



## ABSTRACT

This user's guide describes the operation of the TI's Haptic Control Console software. Haptic Control Console (HCC) is an evaluation and development suite for TI Haptic Drivers. HCC supports the evaluation of TI haptic drivers and third-party haptic actuators for developing advanced tactile feedback.

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## 1 Trademarks

Immersion® and TouchSense® are registered trademarks of Immersion Corporation.

All trademarks are the property of their respective owners.

## 2 Description

Haptic Control Console (HCC) is an evaluation and development suite for TI Haptic Drivers. HCC supports the evaluation of TI haptic drivers and 3rd party haptic actuators for developing advanced tactile feedback.

Users can connect TI Haptic Driver evaluation modules (EVM) to HCC through USB to set up, control, and evaluate the entire device. HCC includes custom device control consoles, detailed register maps, and basic RAM management (for applicable devices). See board compatibility in [Table 5-1](#).

## 3 Features

HCC:

- Supports evaluation of haptic actuators, including eccentric rotation mass motors (ERM), linear resonance actuators (LRA), piezos, and solenoids.
- Includes device management features including custom device control consoles, complete register map access, and RAM management.
- Is compatible with TI evaluation modules in [Table 5-1](#).
- Includes firmware update utility for compatible EVMs. An adapter board may be required.

## 4 Related Products

- [DRV2510-Q1 – DRV2510Q1EVM](#)
- [DRV2511-Q1 – DRV2511Q1EVM](#)
- [DRV2604 – DRV2604EVM-CT](#)
- [DRV2605 – DRV2605EVM-CT](#)
- [DRV2604L – DRV2604LEVM-CT, DRV2604LDGSEVM-M](#)
- [DRV2605L – DRV2605LEVM-CT, DRV2605LDGSEVM-M, DRV2605LEVM-MD](#)
- [DRV2624 – DRV2624EVM-CT, DRV2624EVM-MINI](#)
- [DRV2625 – DRV2625EVM-CT, DRV2625EVM-MINI](#)
- [DRV2667 – DRV2667EVM-CT](#)

## 5 Supported Evaluation Modules and Required Hardware

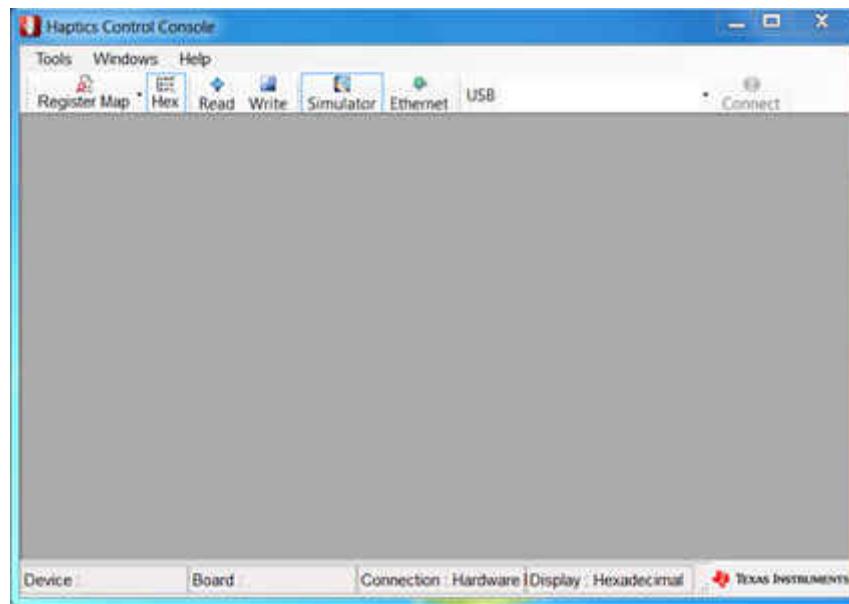
**Table 5-1. HCC-Compatible Boards and Required Hardware**

EVM	Additional Hardware
DRV2510Q1EVM	None
DRV2511Q1EVM	None
DRV2604EVM-CT	USB2ANY
DRV2605EVM-CT	USB2ANY
DRV2604LEVM-CT	USB2ANY
DRV2605LEVM-CT	USB2ANY
DRV2604LDGSEVM-M	USB2ANY
DRV2605LDGSEVM-M	USB2ANY
DRV2605LEVM-MD	None
DRV2624EVM-CT	None
DRV2624EVM-MINI	USB2ANY
DRV2625EVM-CT	None
DRV2625EVM-MINI	USB2ANY
DRV2667EVM-CT	USB2ANY

## 6 Getting Started: General Overview

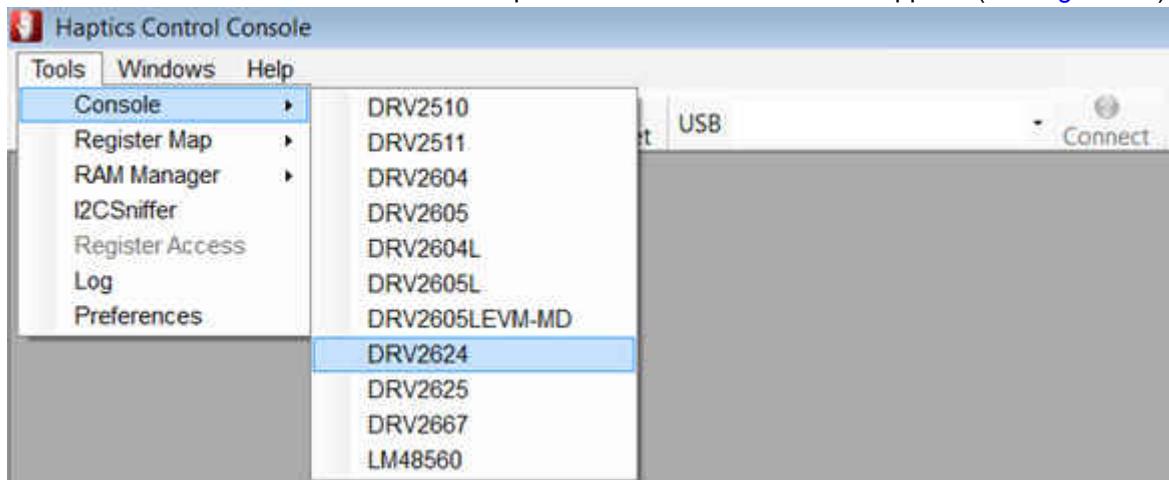
HCC GUI can be downloaded from [Haptics Control Console Software](#).

After the user downloads the HCC GUI and goes through the setup wizard, the program will open a new window (see [Figure 6-1](#)).



**Figure 6-1. Empty Haptics Control Console**

1. Select Tools → Console to see a list of the haptic drivers that the HCC GUI supports (see [Figure 6-2](#)).



**Figure 6-2. Supported Haptic Drivers**

2. Plug in the board (in this example, the DRV2624EVM-CT) through the micro USB connector.

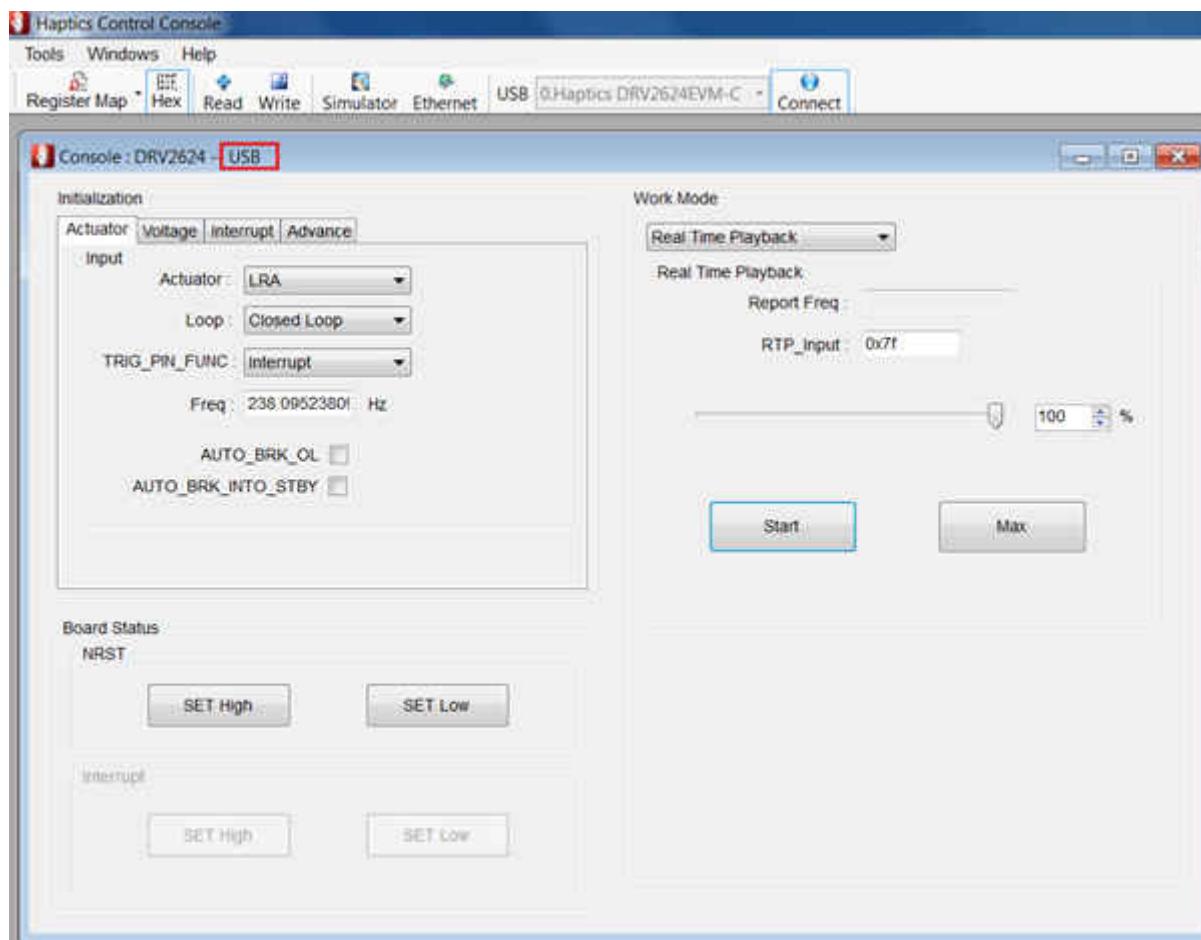
Once plugged in, the board must be set to GUI mode by holding down the plus (+) button for approximately three seconds. The LEDs will flash and then the right half of the LEDs will remain on to indicate the board is in GUI mode. For devices other than the DRV2625EVM-CT, DRV2605LEVM-MD, DRV2510Q1EVM, and DRV2511Q1EVM, the USB2ANY is required to transfer data between the haptic driver and the computer. After the user plugs in the device (through the USB2ANY or directly to the computer), the name of the driver will appear next to USB (see [Figure 6-3](#)). For the USB2ANY, the driver will be DRV-USBCOM-EVM if the firmware is flashed correctly. The user must then select Connect to begin interacting with the device. At the bottom of the screen, the connection to the device is monitored.



**Figure 6-3. HCC Window After Board Connection**

#### Note

At the top left of the console window (after DRVXXXX), the window must indicate USB (for example, see [Figure 6-4](#)). If it says Simulator, the board is not fully connected and the user will not be able to program the device. If it does not read properly the first time, try removing the USB from the computer, restarting the HCC program, and connecting again.

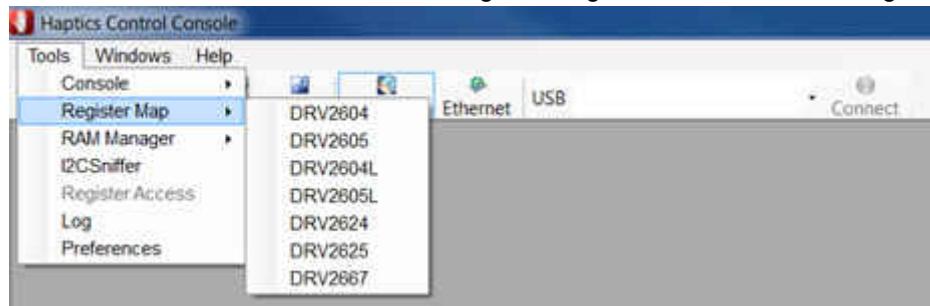


- A. The console window may look different for other drivers.

**Figure 6-4. Console Window for DRV2624 With Proper Connection**

The console window for the DRV2624 is divided into three sections: Initialization, Work Mode, and Board Status.

3. Click the Start button in the Work Mode section to begin testing the board, and click it again to stop.



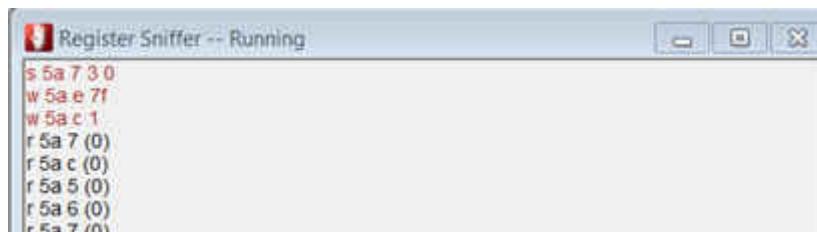
**Figure 6-5. Program Windows Under the Tools Tab**

In the Console option in the Tools tab is the Register Map, which shows a complete overview of the registers and their values for the selected board. The Register Map updates in real time and has a search bar for easy access (users may have to expand the window to view the search bar). For each register, there is a Name, Address, Value, and Description. More information about each register is also available in the respective data sheets.

**Figure 6-6. Register Map Window**

Users can change the register addresses and values from hexadecimal to decimal and vice-versa by selecting the Hex button in the toolbar (next to Register Map). For drivers with RAM, the RAM Manager allows the user to upload custom waveforms to the device. The DRV2604, DRV2604L, DRV2624, and DRV2667 can use the RAM manager. For detailed instructions on how to properly load the waveforms through the RAM Manager, view the data sheet of the board being used.

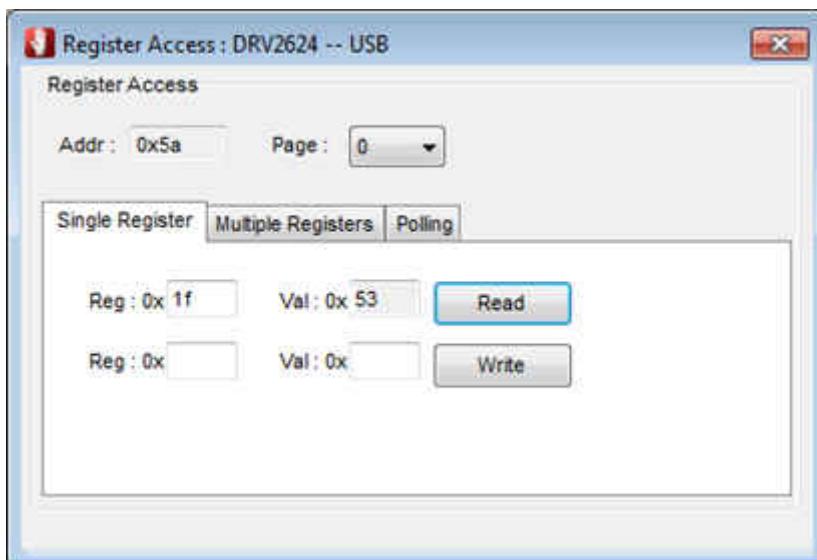
The I<sup>2</sup>C Sniffer (or Register Sniffer) records the data exchange between the device and HCC by displaying the data operations for each register. By default the sniffer is off and the user must right-click the window and select Start to begin observing the transactions (see [Figure 6-7](#)).



**Figure 6-7. Output of I<sup>2</sup>C Sniffer**

Besides the Register Map, the user has direct control over the registers through the Register Access window (see [Figure 6-8](#)) when a board is connected. Users can perform single- or multi-byte writes and reads. There is also an option to poll the I<sup>2</sup>C to constantly monitor the communication lines.

The log is a useful tool for users who are experiencing difficulties. It will show errors for improper connections and other errors, such as when the user selects the Ethernet button when no Ethernet cable is attached. When something is not functioning correctly, the user should check the log for more information.



**Figure 6-8. Register Access Window for Register R/W**

#### Note

In the Preferences tab, there is an option called Force USB Data, which forces HCC to send data even if a haptic device is not recognized as present. When troubleshooting connection issues, users should consider this feature.

## 7 USB2ANY Setup Instructions

### 7.1 Updating the Firmware

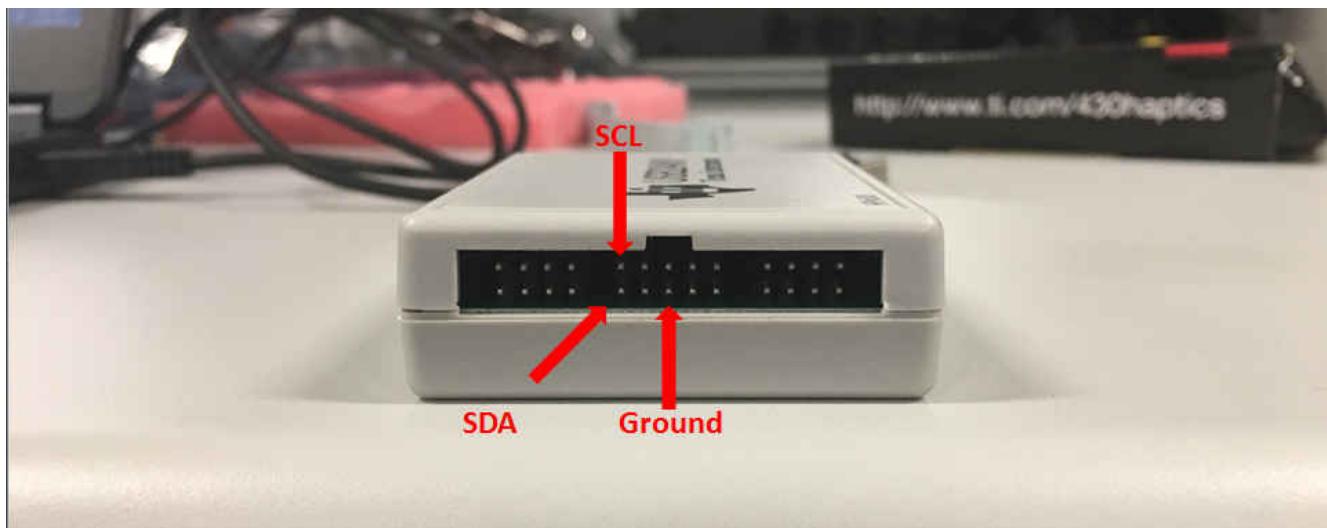
The default USB2ANY code does not work with Haptic Control Console. Use these instruction to update the USB2ANY firmware:

1. Hold down the BSL button located next to the USB-Mini socket while plugging in the USB-Mini.
2. Open HCC and go to Help --> Firmware Update.
3. Click Scan Device. A return message should say "TI Standard BSL deice found."
4. Click Open FW and select "DRV-USBCOM-EVM\_v1p4".
5. Click Update and the firmware should update.

### 7.2 Connecting the USB2ANY

The USB2ANY now appears as the DRV-USBCOM-EVM in the Haptic Control Console Window. See [Table 5-1](#) for specific EVMs. Connect wires between SDA, SCL, and GND from the USB2ANY to the EVM selected. These pins are shown in [Figure 7-1](#).

If such programming isn't needed a multitude of Demo modes are available on each board as long as power is supplied, but no GUI will be utilized in this case.



**Figure 7-1. USB2ANY Connections**

## 8 Board Specific Information

### 8.1 DRV260x and DRV260xL

#### 8.1.1 Getting Started

The USB2ANY is required to interact with the DRV260x EVMs and DRV260xL EVMs through HCC. For simplicity, this guide will refer to the DRV2605EVM.

1. Connect the USB2ANY by using three jumper cables to connect SDA, SCL, and GND on the DRV2605LEVM to the three pins by the same name on the USB2ANY. See the USB2ANY datasheet for a detailed map of the board (pending USB2ANY release).

The DRV2605EVM will be ready to accept I<sup>2</sup>C transactions once it is powered on and in GUI mode. To set the board to GUI mode:

- a. Press and hold the increment mode button (+) for approximately three seconds until the mode LEDs flash and the colored LEDs flash once.
  - b. Press and hold the increment mode button (+) one more time until the mode LEDs flash and the colored LEDs flash twice. For more information, see the *Additional Hardware Modes* section of [DRV2605 Haptic Driver for ERM and LRA With Built-In Library and Smart-Loop Architecture](#).
2. Press B1 once in GUI mode to control the ERM, and press B2 to control the LRA.

The actuator must be chosen through the hardware by physically pressing the buttons. Changing the Actuator in the settings tab on HCC will not change which actuator is in operation on the board, only which signal is being sent from the driver. The user must separately chose the actuator through HCC and chose the same actuator on the board using buttons B1 or B2.

#### 8.1.2 Consol Window Overview

The console window is divided into two sections: Settings and Work Mode. The Settings section contains four tabs (Actuator, Voltage, Calibration, and Advanced) that are used to set the registers of the DRV260x device. The Work Mode section has a drop down menu containing the different types of trigger modes, PWM input, Analog input, Real Time Playback, Diagnostics, Actuator Life Test, and Audio to Haptics (for DRV2605 and DRV2605L only). The user should first input the settings according to the actuator being driven and then choose the appropriate work mode.

##### 8.1.2.1 Console Window Settings

In the Actuator tab, the user can choose whether they want to drive an ERM (eccentric rotating mass) or an LRA (linear resonant actuator) by selecting the Actuator tab and choosing accordingly. From here, they can select closed or open loop to run the device with or without the auto-resonance frequency tracking. The DRV2605 and DRV2605L have a selection of six ERM and one LRA libraries for the user to choose from in the Library drop-down tab. For LRA mode, users should also enter the resonance frequency of the LRA being driven. This frequency is used in the calculation for Rated Voltage and DRIVE\_TIME.

In the Voltage tab, the user can adjust rated voltage (full-scale output during closed-loop) and the overdrive voltage (maximum voltage allowed to actuator). In open loop the output voltage is determined by the overdrive voltage. The corresponding register addresses and values are also shown.

The Calibration tab is used to calibrate the ERM or LRA being tested. The result of the calibration will appear letting the user know if the calibration was successful or failed. In the event of failing calibration make sure the ERM and LRA parameters are correct and the actuator is attached to a stable mechanical ground. If the calibration still fails move to the Advanced tab and refer to the datasheet.

The Advanced tab contains advanced settings used for calibrating the actuator. The DRIVE\_TIME should be set appropriately based on the LRA frequency or the frequency in which the user wants to sample the BEMF voltage of the ERM. The DRIVE\_TIME is one half of the period of the resonance frequency of the LRA. The DRV26xx devices use this DRIVE\_TIME as an initial guess of the LRA frequency as the auto-resonance tracking algorithm begins. BLANKING and IDISS are described in the datasheet. The ZC\_DET\_TIME only appears in the DRV260xL console window and represents the minimum length of time devoted for detecting a zero crossing.

For a more detailed explanation of the registers used in the Actuator, Voltage, Calibration, and Advanced tabs, the user should utilize the Register Map (Tools → Register Map → DRV260X) or the data sheet.

### 8.1.2.2 Console Window Work Mode

Within the Work Mode section, the user has several options according to how they wish to control the actuator. For the DRV2605 and DRV2605L, the internal libraries are available for use in the first three tabs (Internal Trigger, External Edge Trigger, and External Level Trigger). The DRV2604 and DRV2604L contain RAM for the user to load custom waveforms (through the RAM Manager) while the DRV2605 and DRV2605L have ROM that contains the licensed Immersion® TouchSense® waveform library. The first three tabs are not usable for the user with the DRV2604 and DRV2604L until they upload waveforms onto the board.

To control the actuator using an outside waveform, select External PWM or External Analog accordingly and then reference the *Hardware Configuration* section of the [DRV2605EVM-CT](#) or [DRV2605LEVM-CT](#) user's guides for information on how to connect the hardware.

Real Time Playback gives the user direct control over the chosen actuator. Remember, the user must have the same actuator chosen on the board (B1 for ERM, B2 for LRA) and on HCC in the Actuator tab.

The Diagnostic mode will run diagnostics and show the results for success or fail.

The Actuator Life Test mode give users the ability to run long lifetime tests with specified ON and OFF times. Enter the desired times to be tested and then the number of cycles to test. The last mode, Audio to Haptics, shows the settings for the Audio to Haptics function. Refer to the datasheet for explanations of these settings.

## 8.2 DRV2505LEVM-MD

### 8.2.1 Getting Started

The DRV2605LEVM-MD is capable of directly connecting to the HCC GUI without external I2C control and therefore does not need the USB2ANY. First, connect the DRV2605LEVM-MD to the PC USB port. Next, the user switch must be pressed. When the user switch is pressed, the board goes to USB communication mode, which disables the capacitive touch buttons. A power cycle or software reset is required to go back to capacitive-touch mode. The user switch is a pushbutton labeled USER SW and LED1 turns on to indicate that the firmware is active for USB transactions.

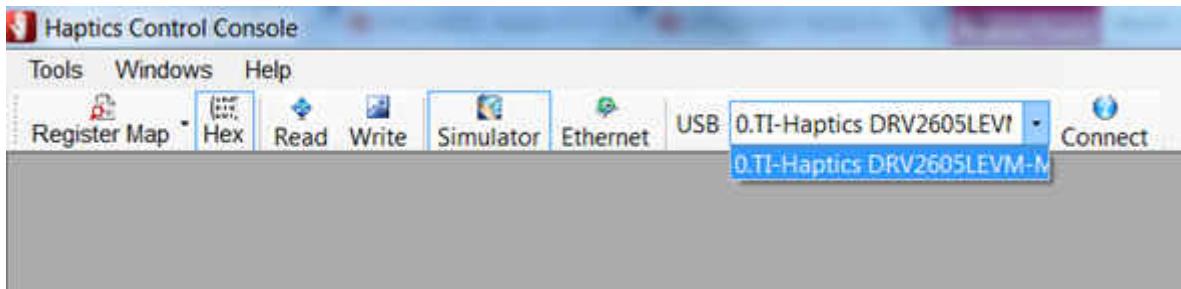


Figure 8-1. HCC After DRV2605LEVM-MD Connection to PC

After selecting the user switch and ensuring the LED1 light is on, open up HCC and select 0.TI-Haptics DRV2605LEVM-MD and then Connect in the drop-down window next to USB.

After connecting, the DRV2605LEVM-MD console window automatically appears. If properly connected, the console window displays a *Console: DRV2605LEVM-MD – USB* title. If the DRV2605L console window appears instead of the DRV2605LEVM-MD, then the board needs a firmware update to communicate properly with HCC. To perform a firmware update, go to Help → Firmware Update and then follow the instructions listed at the bottom of the window and try the process again.

### 8.2.2 Console Window Driver and Settings

In the console window, there are two main tabs: Driver and Settings. Within the Settings tab, the user can properly initialize the board for use with the actuators and run Auto Calibration to ensure optimum performance. Settings can also be imported and exported in the Settings tab. In the Driver tab, there are two modes: Effect Sequence Playback and Real Time Playback (RTP). In Effect Sequencer mode, the user can set different waveform sequences to different actuators, and then trigger all of the actuators to vibrate with one click. In RTP mode, all the actuators will vibrate at the same amplitude with one click.

## 8.3 DRV2624 and DRV2625

### 8.3.1 Getting Started

To control the board with HCC, the user must first plug in the board and then set it to GUI mode. For the DRV262x-EVM-CT, set the board to GUI mode by holding down the (+) button for approximately three seconds. The LEDs will flash and then the right half of the LEDs will remain on to indicate the board is in GUI mode. Once the user plugs in the device, the name of the driver will appear next to USB (shown in [Figure 6-3](#)). The user must then select “Connect” in order to begin programming the device. At the bottom of the screen, the connection to the device is monitored. If using the DRV262X-EVM-mini, please connect the NRST pin to VDD or a GPIO because HCC does not control the NRST pin. Also, connect the SDA, SCL, and GND lines to the USB2ANY (required for the mini-board). If HCC recognizes the DRV-USBCOM-EVM but not the DRV262X-EVM-mini, try using the console window simulator and forcing the USB communication (Tools → Preferences → Force USB Data). The DRV262X must be externally powered to receive I<sup>2</sup>C commands. As an alternative resource a [three-part video series](#) on our TIPL platform is available which guides you through using the HCC and DRV262x-EVM-CTs, covering the same material as below.

### 8.3.2 Console Window Overview

The DRV2624 and DRV2625 have the same console window layout. The console is divided into three sections. The initialization section is divided into four tabs: Actuator, Voltage, Interrupt, and Advance. This section is used to change the actuator settings. The work mode section is used to start and stop different processes available for driving actuators. The final section contains reset buttons, NRST high/low, and a pulse trigger button.

#### 8.3.2.1 Initialization: Actuator

Within the Actuator tab, the user can select the settings at which they would like to operate their chosen haptic actuator. By selecting Open Loop instead of Closed Loop, the user bypasses the auto-resonance tracking and can manually set the frequency. The TRIG PIN FUNC refers to the type of trigger used to start all processes (RTP, Waveform Sequencer, Calibration and Diagnostics). The trigger can be controlled by software using the GO bit (internal trigger), or by hardware using the TRIG/INTZ pin (external trigger pulse or level). For more information, refer to the DRV262x data sheet. The AUTO BRK OL box will enable auto-braking out of open loop operation. The AUTO BRK INTO STBY will enable braking when the part is put into standby. The user cannot select the Voltage, Interrupt, or Advance tabs until a frequency value is input.

### 8.3.2.2 Initialization: Voltage

Within the voltage tab, the user can adjust rated voltage (full-scale output during closed-loop) and the overdrive voltage (maximum voltage allowed to actuator). In open loop the output voltage is determined by the overdrive Voltage. The corresponding register names, values, and addresses are also shown (see [Figure 8-2](#)).

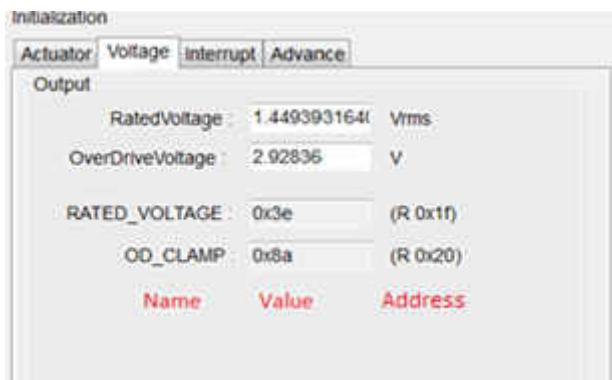


Figure 8-2. Initialization: Voltage Tab

### 8.3.2.3 Initialization: Interrupt

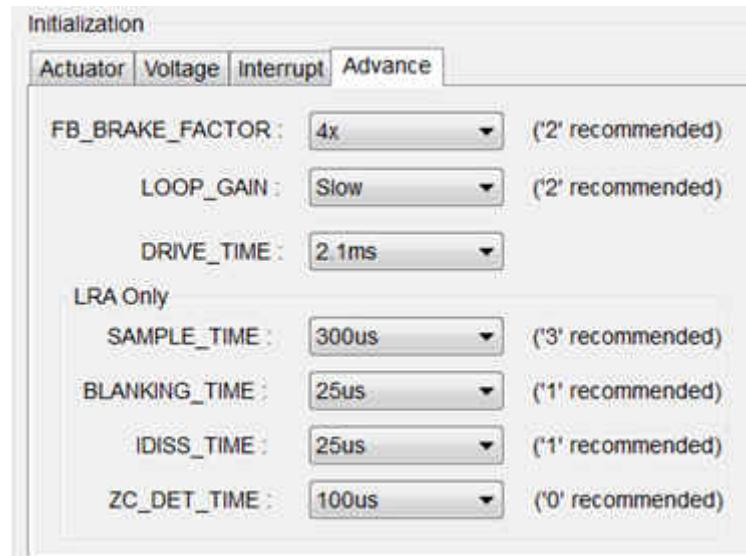
The Interrupt tab contains five different interrupt notifications. The details of each type of notification can be found in the register map with the name of the register as shown in [Figure 8-3](#). The register map window may need to be enlarged to reveal the search bar. More information can be found in the device data sheet.



Figure 8-3. Result From Searching OC\_DETECT in Register Map

### 8.3.2.4 Initialization: Advanced

The final tab in the Initialization section gives the user advanced control over the actuator. Some actuators may require fine-tuning for proper auto-calibration. The specifics of each parameter can be found by looking up the register in the register map or referring to the datasheet.



**Figure 8-4. Advanced Tab That Provides More Actuator Control**

### 8.3.3 Work Mode: Overview

Within the Work Mode section, there are several options: Real Time Playback, Waveform Sequence, Diagnostic, AutoCalibration, and Actuator Life Test. Users should fill out the Initialization section before moving to the work mode section. Next, users should use the auto-calibration mode.

#### 8.3.3.1 Work Mode: Auto-Calibration

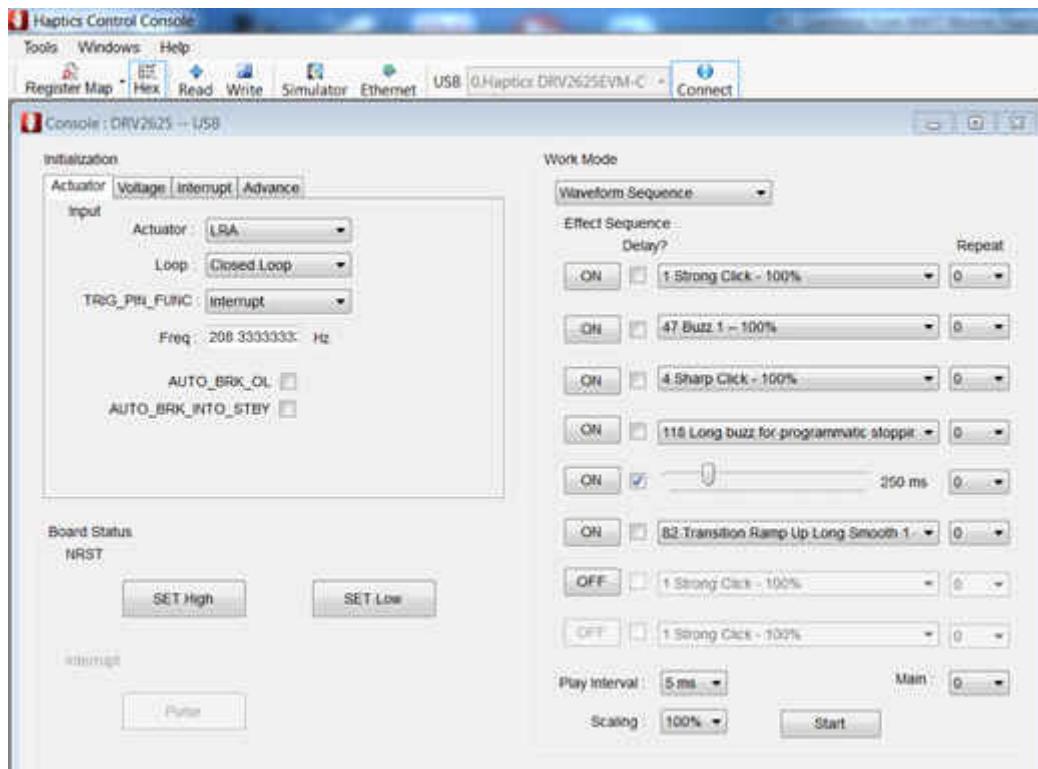
Before testing the device, the user should run auto-calibration. The auto-calibration routine expects the actuator to have reached a steady acceleration before the calibration factors are calculated. Because the start-time characteristic can be different for each actuator, the AUTO\_CAL\_TIME parameter can change the duration of the automatic level-calibration routine to optimize calibration performance. The calibration routine will return and automatically populate the A\_CAL\_COMP, A\_CAL\_BEMF, and BEMF\_GAIN registers with the appropriate value for the actuator.

#### 8.3.3.2 Work Mode: Real Time Playback

After adjusting the settings, Real Time Playback allows the user to proportionally control the actuator. The user can adjust the playback strength of the actuator by moving the sliding bar and the value is stored in the RTP\_INPUT register. If an LRA is operating in closed loop mode, the Report Freq box shows the resonant frequency. The user can observe the usefulness of Auto-Resonance Detection by operating a LRA in open loop mode at a frequency different than the resonant frequency and observing the drop in performance.

#### 8.3.3.3 Work Mode: Waveform Sequence

For the DRV2625, the waveforms stored in ROM memory appear in the drop-down menu. The DRV2624 contains 1 kB of integrated RAM for custom waveforms instead of the library. For the drivers with RAM such as the DRV2624, the Waveform Sequence tab will not be usable until the user loads waveforms onto the board using the RAM Manager (Tools → RAM Manager → DRV2624).



**Figure 8-5. Waveform Sequence Used by DRV2625**

As shown in [Figure 8-5](#), the user can select from 123 waveforms using the drop down menu to navigate the waveforms and can repeat the waveform up to three times per sequence. Additionally, the user can enable a delay into the sequence by selecting the Delay box, and can use the slide bar to set a delay from 0 to 1270 ms. There are also several other controls such as play interval, scaling, and main repeat (repeats the entire sequence) to provide ease of use and control.

Scaling will control the output magnitude. The Playback Interval controls the time step of waveforms. When switching from 5 ms to 1 ms, the waveforms will be approximately five times shorter.

#### 8.3.3.4 Work Mode: Diagnostic

In the Diagnostic tab, the user can determine the actuator impedance. The DRV262x device is capable of determining whether the actuator is not present (open) or shorted. If a fault is detected during the diagnostic process, the DIAG\_RESULT bit is asserted. The DRV262x device also features actuator resistance measurement, which is available in the DIAG\_Z\_RESULT parameter. More information is available in the DRV262x data sheet.

#### 8.3.3.5 Work Mode: Actuator Life Test

The final option in Work Mode, the Actuator Life Test, lets the user run the actuator for a number of cycles to observe the performance over time.

#### 8.3.4 Board Status and Pulse Trigger

The DRV2624 and DRV2625 devices have an automatic go-to-standby state and a battery preservation function to help reduce power consumption without user intervention. The NRST pin allows for a full shutdown state for additional power savings and the user can set it HIGH or LOW. In order to utilize the Pulse Trigger button, the user must set the TRIG\_PIN\_FUNC to 0 (Ext-pulse Trigger) within the Actuator tab of the Initialization section. The Pulse button will pulse a high signal on the TRIG pin.

## 8.4 DRV2667

### 8.4.1 Getting Started

A USB2ANY is needed to connect the DRV2667 to the computer. Connect the USB2ANY by using three jumper cables to connect SDA, SCL, and GND on the DRV2667EVM-CT to the three pins by the same name on the USB2ANY. See the USB2ANY datasheet for a detailed map of the board (pending USB2ANY release). The DRV2667EVM will be ready to accept I<sup>2</sup>C transactions once it is powered on. The DVR2667EVM does not need to be in GUI mode to communicate with HCC over the USB2ANY through I<sup>2</sup>C. See External I2C Input on the DRV2667EVM for more information. After connecting the USB2ANY to the DRV2667EVM and both boards to the computer, the user must press Connect to begin controlling their device through the GUI.

### 8.4.2 Console Window Overview

After connecting to the DRV2667EVM, the console window will appear. The console window is divided into two sections, settings and work mode. In the settings section, the user can adjust the gain, which adjusts the output voltage from the driver that goes into the Piezo. A breakdown of the gain is shown below:

- 28.8 dB, 50 Vpp
- 34.8 dB, 100 Vpp
- 38.4 dB, 150 Vpp
- 40.7 dB, 200 Vpp

Refer to the *Adjusting the Boost Voltage Using Software* section of the [DRV2667EVM-CT](#) user's guide to adjust these settings via software or hardware. Within work mode, there are three options: Internal trigger, External Analog, and FIFO Playback. In order to operate the Internal Trigger RAM mode, the user must upload waveforms using the RAM Manager. In External Analog mode, waveforms must be input into the device. In FIFO Playback mode, the user can control the actuator by adjusting the settings and selecting Start.

#### 8.4.2.1 Work Mode: Internal Trigger – Uploading Waveforms

To upload waveforms through the RAM Manager, the user must go to Tools → RAM Manager → DRV2667. Here the user can load waveforms from binary files (.bin) by selecting Import and then Write RAM. The user can create custom waveforms for non-commercial use through the WaveSynthesizer (see [Figure 8-6](#)) by selecting Advanced in the DRV2667 RAM Manager.

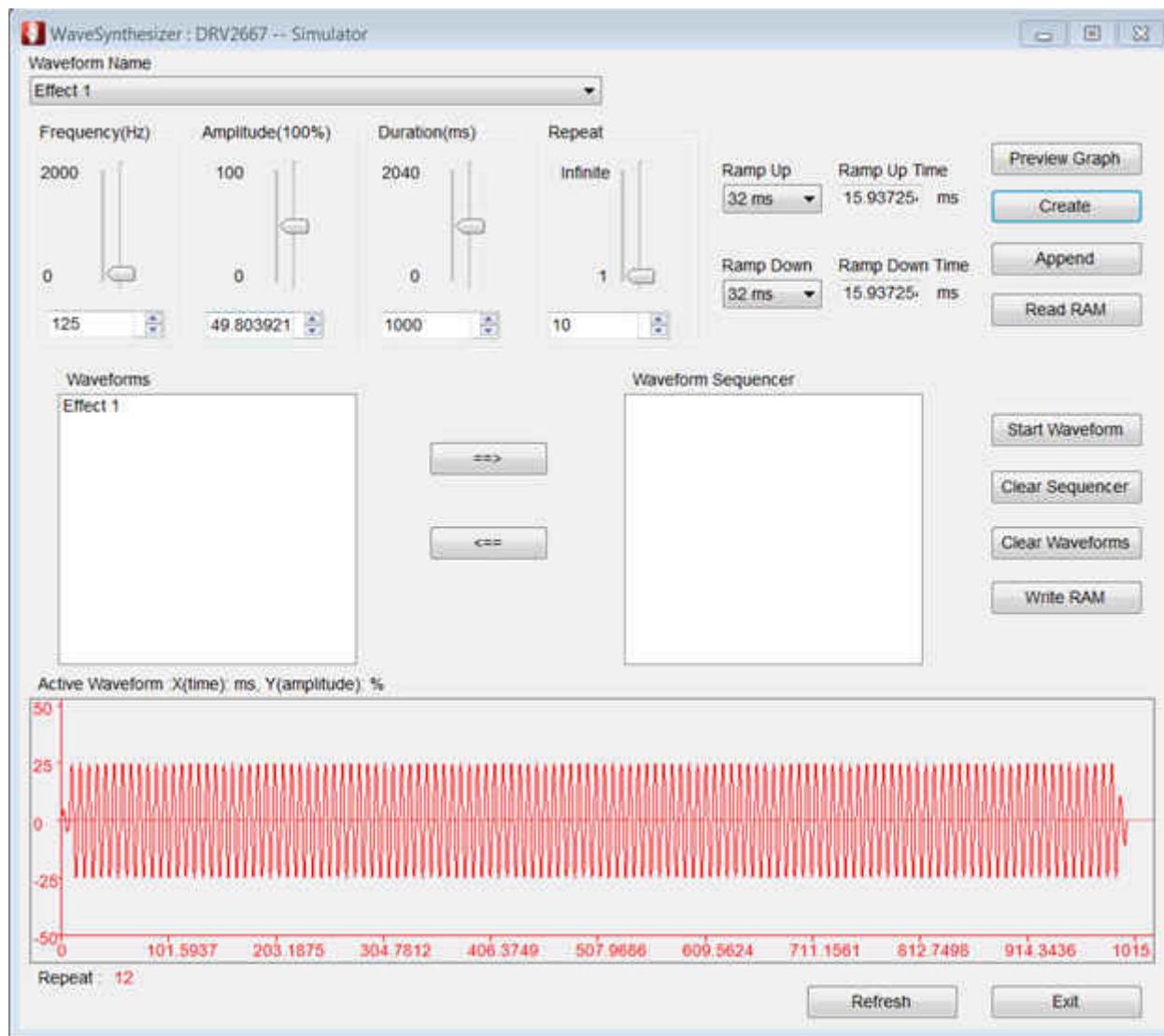
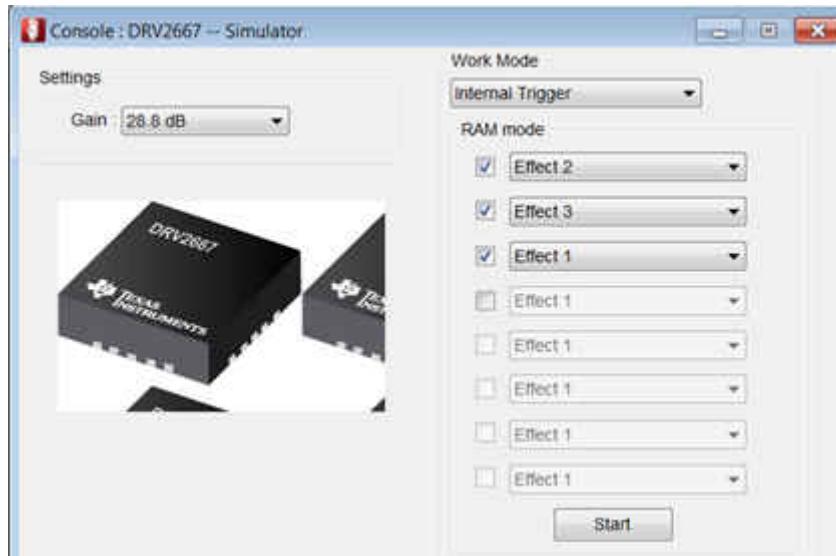


Figure 8-6. WaveSynthesizer for DRV2667

The user can create waveforms by adjusting the frequency, amplitude, duration, and number of times the waveform will repeat and then selecting Create. For haptic applications of piezos, the frequency of the waveforms is generally 100 to 200 Hz. Higher frequency waveforms may emit audible noise. Once created, the waveform will appear in the Waveforms block with the name Effect 1. Subsequent waveforms will be named Effect 2, Effect 3, and so on. The most recently created waveform will appear in the graph at the bottom. After creating the desired waveforms, selecting Write RAM will make the created waveforms selectable in the DRV2667 console window.

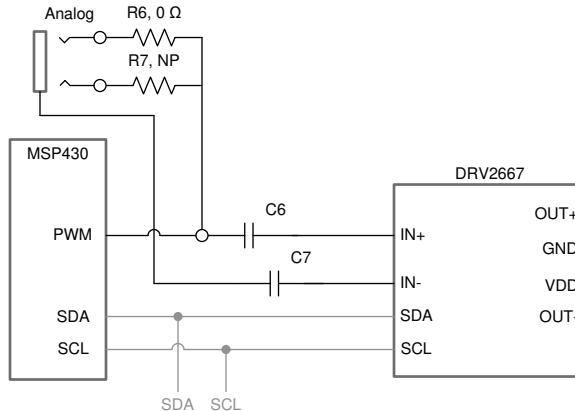


**Figure 8-7. Selecting Waveforms After Creating With WaveSynthesizer**

Alternatively, the waveforms could be controlled from the WaveSynthesizer window via the Waveform Sequencer block. The user must move the waveforms from the Waveform block to the Waveform Sequencer block by selecting the name of the waveform and clicking the appropriate arrow. To play the waveforms on the attached piezo, select Start Waveforms.

#### 8.4.2.2 Work Mode: External Analog

In External Analog mode, waveforms must be input into the device. The *Analog.PWM Input* section of the [DRV2667EVM-CT](#) user's guide is referenced below for more information:



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**Figure 8-8. External Analog and PWM Input**

The DRV2667EVM-CT accepts analog or PWM inputs for the analog IN+ and IN– pins of the DRV2667. To use the IN+ and IN– pins of the DRV2667 follow the instructions below:

1. Enter Design and Test Modes. Select Mode 7 (00111'b) using the increment mode button (+).
2. Select the gain and voltage using buttons B1–B4:
  - B1 – 28.8 dB, 50 Vpp
  - B2 – 34.8 dB, 100 Vpp
  - B3 – 38.4 dB, 150 Vpp
  - B4 – 40.7 dB, 200 Vpp
3. Turn on the signal source to begin output.

#### 8.4.2.3 Work Mode: FIFO Playback

For immediate control of the piezo, FIFO Playback mode outputs a 200-Hz sine wave or a custom waveform to the piezo. The duration can be adjusted from 5 to 20 ms.

### 8.5 DRV2510 and DRV2511

#### 8.5.1 Getting Started

The user must plug the DRV2510EVM or DRV2511EVM into the computer through a micro USB cable. After 0.7/  
*DRV251XQ1 EVM* appears in the toolbar next to USB, select Connect. The console window should appear with the title *Console: DRV251XEVM – USB*. If the console window displays Simulator instead of USB, the board is not connected correctly. In addition to the USB, the DRV251xEVM must receive a separate power source for the driver. VDD is provided through jumper J5. The user can now connect the solenoid or voice coil and operate it through HCC.

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#### Note

If initially on, the user must toggle Enable off and then back on the first time for the DRV to respond.

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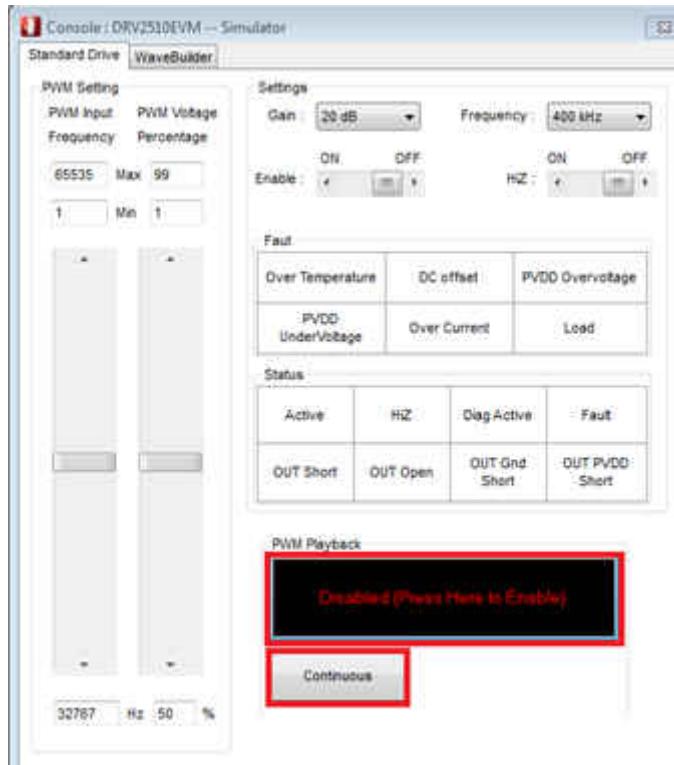
#### 8.5.2 Console Overview

The console window is divided into two tabs: Standard Drive and WaveBuilder. Within Standard Drive, the user can control the PWM input frequency and voltage percentage (duty cycle). The WaveBuilder tab allows users to create custom waveforms for evaluation purposes.

##### 8.5.2.1 Standard Drive Tab

In the Standard Drive tab the frequency can be adjusted for better resolution. Because solenoids do not undergo high frequencies, users can keep the PWM frequency at 32 kHz and create a square wave output by using the

different types of PWM Playback. The PWM Playback can be changed by clicking on the Continuous button at the bottom of the window (see [Figure 8-9](#)). The three different modes are Continuous, Pulse, and Single output. If operating in Continuous mode, the user can adjust the frequency to approximately 200 Hz for best performance with solenoids. The Single and Pulse modes should use a higher PWM frequency with a setting that creates an output at the desired frequency. The recommended range for most solenoids is less than 200 Hz. Click the black box to enable and disable the output. There is a toggle switch for Enable and Hi-Z. To drive an output signal, the Enable slider must be in the ON position and the Hi-Z slider must be in the OFF position.



**Figure 8-9. DRV2510 Console Window**

#### Note

To change the PWM Input Frequency, the user must press the Enter key on their keyboard for HCC to recognize the new frequency. If the user enters a new frequency without pressing enter, the old frequency will be played.

##### 8.5.2.1.1 Standard Drive Tab Diagnostics

In the status section of the DRV2510, there is a grid of eight different boxes labeled Active, Hi-Z, Diag Active, and so on that the user can find more information on by searching STA in the DRV2510 register map or by referencing the DRV2510 data sheet. If a fault is triggered, it will turn red on the console window. The DRV2511 does not have diagnostic reporting.

### 8.5.2.2 WaveBuilder Tab

The WaveBuilder tab allows users to create custom waveforms for evaluation purposes. The output PWM frequency is set at 32 kHz allowing high resolution. The control buttons do the following:

- Clear Plot: erases any data in the plot.
- Add Many Points from Text Box: loads the points into the plot.
- Add Single Point: appends the point in the box directly below the button to the plot.
- Start Waveform: enables the output.
- Triangle, Sine, and Impulse: appends preset waveforms to the plot area when clicked.
  - Use care when adding points to the graph because users cannot delete single points, users can only clear the whole plot.
- Time Between Steps: sets the time each point will last at that magnitude.
  - Users can also select the number of times to repeat the output or set an infinite loop.
- 

The large box in the middle can be filled with points separated by commas to build the desired evaluation waveform.

In the status section of the DRV2510, there is a grid of eight different boxes labeled Active, Hi-Z, Diag Active, and so on, and the user can find more information about each one by searching STA in the DRV2510 Register Map. If a fault is triggered, it will turn red on the console window. The DRV2511 does not have diagnostic reporting.

#### 8.5.2.1

## 9 Revision History

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

Changes from Revision A (May 2018) to Revision B (January 2022)	Page
• Added “DRV2605LEVM-MD” to list of devices that does not require USB2ANY.....	<a href="#">2</a>
• Added information for the three-part video series.....	<a href="#">10</a>

Changes from Revision * (December 2017) to Revision A (May 2018)	Page
• Added new section: <a href="#">Section 7</a> .....	<a href="#">7</a>

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