NCV705XXGEVK

NCV705XX Micro-stepping Motor Driver Evaluation Board User's Manual

ON Semiconductor®

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EVAL BOARD USER'S MANUAL

Introduction

The evaluation board allows in an easy way to demonstrate features of NCV705xx device family − a micro−stepping stepper motor drivers for bipolar stepper motors. With supporting GUI SW it is possible to create and apply different speed profiles and characterize the Bemf (Back electromotive force) performance of specific setup. GUI SW allows to access and control any register or external I/O pin of the devices.

The provided motherboard gives a lot of flexibility during your development process. Easy access to several signals makes debugging very easy and gives you the possibility to connect the evaluation kit with your own application which reduces the development time.

Evaluation of the complete NCV705xx family is made very easy by means of the separate daughter boards.

NCV705xx family contains a current−translation table and takes the next micro−step depending on provided clock signal. Error message is provided if an electrical error, an under−voltage or an elevated junction temperature is detected. Proprietary PWM algorithm for reliable current control is used.

NCV705xx family is fully compatible with the automotive voltage requirements and is ideally suited for general−purpose stepper motor applications in the automotive, industrial, medical, and marine environment. Due to the technology, devices are especially suited for use in applications with fluctuating battery supplies.

Evaluation Board Features

- Wide Range of Supply Voltage: 6 to 29 V
- Connection of Bipolar Stepper Motor
- Test Points for Every Signal
- Preparation for Daisy−chain Connection of more Devices
- Single Side PCB Assembly
- User Friendly GUI SW

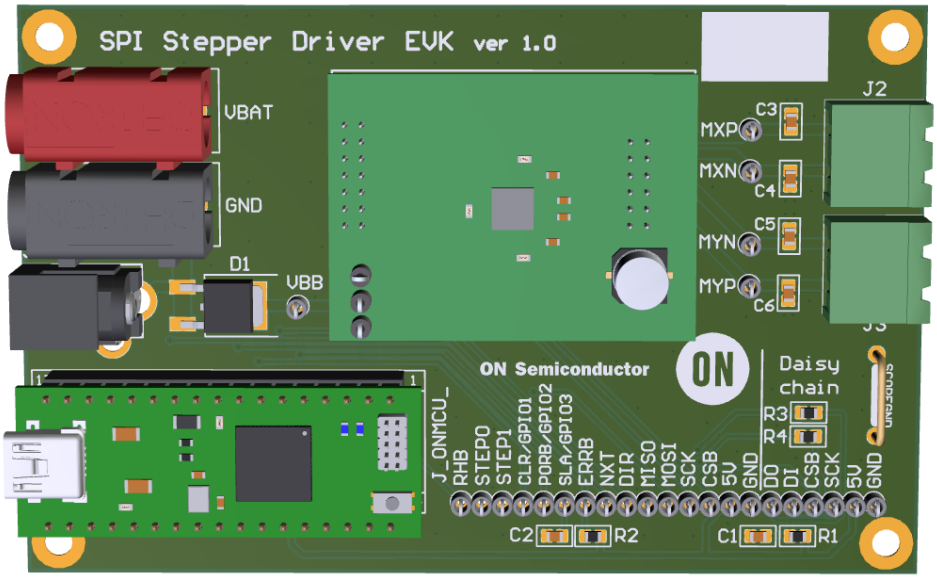


Figure 1. Evaluation Board (Top View)

Table 1. ABSOLUTE MAXIMUM RATINGS

Rating	Value	Unit
Supply Voltage (V_{BAT})	−0.3 to 40	V
Stepper Motor Current	2	A
Junction Temperature (NCV70517, NCV70514, NCV70516)	−40 to 175	°C
Ambient Temperature	−40 to 105	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

Table 2. RECOMMENDED BOARD OPERATING CONDITIONS

Rating	Value	Unit
Supply Voltage (V_{BAT})	6 to 29	V
Stepper Motor Current	1.1	A
Ambient Temperature	−40 to 105	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

Table 3. INTERFACE FUNCTION DESCRIPTION

Connector Name	Connector Type	Description / Function
J1	DC POWER JACK 2.5MM	Input supply connector, DC 6 – 29 V
VBAT	BANANA RED 4MM	Input supply connector, positive, 6 – 29 V
GND	BANANA BLACK 4MM	Input supply connector, GND
J_ONMCU_	2 pcs 1x17 pins / 2.54 mm / Socket Header	Connector for ONMCU_DIL microcontroller board
CON1	HARWIN_M80−8501445 14WAY/2x7/Socket 2MM	Connector for NCV705XX Daughterboard
CON2	HARWIN_M80−8501245 16WAY/2x8/Socket 2MM	Connector for NCV705XX Daughterboard
J2, J3	2 pins / 5.08 mm / Header Terminal Block	Connection of Stepper Motor
SCOPEGND	Wire Bridge	Ground wire, global ground
Test points	TEST POINT TH 1MM	Easy access to all signals

Getting Started

The evaluation board can be supplied through a standard 5.5 x 2.5 mm power jack DC connector, but preferred way is to connect current limited laboratory power supply through standard 4 mm bananas. Supply voltage is then provided to battery voltage input VBB of NCV705xx Stepper Driver through reverse polarity protection diode.

Battery voltage should be connected first, followed by connection of USB mini cable.

J2 and J3 connectors are intended for connection of bipolar stepper motor, each winding going to separate connector. Swapping of positive and negative terminals will just cause opposite direction of motor rotation.

CON1 and CON2 serve to plug any compatible daughter board with stepper driver IC.

Microcontroller board ONMCU_DIL creates communication bridge and translates dedicated text protocol commands going over USB into SPI commands for stepper driver IC or control of external I/O pins.

Daisy Chain Mode

The board is prepared from hardware point of view for daisy chain mode configuration of more NCV705xx devices by means of resistors R3 and R4. By assembling zero ohm resistors, the basic connection of single IC is done. By combining two EVK boards, with help of signals MISO, MOSI, DO and DI available on test points, daisy chain connection of SPI data lines can be made. Other required signals can be easily connected in parallel via test points.

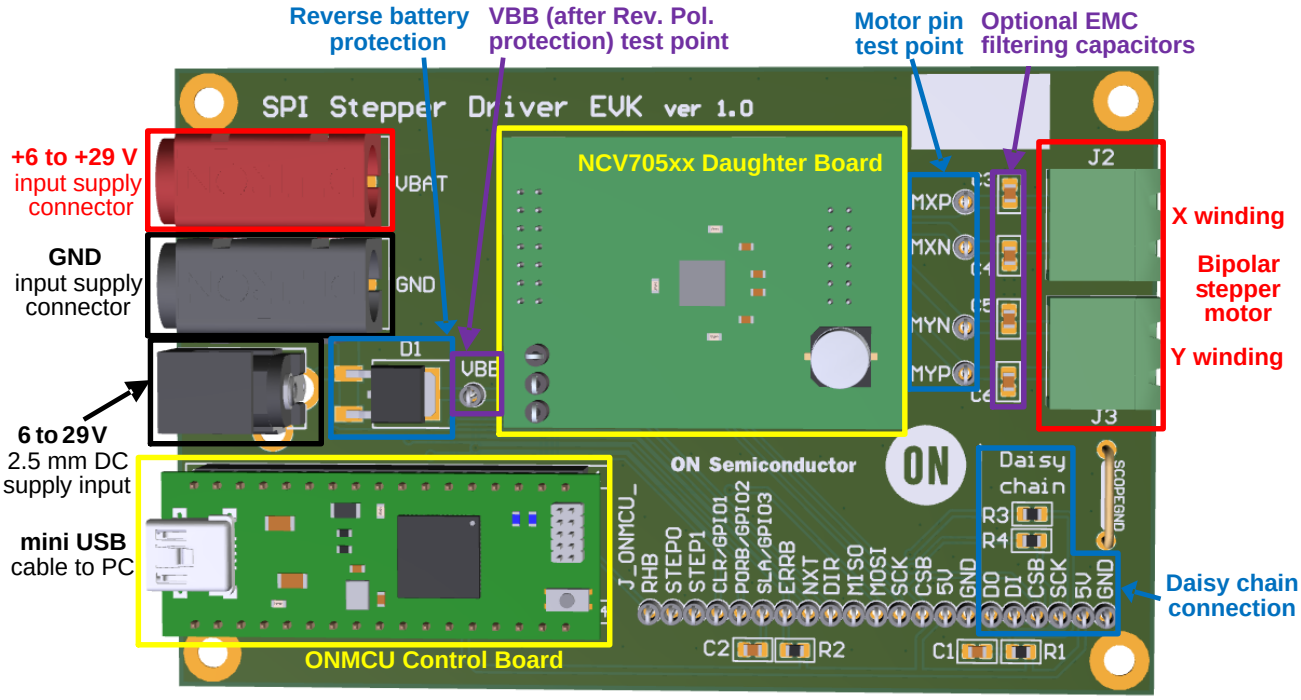
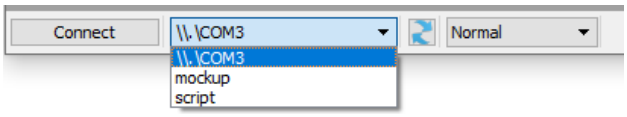


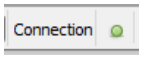
Figure 2. NCV705XXGEVK Micro−stepping Motor Driver Evaluation Board Picture

Using of GUI SW

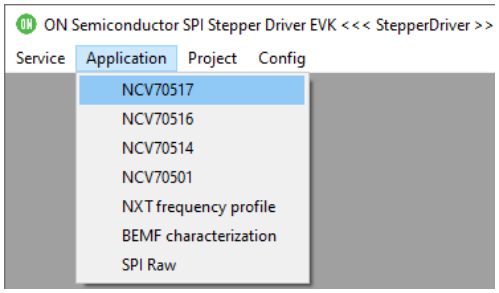
After connection of the battery supply and mini USB cable to the evaluation board, the button in status bar should be used to relist all active virtual COM ports. From the list select COM port where evaluation board is connected. In case there is no real hardware available, the “Mockup” simulation mode can be selected to run the GUI SW.



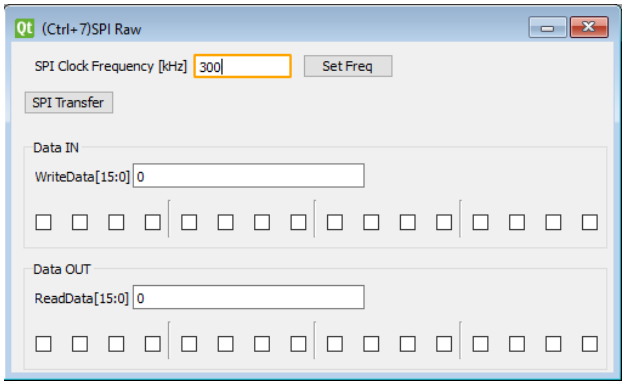
After clicking “Connect” button, the successful connection status should be indicated in status bar:



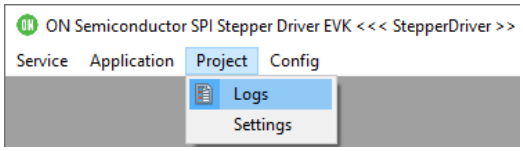
NCV705xx device used on daughter board has to be manually selected from the menu “Application” and “NCV705xx Register Access” window allowing access to all SPI registers and control of external signals will open, see dedicated chapter for more details.



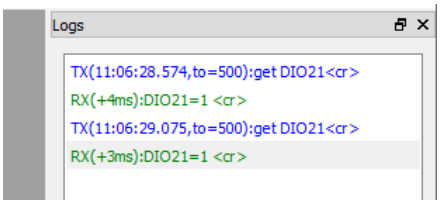
There is a possibility to use low level access where each bit in SPI frame can be controlled via “SPI Raw” panel. This allows to create non−standard frames for testing purposes (e.g. with corrupted parity).



For debugging purposes, logging of the communication between GUI SW and Evaluation board can be useful. This can be enabled in menu “Project” by item “Logs”:

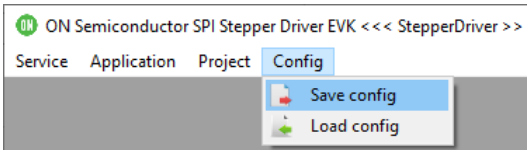


On the right side of the application area, the dedicated “Logs” window should appear:

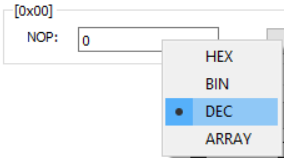


Logging of the ongoing commands can be then started/stopped by clicking check box “Log”:

Current state of the GUI SW including all control elements can be saved and restored in the “Config” menu.



Please note that format of the number in any text box can be changed by clicking the right mouse button:



GUI SW framework allows to access and control all GUI elements in “NCV705xx Register Access” window from Python scripts. This can help with evaluation of the device significantly by automatizing many steps. For more details about Python scripting look for dedicated document.

NCV705xx Register Access

In menu “Application” the correct NCV705xx device which is present on daughter board has to be selected and appropriate window will open. Window is split into two parts, on the left side the section for control of external pins is available and on the right side, all internal SPI registers can be accessed. Status registers (Diagnostic) can be read out and Control registers (Motion parameters) can be written or read out. Button “Read All” serves to read content of whole SPI map.

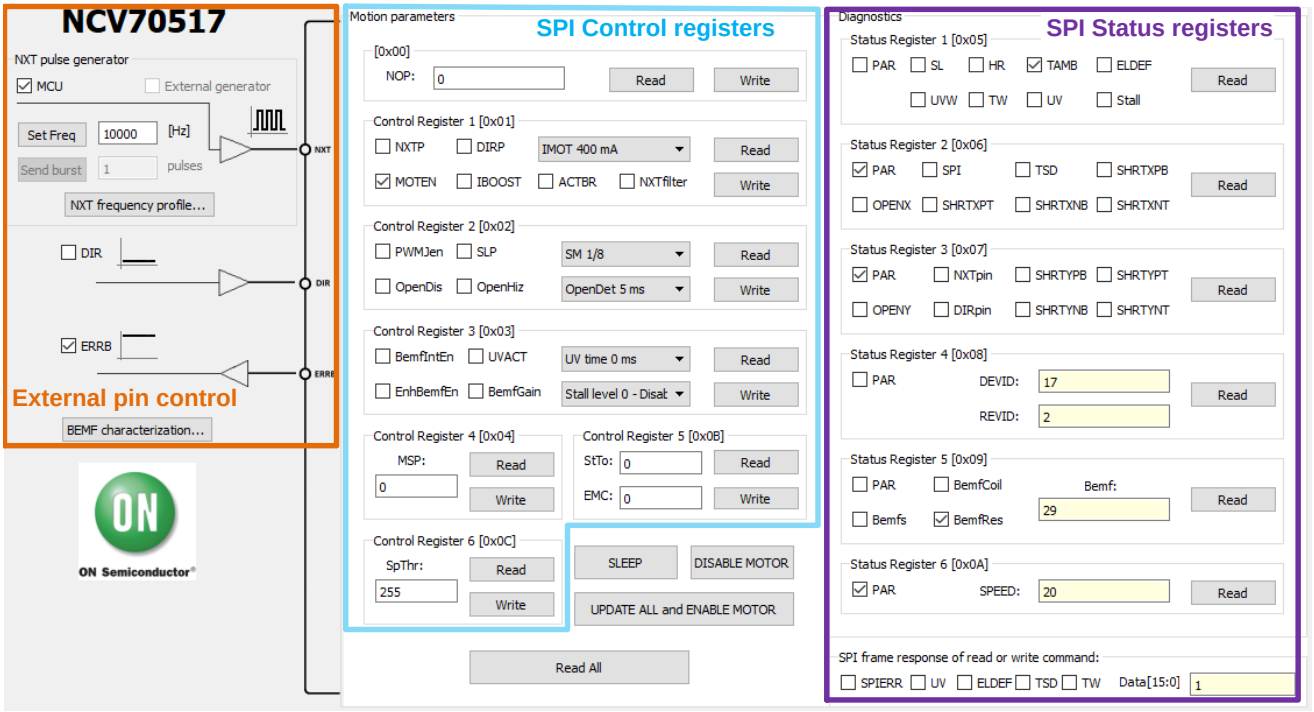


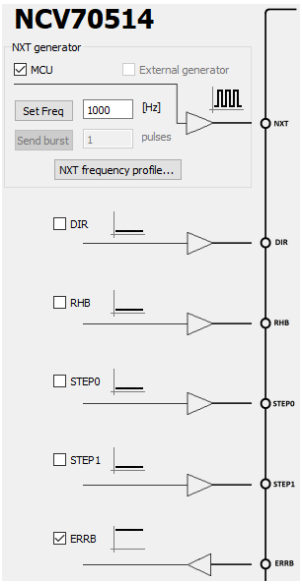
Figure 3. Basic NCV705xx Control Window

External Pin Control

External pins section allows to control all individual external pins of the device from GUI SW.

NXT pulses with accurate frequency can be provided from microcontroller when “MCU” check box is selected. When “External generator” check box is selected, the microcontroller’s IO pin is configured as input and NXT pulses can be provided from external source. There is also a possibility to send Burst of defined number of NXT pulses from microcontroller via writing required number into text box and clicking on “Send burst” button. On top of that, advanced “NXT frequency profile...” generator is available, for more details see dedicated chapter.

Please note, that on NCV70514 device, pins RHB, STEP1 and STEP0 need to by physically connected from mother board to daughter board by additional wires, these signals are not available on daughter board connectors from compatibility reasons. Control of these signals via SW GUI will not work without this patch.



NXT Pulse Generator

Beside the continuous sending of NXT pulses and sending Burst with defined number of NXT pulses, dedicated “NXT frequency profile” window exists and can be open either from “Application” menu or via “NXT frequency profile” button. Profile contains starting speed, acceleration phase, target speed, deceleration phase and end speed – any of which can be modified. Value is entered in Full Steps per second [FS/s] and according to selected step mode recalculated to NXT frequency fNXT. Please note that “Step Mode” in this window does not affect real Step mode programmed in the NCV705xx device, it serves just for recalculation of FS/s to fNXT and resulting fNXT is provided to NXT pin of the device. Number of full steps in each phase can be entered in bottom part of the window. Profile is then applied by “Send profile” button.

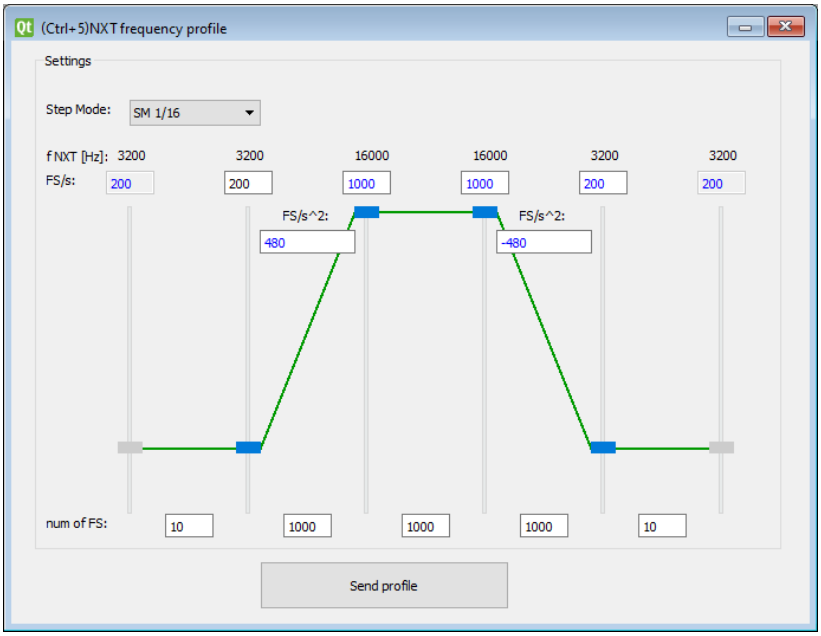


Figure 4. “NXT Frequency Profile” Window

BEMF Characterization Tool

Back electromotive force (Bemf) voltage generated by the stepper motor is directly related to the speed of the motor rotation. The voltage is measured by NCV705xx family devices and result is provided in SPI register. Bemf voltage can be used for Stall detection in the application. However detailed characterization is usually required (including speed, load, battery voltage, temperature).

BEMF characterization tool allows to characterize the setup and find resonant frequencies which should be avoided during operation. Speed of rotation can be swept in user defined range and at each speed the Bemf register is read out multiple times to obtain enough statistical data.

Steps to perform Bemf characterization:

1. NCV70517/NCV70514 device has to be setup with required parameters: set motor current IMOT[3:0]/IRUN[3:0], select required Step mode in SM[2:0] register and enable H−bridge by MOTEN=1,
2. Set SpThr[7:0] register to 255, this will enable Bemf register reading for all speeds
3. In “BEMF characterization” window set required range of NXT pulse frequencies for the characterization and set the step in between
4. Select how many samples at each frequency should be read out
5. Click “Launch”, select folder where file with measured values should be saved.
6. Measured values become appearing in the graph area

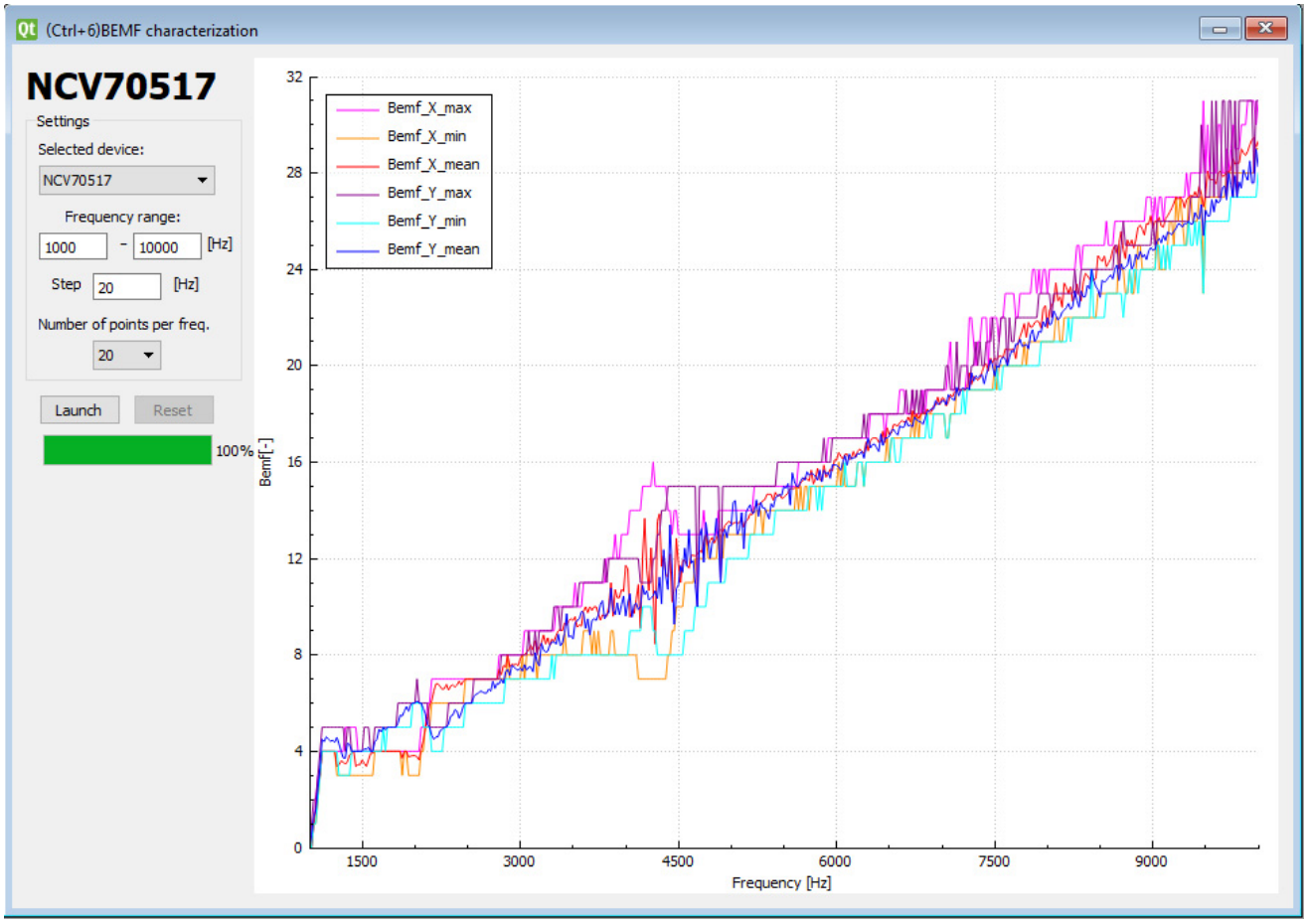
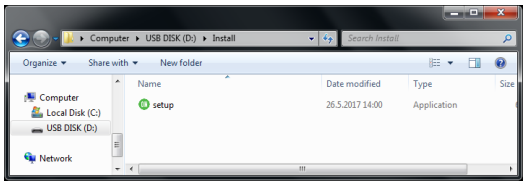


Figure 5. "BEMF Characterization" Window

Installation of GUI SW

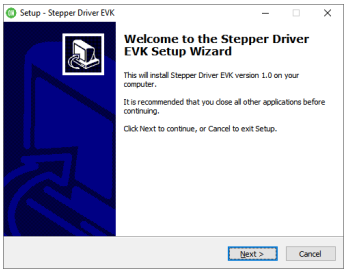
In case the USB drivers for GUI SW are not yet present on PC, the following procedure should be used:

1. Run "setup.exe" installer:



2. Follow instructions and click Next button until finish:

a)



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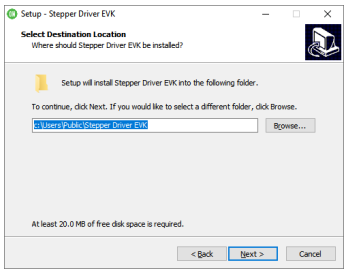
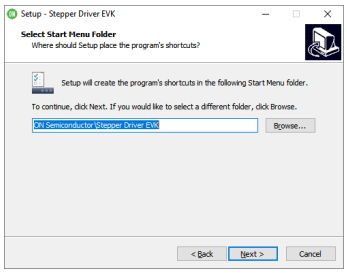
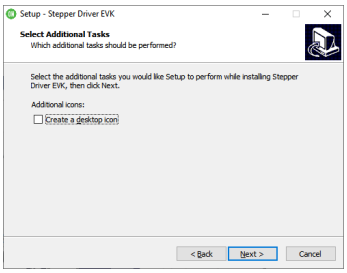


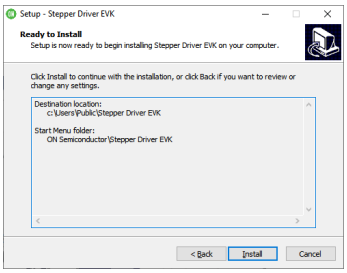
c)



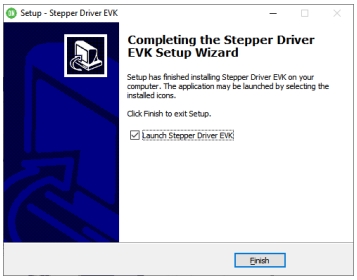
d)



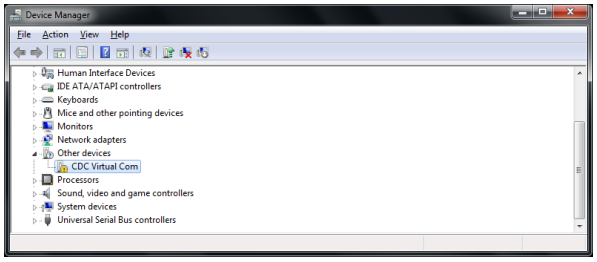
e)



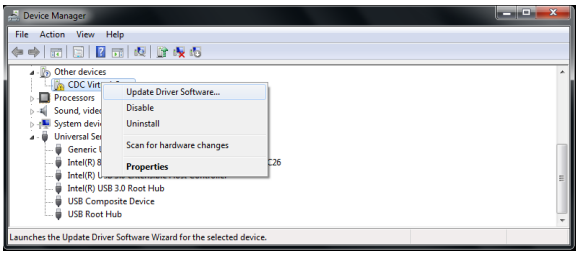
f)



3. Connect USB mini cable to PC
4. Open Device Manager (Press Win+R and type ***devmgmt.msc***)

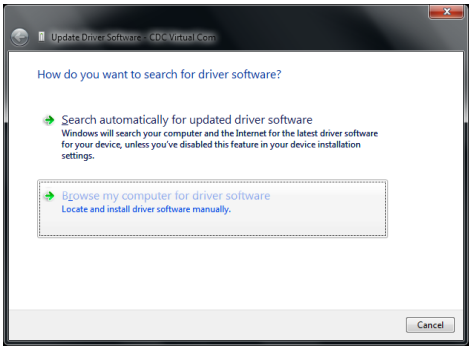


5. Update Driver of not correctly installed device “CDC Virtual Com” by Right button click and select “Update Driver Software”



6. Select “Browse my computer...” then “Let me pick from a list...”

a)



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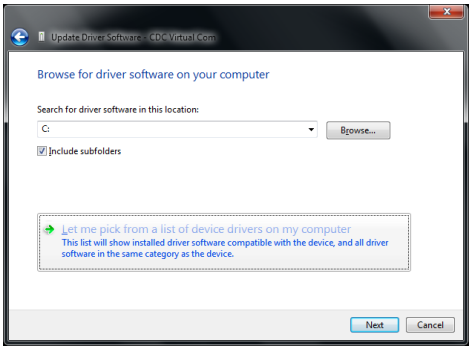
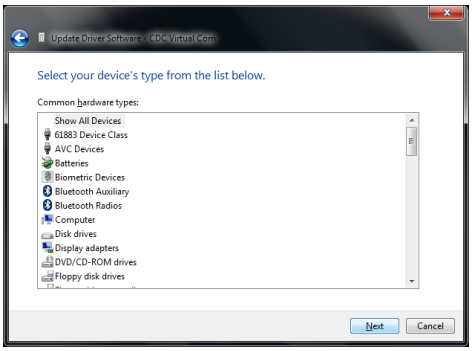


7. Click on “Next” then click on “Have Disk...”

a)



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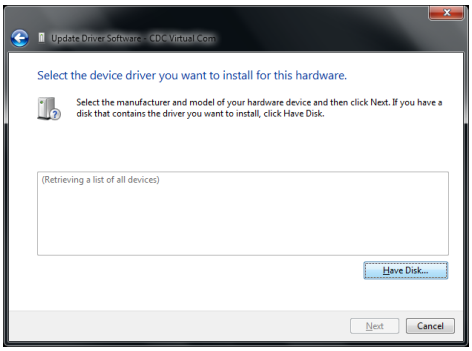
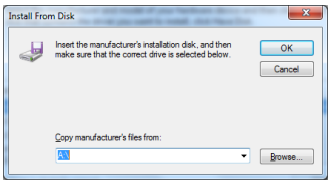
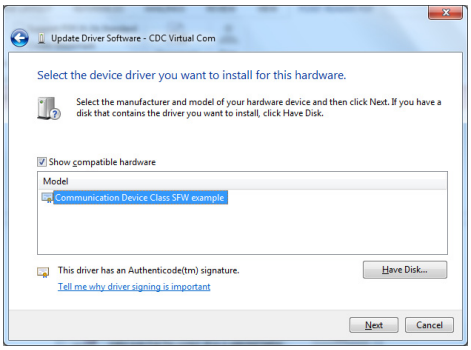


8. Click on “Browse” and select path to driver − default location is “C:\Users\Public\Stepper Driver EVK\driver” if not changed during GUI SW installation



9. Click on “OK”, “Next” and “Install”

a)



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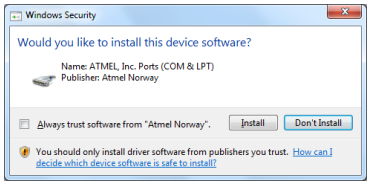
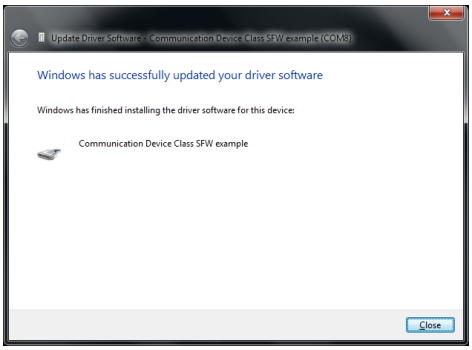
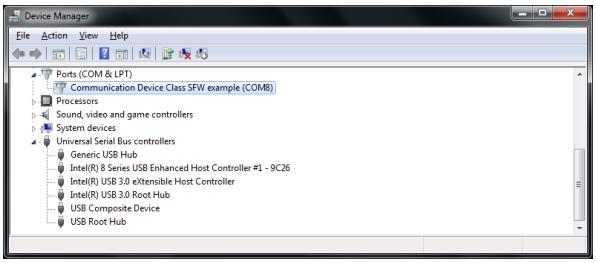


10. Finish USB Driver update by click on “Close”



11. Verify COM port device “Communication Device Class SFW example”



Evaluation Board Schematic

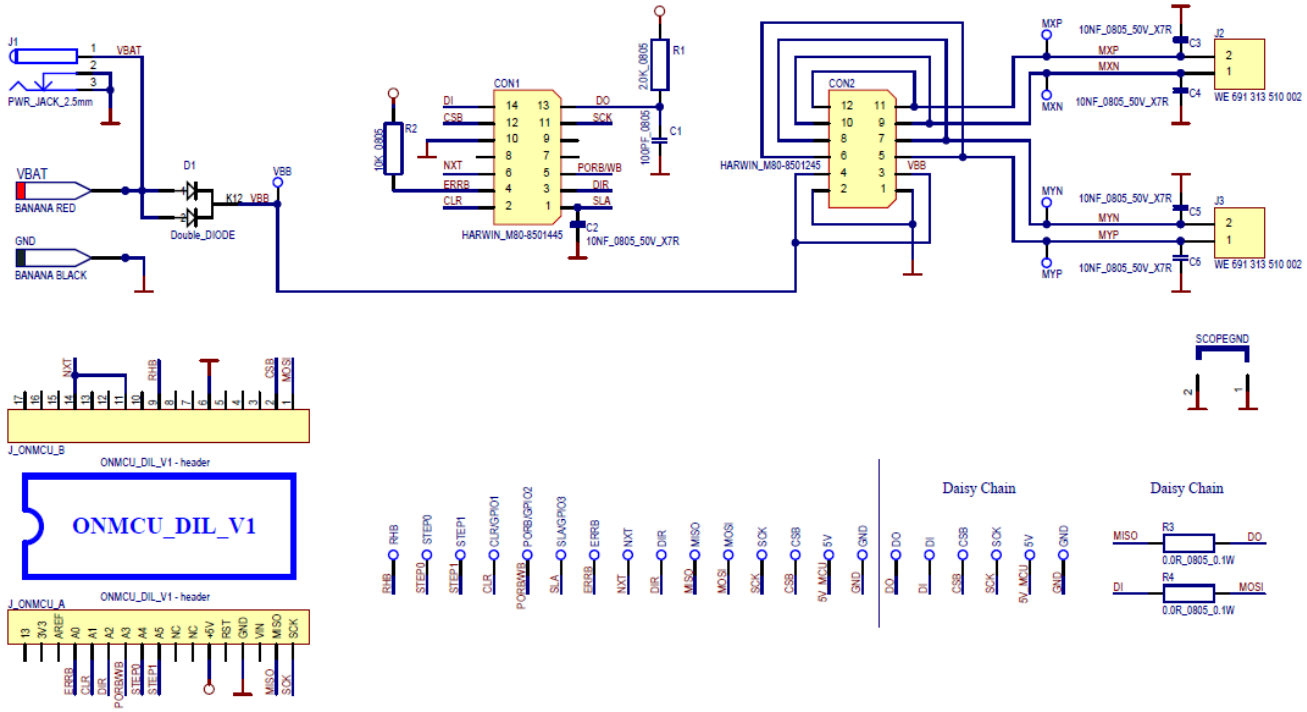


Figure 6. Schematic of SPI Stepper Driver EVK Mother Board

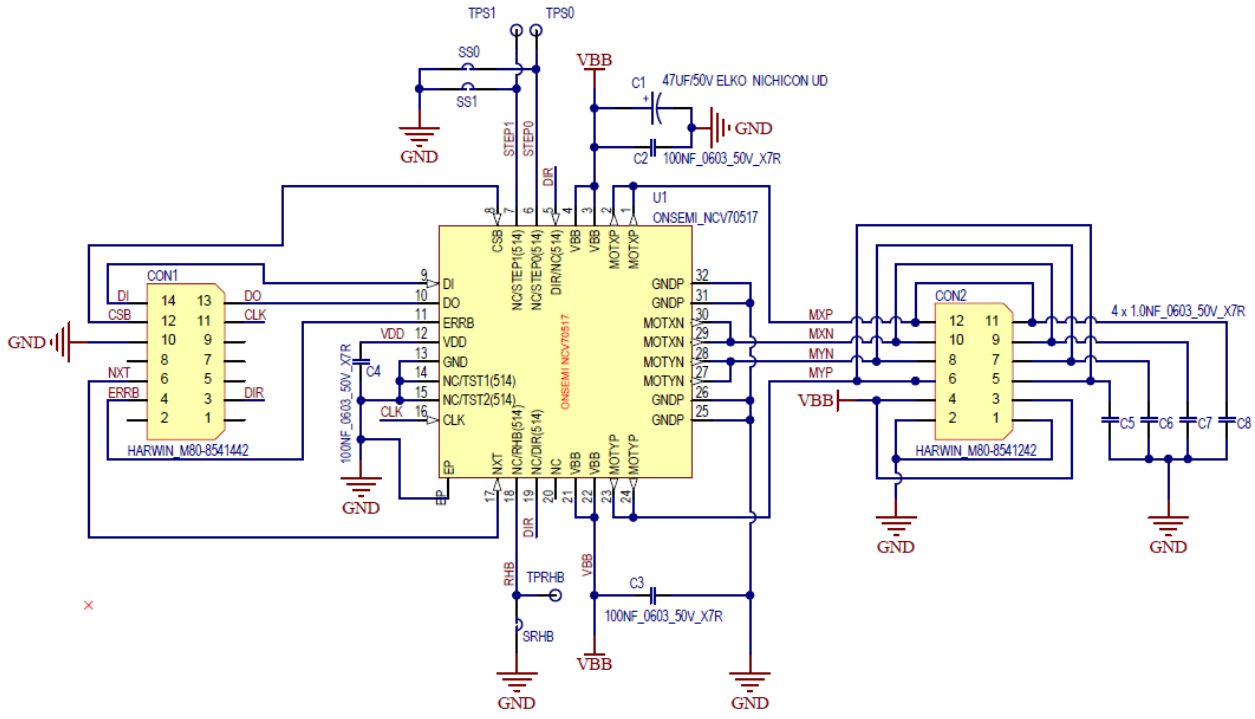


Figure 7. Schematic of NCV70517/NCV70514 Daughter Board

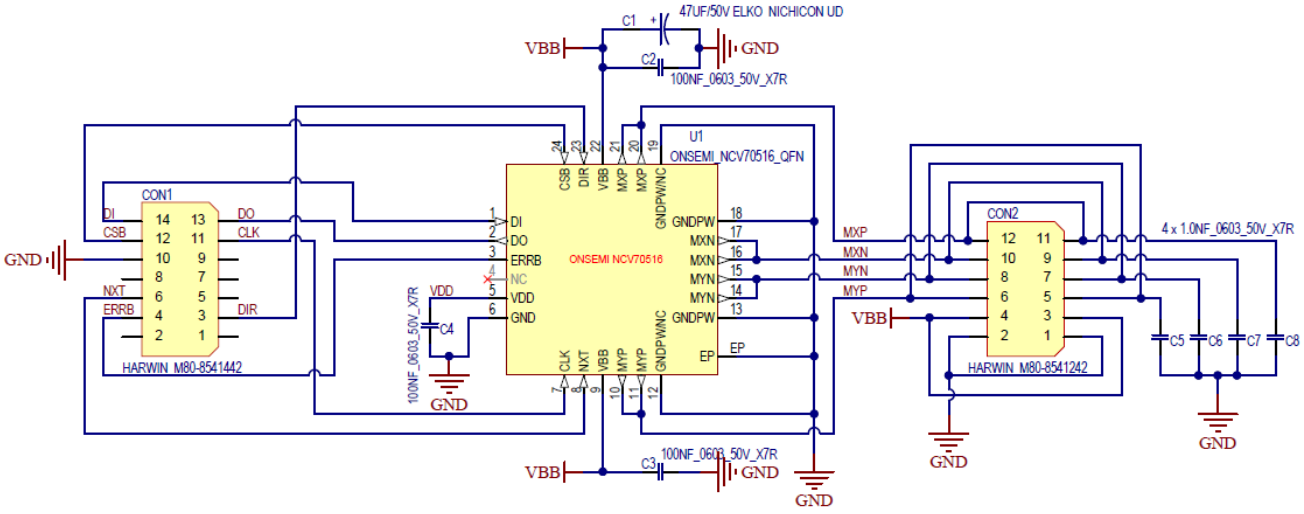


Figure 8. Schematic of NCV70516 Daughter Board

References

[1] ON Semiconductor, NCV70517−D: Micro−stepping Motor Driver rev.0, December 2018
[2] ON Semiconductor, NCV70514−D: Micro−stepping Motor Driver rev.5, March 2019
[3] ON Semiconductor, NCV70516−D: Micro−stepping Motor Driver rev.1, June 2018

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