and DRV10975.....	1
• Changed power supply rail voltage from "8 to 26 V" to "8 to 28 V"	4
• Changed first image under Section 4.2.3	7
• Deleted first five steps from previous revision, Added first five steps from Section 6 in previous revision	10
• Changed voltage limit for DRV10983 EVMs from 26 V to 28 V	10
• Changed Step 9	14
• Deleted Steps 6 and 7 and Figure 13 from previous revision	14
• Deleted "Trimmed" register map from "Status" row	39

Revision D History

Changes from C Revision (January 2015) to D Revision	Page
• Deleted BLDC motor as being part of the kit contents, and from remaining sections of the user's guide.....	3

Revision E History

Changes from D Revision (October 2017) to E Revision	Page
• Changed <i>Out-of-the-Box Quick Start Guide</i> section text	10
• Deleted <i>motor</i> designator row from <i>DRV10983 and DRV10975 Bill of Materials</i> table	16

STANDARD TERMS FOR EVALUATION MODULES

1. **Delivery:** TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
 - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductor products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
 - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. **Limited Warranty and Related Remedies/Disclaimers:**
 - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
 - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
 - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.
3. **Regulatory Notices:**
 - 3.1 **United States**
 - 3.1.1 **Notice applicable to EVMs not FCC-Approved:**

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.
 - 3.1.2 **For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:**

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿 6 丁目 2 4 番 1 号
西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page
電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。 http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

IMPORTANT NOTICE FOR TI DESIGN INFORMATION AND RESOURCES

Texas Instruments Incorporated ("TI") technical, application or other design advice, services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using any particular TI Resource in any way, you (individually or, if you are acting on behalf of a company, your company) agree to use it solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources.

You understand and agree that you remain responsible for using your independent analysis, evaluation and judgment in designing your applications and that you have full and exclusive responsibility to assure the safety of your applications and compliance of your applications (and of all TI products used in or for your applications) with all applicable regulations, laws and other applicable requirements. You represent that, with respect to your applications, you have all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. You agree that prior to using or distributing any applications that include TI products, you will thoroughly test such applications and the functionality of such TI products as used in such applications. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

You are authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING TI RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY YOU AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

You agree to fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of your non-compliance with the terms and provisions of this Notice.

This Notice applies to TI Resources. Additional terms apply to the use and purchase of certain types of materials, TI products and services. These include; without limitation, TI's standard terms for semiconductor products (<http://www.ti.com/sc/docs/stdterms.htm>), [evaluation modules](#), and [samples](http://www.ti.com/sc/docs/sampterm.htm) (<http://www.ti.com/sc/docs/sampterm.htm>).

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2018, Texas Instruments Incorporated