EVBUM2683/D

Register Configurable Single-phase BLDC Motor Driver Evaluation Kit

ON Semiconductor®

www.onsemi.com

EVAL BOARD USER'S MANUAL

GUI ver. 0.3.0.0
FW ver. Flash_LV83xx_1p3

Overview

This Evaluation Kit is designed to provide an easy and quick development platform for LV8324C, single−phase BLDC motor control applications.

This device has the following unique features.

- Communication mode using a standard fan inter face (PWM and FG)
- Control parameters change on−the−fly
- Digital emulation of an input PWM duty cycle
- Store the parameters and configurations to the on−chip nonvolatile memory

To activate these features, the mother board with a microcontroller is included in the kit, which communicate via USB with the PC based graphical user interface (GUI), and via PWM – FG with the device. The kit consists of:

1. The Motor Driver Evaluation Board (EVB)
2. Mother Board
3. USB Cable Type A to Mini B
4. Graphical User Interface Software (download from the web site)

Quick start

The evaluation board is programmed to work standalone without PC. The following procedure allows the operation of most motors with the default parameters that are preloaded into the device.

step 1. Connect a motor to J3
step 2. Connect PWM signal to the pin labeled "PWM"
step 3. Connect a power supply to Power pin.
step 4. Turn on power supply

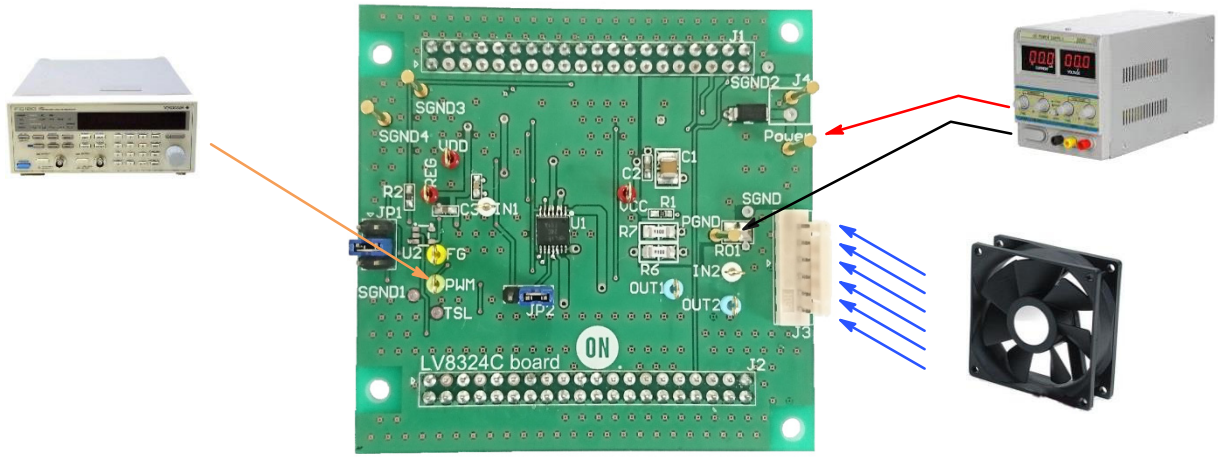


Figure 1. LV8324C Evaluation Board

HARDWARE DESCRIPTION

NAME AND FUNCTION

1.	Daughter board	The main board which works standalone (without the mother board)
2.	Mother board	It contains a microprocessor to communicate with a graphical user interface (GUI) program running on a PC.
3.	Power pin	Main power input pin
4.	Connector J3	Motor windings and signals related Hall
5.	Pin PWM	PWM input (Do not connect anything when GUI is used.)
6.	Pin FG	FG output (Do not connect anything when GUI is used.)
7.	Connector J1 on the mother board	USB connector (mini)
8.	IC U1	LV8324C

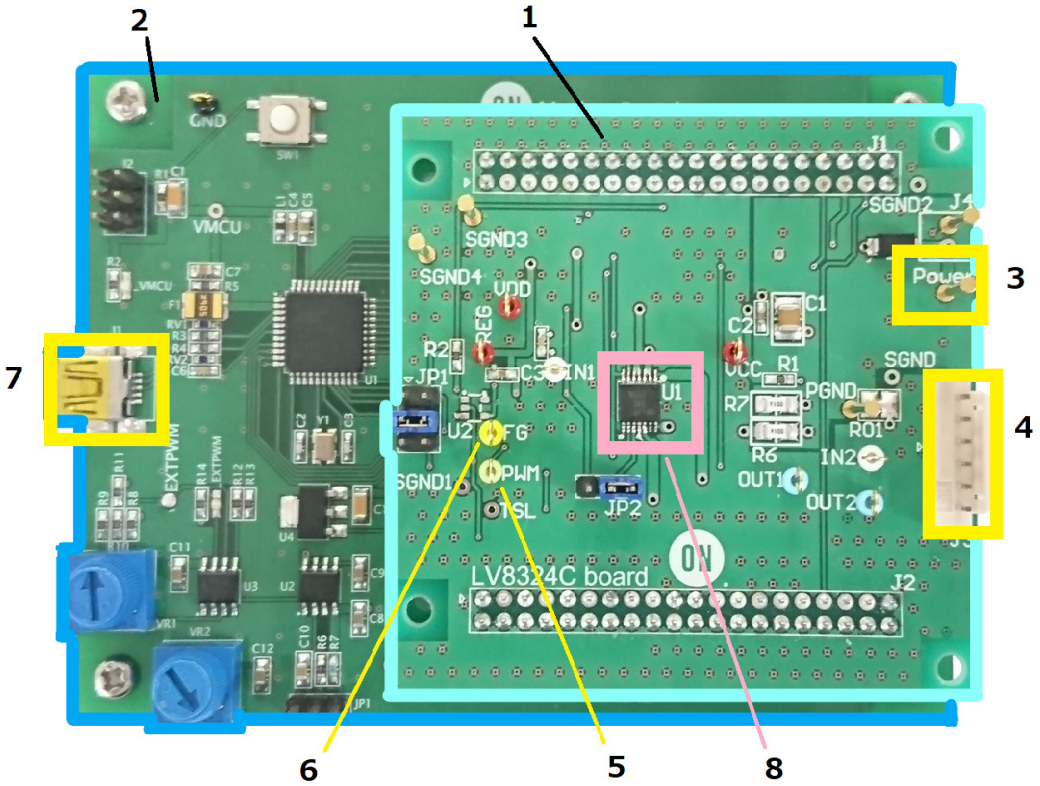


Figure 2. Connectors and Key Parts

Power Supply

Power pin is the main power supply pin. The outputs of a power supplier will be connected to this pin. The boards can handle the operating supply voltage range.

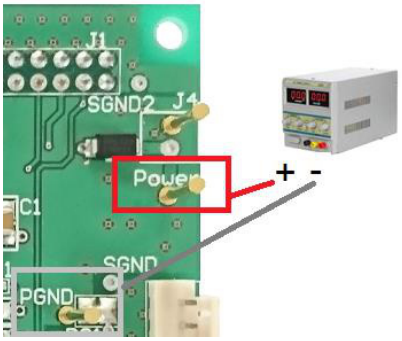


Figure 3. Main Power

Motor

J3 is the motor connector.

Pin #	Silk Label	Connected to
1	OUT2	motor winding 2
2	OUT1	motor winding 1
3	IN2	Hall signal +
4	IN1	Hall signal -
5	GND	ground
6	HB	Hall bias

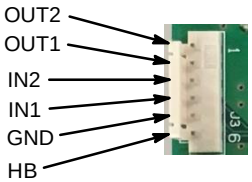


Figure 4. J3 Motor Connector

JP1 and JP2 Settings

When EVB is combination with the mother board, JP1 must set to 3−4 short, and JP2 must set to 1−2 short. Please refer to Figure 5 and Figure 6.

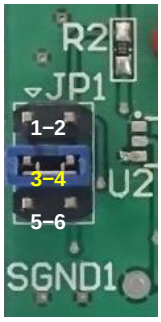


Figure 5. JP1 Setting

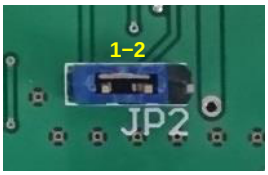


Figure 6. JP2 Setting

External PWM Input

When EVB is attached to the mother board, the external PWM signal must not input to PWM pin as shown in Figure 7. If the external PWM pulse inputs to PWM pin in this situation, signal generator conflicts with microprocessor and EVK may be broken. The external PWM input and the GUI communication are exclusive use.

If the external PWM pulse inputs to PWM pin directly, detach the mother board from EVK to prevent the microprocessor damage.

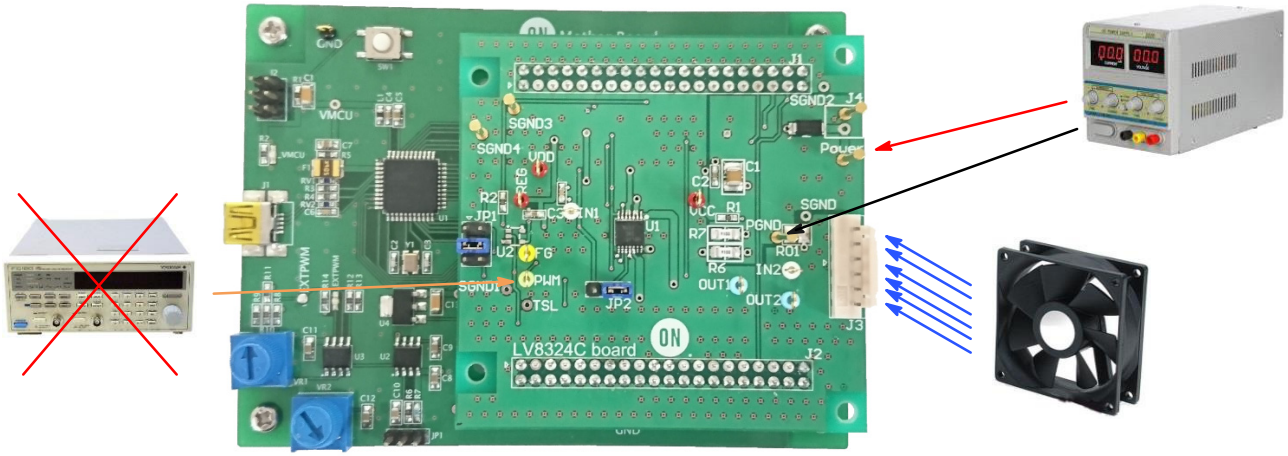


Figure 7. The External PWM Signal Input to EVB Combination with the Mother Board

GRAPHICAL USER INTERFACE PROGRAM

This evaluation kit turns most motors with the default settings out of the box. The strength of this device however, lies in its flexibility to be optimized for each individual motor or user requirement without electrical circuit change. The relevant parameters inside the IC are accessed through UART interface. A graphical user interface (GUI) program, running on a Windows PC (Windows 7 and Windows 10) is available to access these parameters. Please note that the system running this program requires .NET Framework 4.5.1. By using this program, users can tweak the parameters, select the features and monitor the motor status.

User Interface Overview

After program launch, the main window of the GUI appears. It is subdivided into the following areas.

Figure 8.

- A: Product Selector
  Selects the ON Semiconductor IC to be controlled with this GUI
- B: Oscilloscope
  Displays various system relevant signals over time
- C: USB Connection Box and Power OFF button
  Manage the USB connection between Computer and EV−Kit and turn it off with terminating the communication
- D: Fault Register
  Displays detailed system faults
- E: Identify Device
  Shows device P/N and feature
- F: Manipulation Window
  Allows motor control and real time access to system parameters
- G: Event Log displays
  Relevant system messages for debug purpose
- H: Event Log Control
  Clears or saves the system messages

GUI Installation

Program installation is required for first time use. The installation is described in “Device Driver and Program Installation”. Administrator rights are necessary.

Basic GUI Operation

These basic instructions explain how to:

1. Setup the board
2. Start the GUI
3. Link the board
4. Oscilloscope
5. Command Window
6. Fault Messages
7. Configuration Window
8. Register Map Window

1. Setup the Board

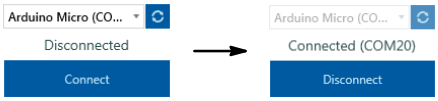
A motor and power supply should be connected as described in Figure 1 and connect USB cable to connector J1 in Figure 2 and PC’s USB port. When USB cable is connected to the PC, the mother board controls the power not to go to a motor then the motor stops the rotation. If it is the first time to connect the board by USB, the device driver installation is required. See “Device Driver and Program Installation”.

2. Start the GUI

The program is started from “Start menu > ON Semiconductor > Motor Driver Evaluation”. The program will start when “LV8324C_EVK” is selected.

3. Link the Board

The software should find the COM port with the Arduino Micro on its own and list it in the connection box above the button. By clicking the “Connect” button, the communication between PC and the board begins. If the link was successful, the message “Connected (COM#)” is shown above the button. Where the COM# is the name of USB−COM port, and the button text is changed to “Disconnect”.



If the message “Disconnected” is still shown above the button the link failed. Sometimes this happens if the USB installation has not finished. A port re−scan can be initiated by clicking the circular arrow button at upper right of the window.

This searches the board through the USB ports again. The “Connect” button should be re−tried afterwards.

If the power or USB connection is interrupted the GUI will return into “Connect” mode.

While the GUI and board are disconnected, the board runs by itself. “Power OFF” button also turns off the power with terminating the communication between GUI and IC.

4. Oscilloscope

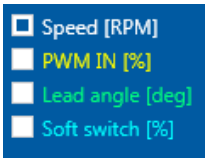
Operation

An oscilloscope type graphic window (B) is provided which can plot the following values:

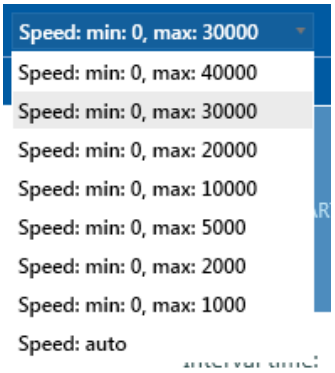
- the motor speed,
- the input PWM duty cycle,
- the lead angle
- the soft switch depth.

For example, to monitor the motor speed:

1. Check the check box “Speed [RPM]”



2. Select vertical axis scale if needed



3. Click play button

4. Click “Run” button

Save Data

The oscilloscope also includes a recoding function. The CSV button exports data in a .CSV (comma separated values) format file.

The file can be read with Microsoft Excel. The maximum data length is 5000. The sampling interval can be changed by the up−down menu next to the play button. All data traces are exported into the .CSV file, even if they are not displayed.

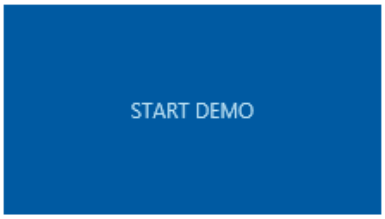
A screen copy function is also provided. It supports JPEG, JPEG FIF and PNG. Its button is located next to the CSV button.

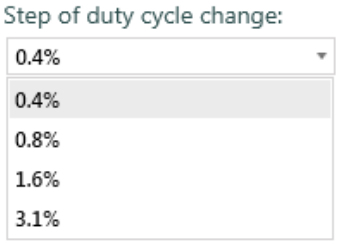
5. Command Window

Demo

Self−run automatic demo mode is provided. Clicking “START DEMO” mode, the input PWM duty cycle will applied. Its duty cycle is automatically ramped up and down between 0% and 99.6%. The up down time interval and duty cycle step can be selected.

When the “STOP DEMO” button is clicked, increment or decrement of duty cycle is stopped.





PWM Duty Cycle Manipulation

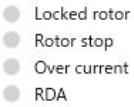
The software (register) PWM duty cycle can be changed with the slider bar or number. When the “Update value” button is clicked, the duty cycle value on the panel will be send to the device.

Run/Stop a Motor

While the GUI is connected with the EVB by the “Connect” button, the device is in communication mode. It might be useful to activate motor driver output in this communication mode. The radio button “Standby” inactivates the output, and “Run” activates the output.

6. Fault Messages

While connected, the GUI will display real time system fault messages in the Fault Register (D).



Following is a list of the faults and possible remedies:

- Locked Rotor alerts the locked rotor situation. The motor doesn’t rotate unexpectedly
- Motor stop indicates that a motor stops
- Over current alerts that the over current fault is detected
- RDA alerts that motor rotational speed is lower than the defined threshold

7. Configuration Window

When the tab named “Config”. in the area (F) is selected, the parameters and functions can be set. The each serial port register is titled by its name specified in the data sheet with a brief description. For some of multiple bit registers, the three−way input method is provided. It can be set with a slide bar, physical value or direct code. The tabbed windows have “Edit mode” button to change the values and settings.

And, once the “Update value” button is clicked, the registers will be updated. And, the profile linear interpolation will be recalculated.

After update, the settings on this window can be write to the nonvolatile memory in the device with the “Write to NVM” button in Register Map Window. Refer the “Register Map Window” for the detail.

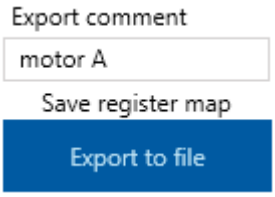
8. Register Map Window

The parameter settings modified in “Configuration Window”, are applied to the device registers. In this window, the register map is shown, reading back from the device registers. Where the cell color

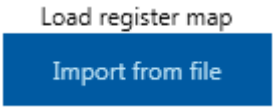
- green represents 1
- white represents 0
- dark red represents 1 of a read−only register
- pink represents 0 of a read−only register

Whenever the bit cell is clicked, 1 and 0 is toggled. Clicking over the register address or name cell, the byte based modification is activated.

For use of next time, the register map can be saved to a CSV file with “Export” button. Optionally, you can add a short note in to the first line of the CSV file with the “Export comment” text box before saving the file. The CSV file name character requires ASCII code.

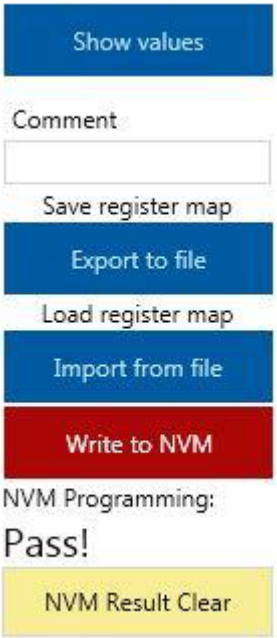


And, the “Import” button loads the register map values from a CSV file to the device registers directly.



The format of imported CSV file has to be same as the format exported CSV file from this GUI.

After the parameter optimization, the setting can be stored into the nonvolatile memory (NVM) in the device by “Write to NVM” button in this page. Please notice that NVM operation needs 14 V supply voltage at least and runs at room temperature. When “Write NVM” succeeds, the message “Pass!” is shown as below.



When other messages are shown, NVM programming is failed. In this case, check the operation and the GUI communication again.

EXAMPLES

Speed Profile

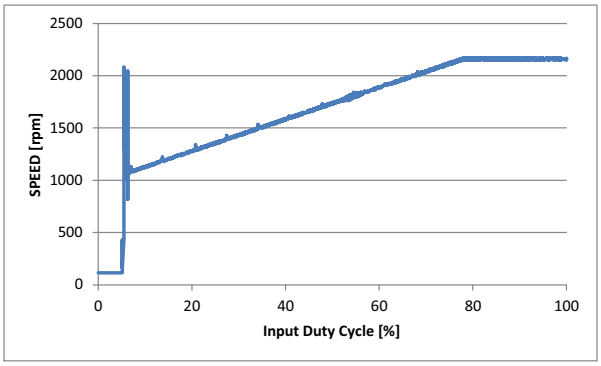
As an example, the speed profile is checked with the following parameters, using LV8316H.

The parameters are:

Duty cycle low side:	3.5%
Duty cycle high side:	78.0%
Target speed min.:	1,030 rpm
Target speed max.:	2,160 rpm
At lower duty cycle:	stop
At higher duty cycle:	max. speed

Procedure:

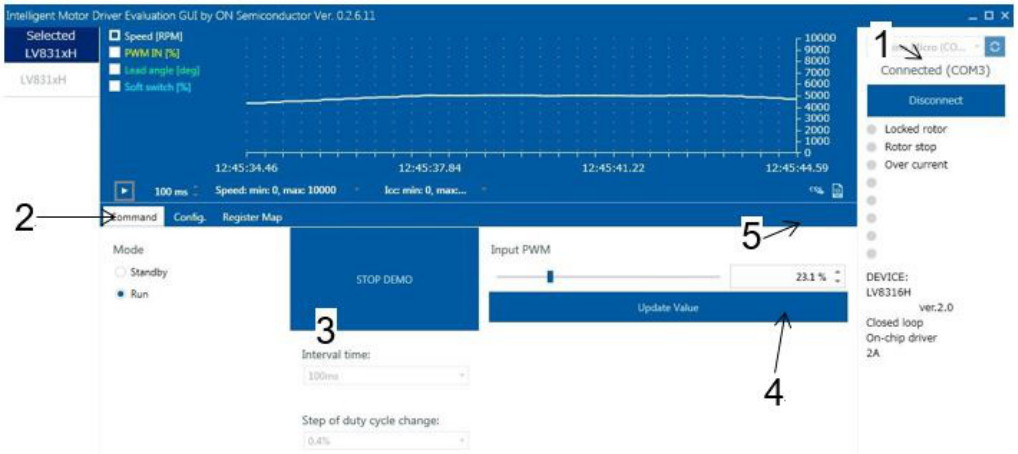
1. connect
2. click play button of the oscilloscope
3. click START DEMO button
4. wait for the duty cycle gets to 100%
5. save plots as a csv file
6. open csv file by Microsoft Excel



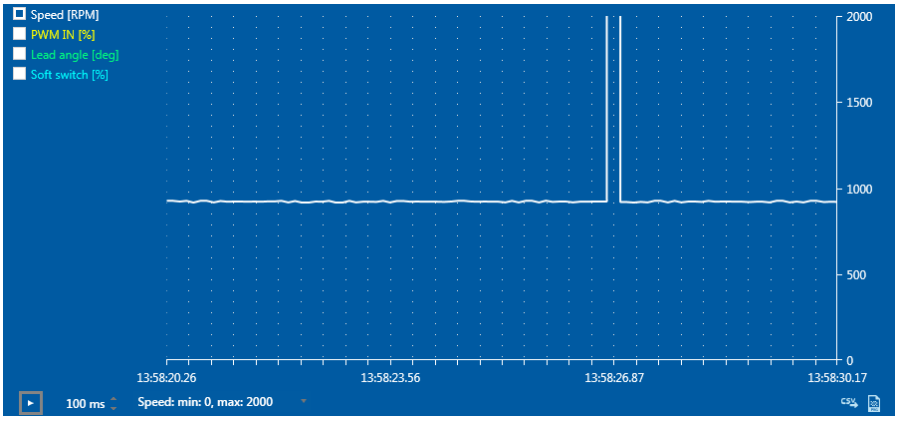
The spike at the lower duty cycle point is overshoot at start up.

Communication Data Corruption

There is a limitation in the motor speed plot. Due to the timing of the read operation from the speed registers, it shows abnormal speed change. But, an actual motor and a device don't work abnormally.



Example demo

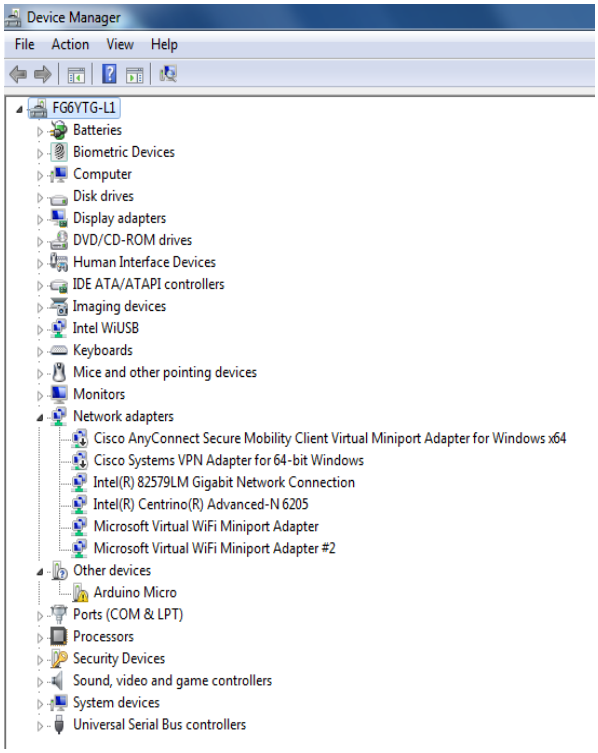


Communication data corruption

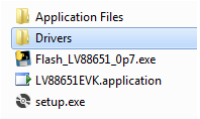
Figure 9.

DEVICE DRIVER AND PROGRAM INSTALLATION

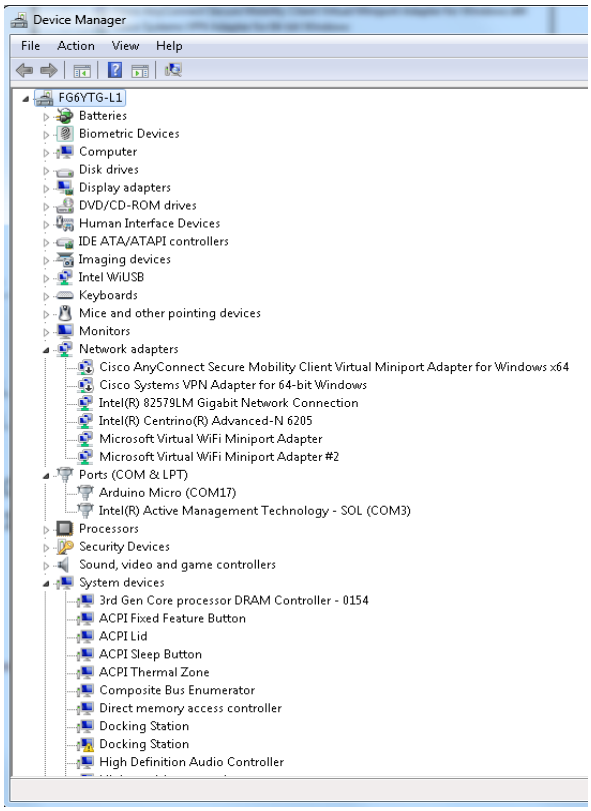
1. In case of the version up of this program, uninstall older version
   a. Open Start menu > Control Panel > Programs and Features
   b. Find “LV8324C_EVK”
   c. Click right
   d. Select “Uninstall/Change”
   e. Select “Remove the application from this computer”
   f. Clik “OK”
2. Unzip the program package
3. Connect the power supply to the EVB
4. Connect the EVB to the PC using the USB cable. Steps 5 to 13 show the driver installation procedure. It is required only for the first time when the “ON Semiconductor Motor Driver Evaluation Board” is connected to the USB port
5. The Windows OS will try to install driver on its own. Wait for 5−10 minutes. Installation will fail
6. Click on the Start Menu, and open the Control Panel
7. Open the Device Manager
8. If “Arduino IDE” has already been installed, either under “Ports (COM & LPT)” or “Other Devices” you should see an open port named “Arduino Micro”.
   If not, “USB Serial Device” can be found in either under “Ports (COM & LPT)” or “Other Devices”. In this case, you should find the port connected to “Arduino”



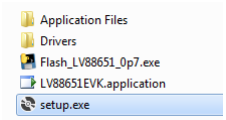
9. Right click on the “Arduino Micro” or “USB Serial Device” port found in #8 and choose the “Update Driver Software” option
   a. If the update driver software option is not available, then the Windows OS is still trying to install the driver on its own. Please wait till the OS finishes self−try
10. Next, choose the “Browse my computer for Driver software” option
11. Finally, navigate to and select the driver file named **“arduino.inf”**, located in the “Drivers” folder



12. Windows will finish up the driver installation from there
13. When the installation is successful, the recognized Arduino Micro port with the port number is shown in the Device Manager



14. Run setup.exe of the installation package

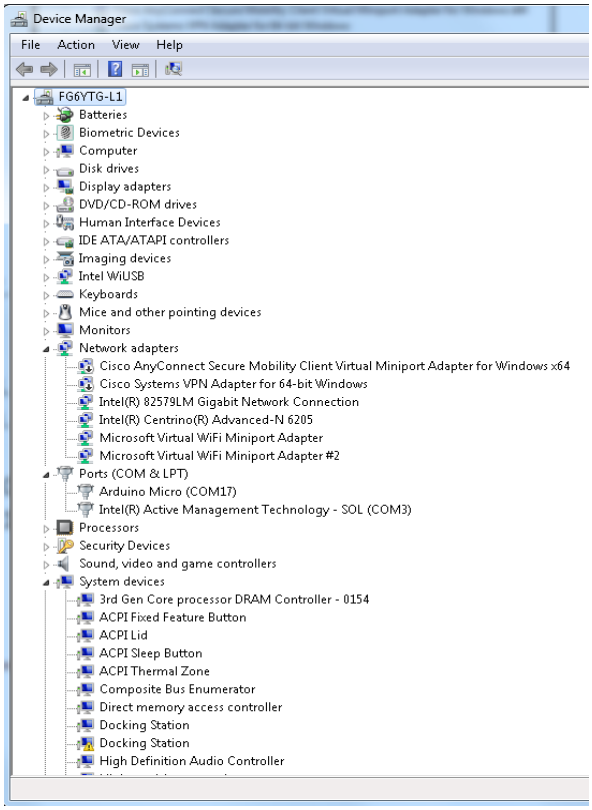


15. Launch the program

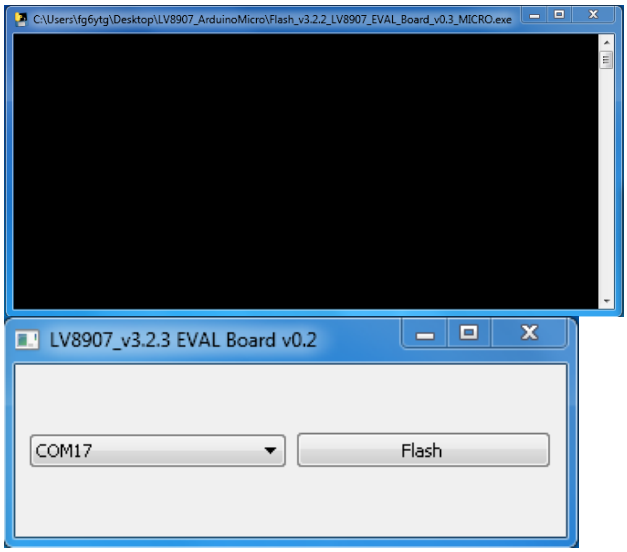
PROGRAMMING THE MCU

When the firmware of the on−board MCU must be updated, following steps are to be followed. Basically, the firmware is pre−loaded before shipment.

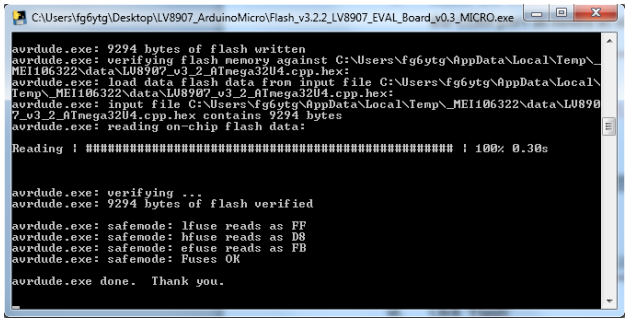
i. Ensure that the EVB is powered up and the USB cable is connected
ii. Note down the COM port number of the Arduino Micro from the Device Manager window



iii. Launch **“Flash_LV83xx_1p3”**. (The name of this file will be changed based on the revision.)
Or, for the Serial Communication Tool, **“Flash_LV83xx_1p3”** is required
iv. Two windows will open



v. Select the COM port from the drop−down menu to ensure that it matches with the COM port as noted in step (ii)
vi. Click “Flash”
vii. Programming of the on−board MCU is initiated



In case programming fails, unplug and re−plug the board, and re−launch the application. It may be because the required driver was not installed during first attempt.

viii. If the user want to program the MCU with their own source code, then use the on−board ICSP interface (refer schematic in Appendix A) to program the MCU with an external programmer

APPENDIX A SCHEMATIC

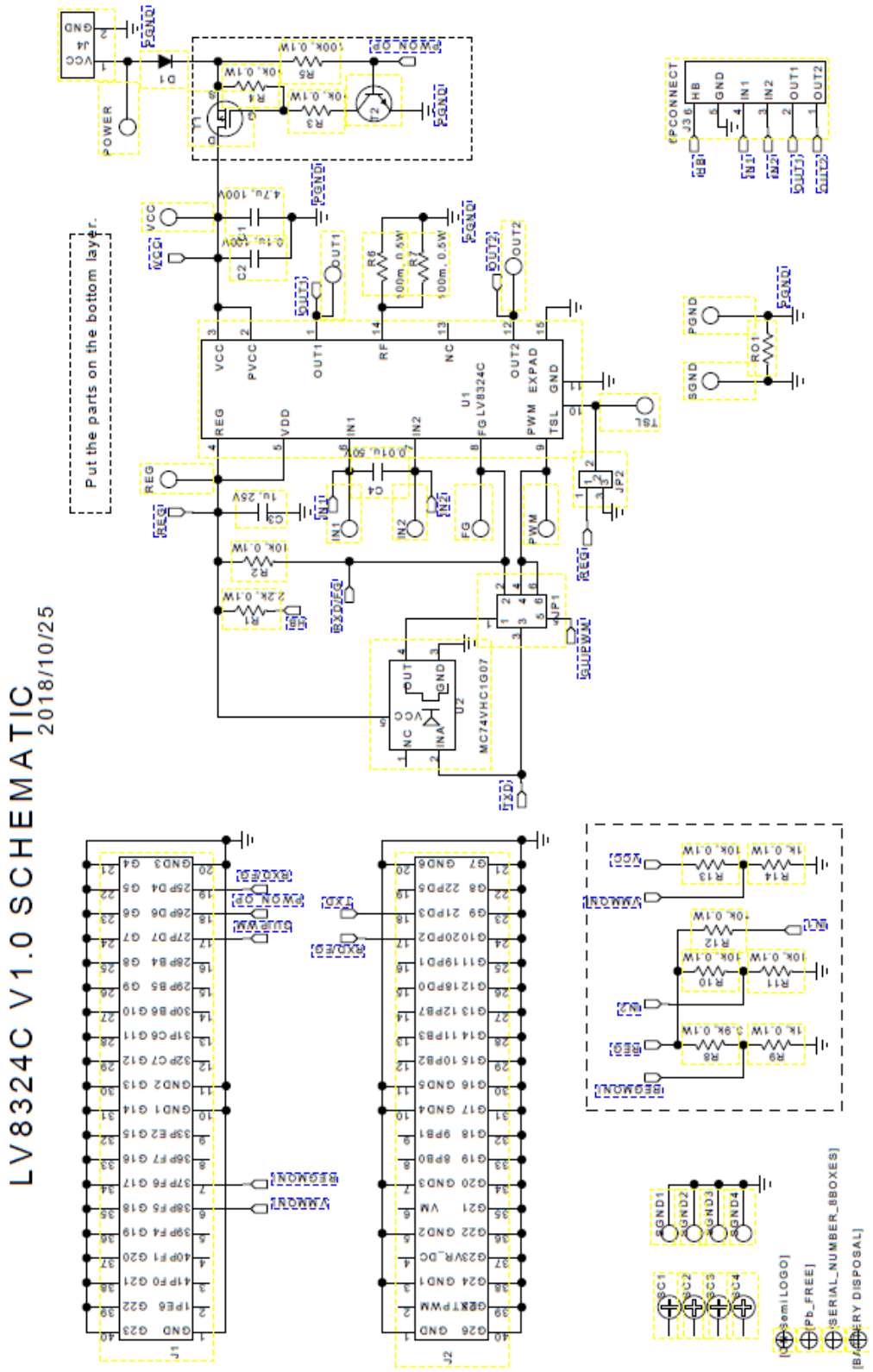


Figure 10.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Email Requests to: orderlit@onsemi.com

ON Semiconductor Website: www.onsemi.com

TECHNICAL SUPPORT
North American Technical Support:
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Europe, Middle East and Africa Technical Support:
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative

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