# ON Semiconductor®

LV8824QAGEVK
Evaluation Kit User Guide

1. Introduction

The LV8824QAGEVK evaluation board (EVB) provides a quick and easy evaluation of the functionalities. User needs to prepare an external power supply (7V-33V) for evaluation. The evaluation kit consists of 2 parts below.

1. LV8824QA Evaluation Board
   LV8824QAGEVK with on-board microcontroller circuit (Daughter board)
2. USB cable

LV8824QA Evaluation Board
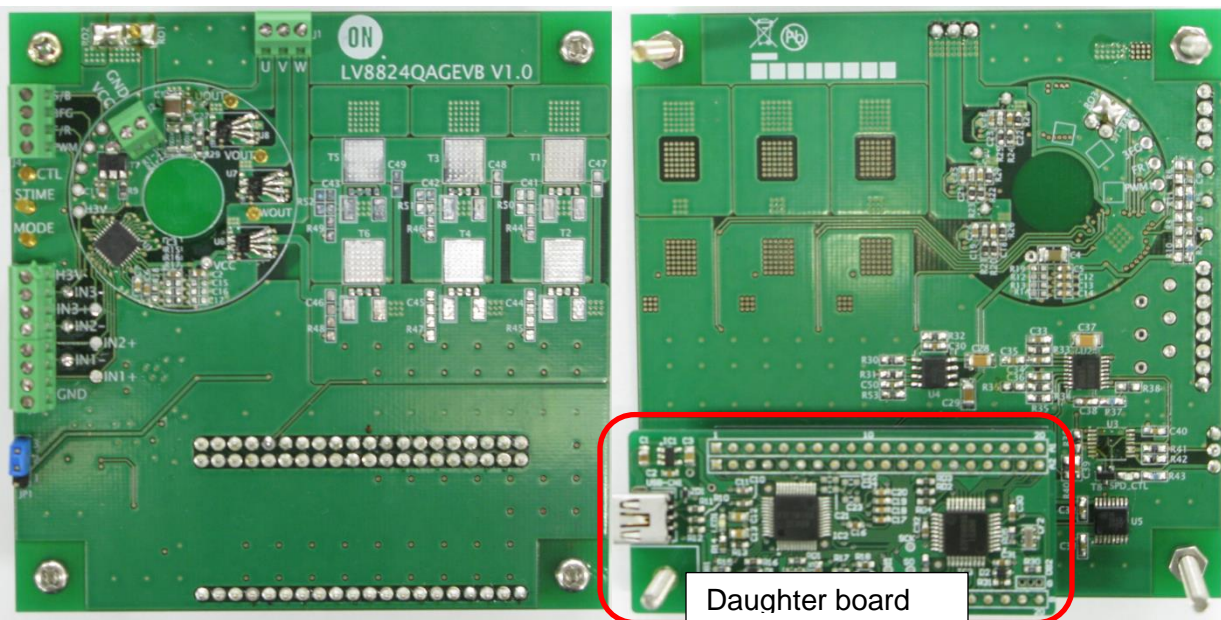
LV8824QAEVK top view　　　　　　LV8824QAGEVK bottom view

USB cable

Figure 1. LV8824QA Evaluation Kit

2. Features

The kit provides an integrated development platform to drive three phase BLDC motor. The key features are below.

– **LV8824QA Evaluation Board: LV8824QAGEVK**
  Daughter board can communicate with the PC by Graphical User Interface (GUI).

– **Graphical User Interface (GUI)**
  It can set/modify LV8824QA parameters in real-time

– **An example of small PCB layout within a circular shape. (1)**
– **Screw connectors to connect a motor and a power supply easily (2)**
– **Optional pads for higher power FETs (3)**
  See also the schematic (T1, T2, T3, T4, T5 and T6) in the appendix B
  Two types of the footprint: DPAK and SO8FL are applicable.
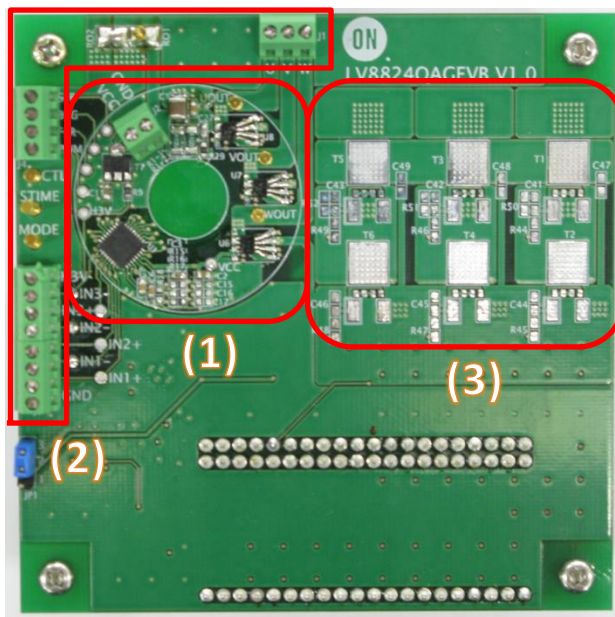
3. LV8824QA Evaluation Board (EVB) Overview

   This EVB has 2 connectors for BLDC motor, 1 connector for power supply and 1 connector to monitor the control signal and a daughter board for GUI. In addition, it can provide the platform to evaluate the performance with using the speed control IC; LB8503V.

J1 : Motor winding connector

 Connect BLDC motor to the connector "J1" in red rectangle in figure 2.

Figure 2. Motor winding Connector

J2 : DC power supply connector

 Connect power supply voltage (7-33V) to the connector "J2" in red rectangle in figure 3.

Figure 3. DC power supply connector

J3 : Hall sensor connector

  This EVB needs Hall sensor. Connect its output to the connector "J3" in red rectangle in figure 4 according to table 1.

J3	Hall sensor
H3V	VCC
IN3-	W channel -
IN3+	W channel +
IN2-	V channel -
IN2+	V channel +
IN1-	U channel -
IN1+	U channel +
GND	GND

Table 1 : Connection to Hall sensor   Figure 4. Hall sensor connector

  This EVB allows to connect a Hall IC. In order to do that, remove C12-14(6800pF) and mount R12-14(0Ω), R15-17(10kΩ) and R18-19(22K) and connect the output of Hall IC to the connector "J3" according to table 2.

J3	Hall sensor
H3V	VCC
IN3-	OPEN
IN3+	W channel OUT
IN2-	OPEN
IN2+	V channel OUT
IN1-	OPEN
IN1+	U channel OUT
GND	GND

Table 2 : Connection to Hall IC

JP1 : Switch for SPD-CTL

The short between Pin1 and Pin2 of the jumper "JP1" enables to use speed control IC; LB8503V for the evaluation. Review the LB8503V data sheet for the detail.
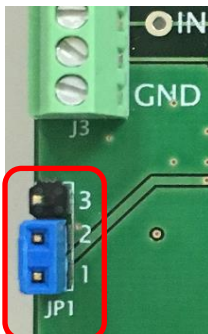

Figure 5. Switch for SPD-CTL

When Pin2 and Pin3 of "JP1" is shorted, it is normal mode. The signal to control motor rotational speed comes from microcontroller and becomes smooth with "R40" and "C39", then goes to "IN2-OUT2" of analog switch "U3". After that, it is input to Pin30; "CTL" of LV8824QA, as shown in blue in figure 6.

When Pin1 and Pin2 of "JP1" is shorted, it is speed control mode. The control signal from microcontroller is directly input to LB8503V as PWM signal whose duty cycle defines the motor rotational speed. LB8503V Pin16 "EO3" outputs DC signal and it goes to "IN2-OUT2" of analog switch "U3" then is input to Pin30; "CTL" of LV8824QA as shown in red in figure 6.
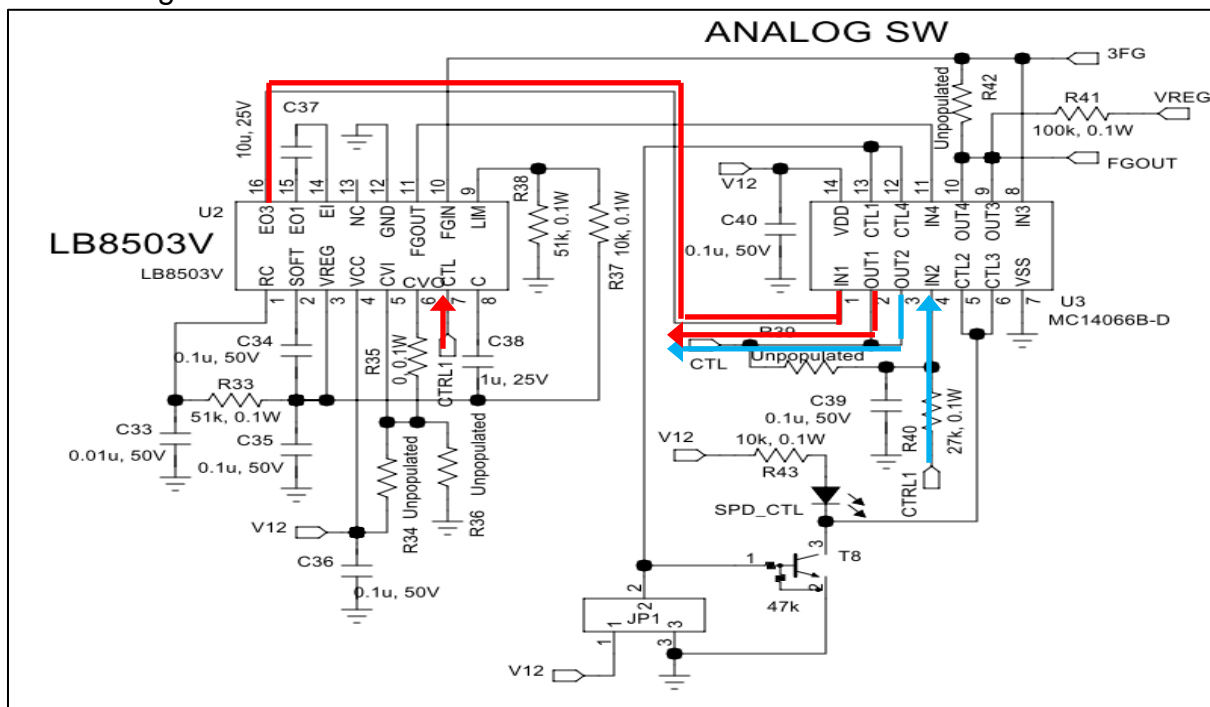

Figure 6. The flow of the motor speed control signal

R1-1-2: Sense resistors (Current limiter circuit)

The peak current of current limiter circuit is determined by the sense resistor R_F and the current reference voltage V_{RF} as following equation.

$$I_{OUT} = \frac{V_{RF}}{R_F}$$

Where,
I_{OUT} : Peak current = 4A
V_{RF} : Current reference voltage = 0.2V(typical)
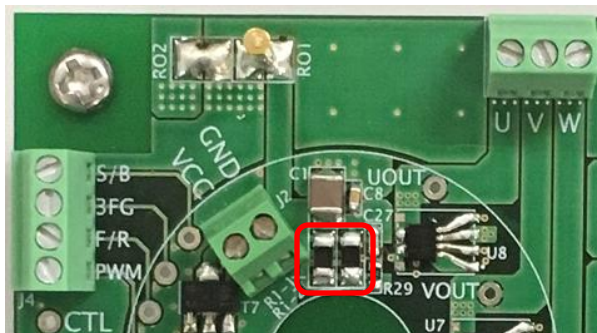R_F : Sense resistor (Default setting value is 0.05Ω.)

Figure 7. Sense resistors

4. Graphical User Interface (GUI) Installation

  LV8824QA GUI is free and an easy-to-use tool. Perform the following steps to get started. This GUI will work with the Windows 7 (32bit, 64bit) and Windows 8 (32bit).

(1) Unpack the zip file **"M-DrAGON_version1136.zip"**, and confirm the files below are extracted.
"M-DrAGON_version1136.exe", **"M-DrAGON_driver.inf"**
"LV8824QAGEVK_USER_GUIDE-D.rev0.pdf"

(2) Connect the LV8824QAGEVK to the PC with the USB cable.
Steps (3) to (11) show the USB driver installation that refers to the case of Windows8 (32bit). The layout and procedure might be different by the operating system. These procedure are required only one time when the LV8824QAGEVK is connected to the USB port at first time.

(3) The Windows OS will try to install driver on its own. However, after a few minutes, the installation will be failed.

(4) Click on the Start Menu and open the Control Panel.

(5) Open the Device Manager.

(6) Find an open port named "USB-MiconI/O Controller" under "Ports (COM & LPT)" or "Other Devices". Right click on it and select "Update Driver Software" option.
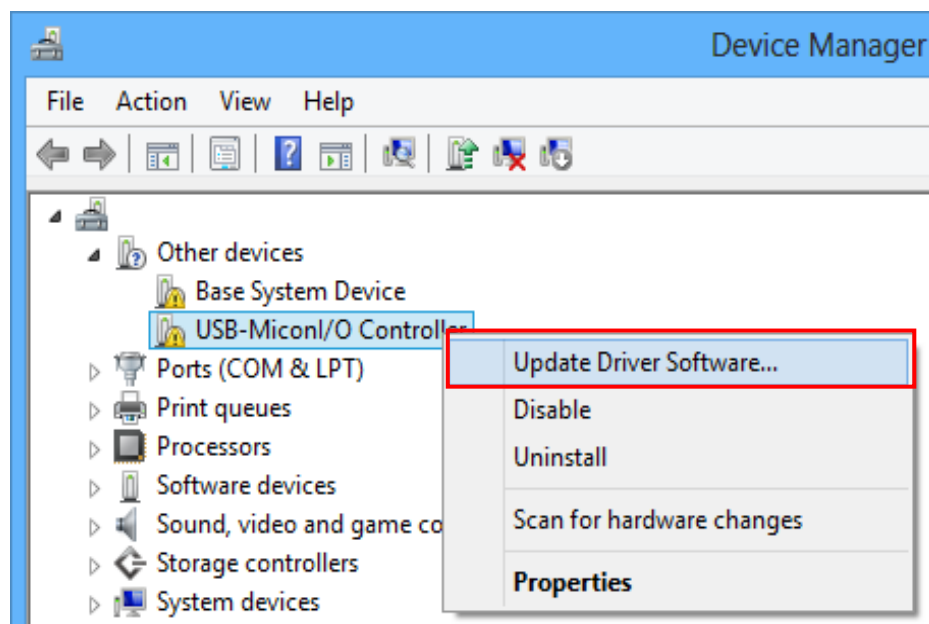

Figure 8. Device Manager-1

If the option is not selected, the Windows OS is still trying to install the driver on its own. Wait for the completion of OS self-try.

(7) Select "Browse my computer for Driver software" option as the left in figure 9.

(8) Select **"M-DrAGON_driver.inf"** located in the "M-DrAGON_driver" folder and click "Next", then the installation is started.
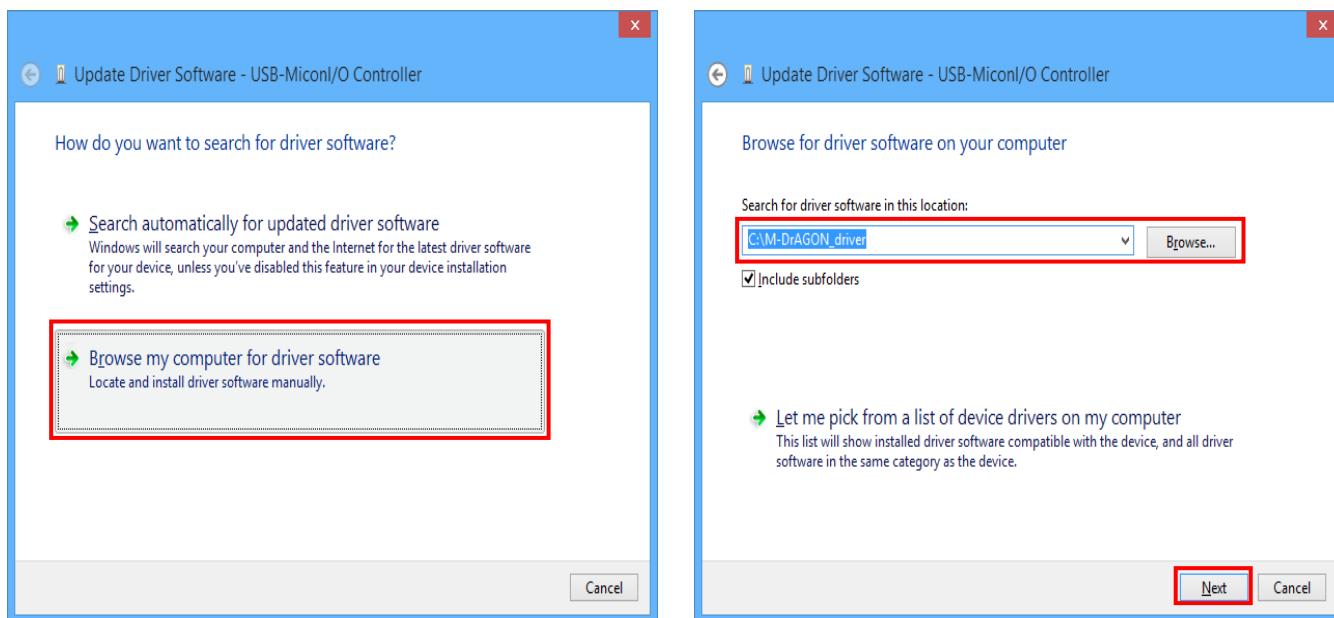
Figure 9. USB-MiconI/ O Controller-1

Note) If "Windows security" is shown, select "Install this driver software anyway".
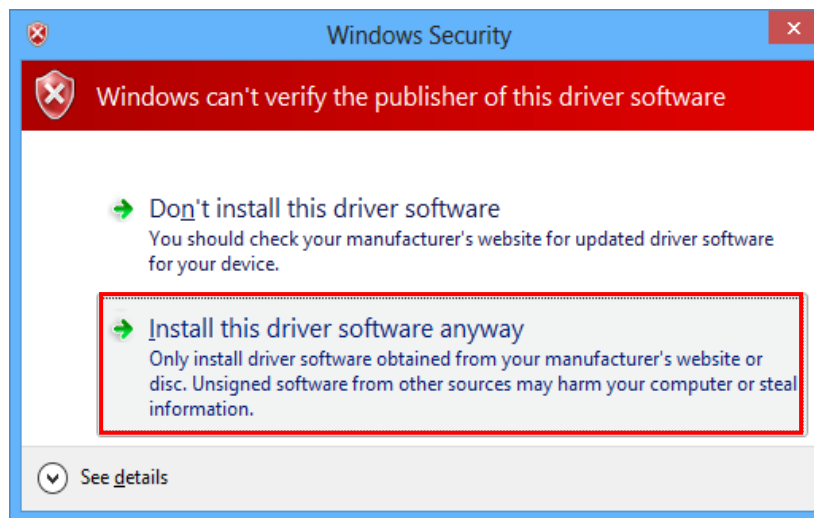
Figure 10. Windows Security

(9)   When the installation is finished successfully, figure 11 is shown. Make sure that new port for "M-DrAGON I/O Controller" is assigned in the Device Manager.

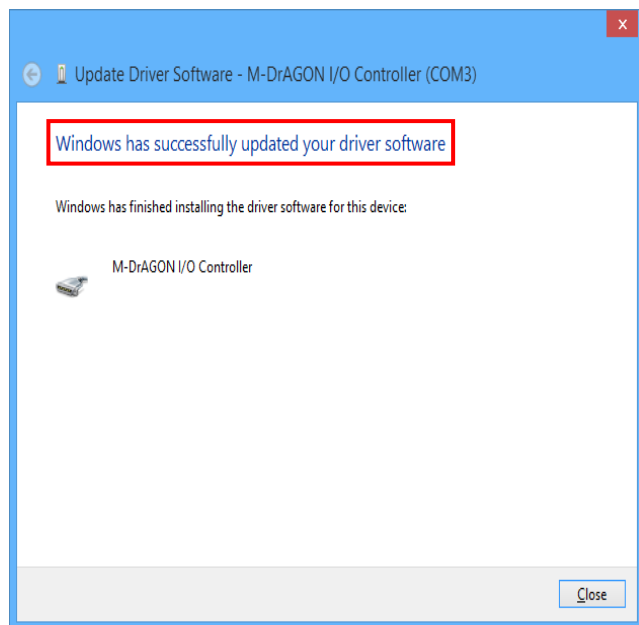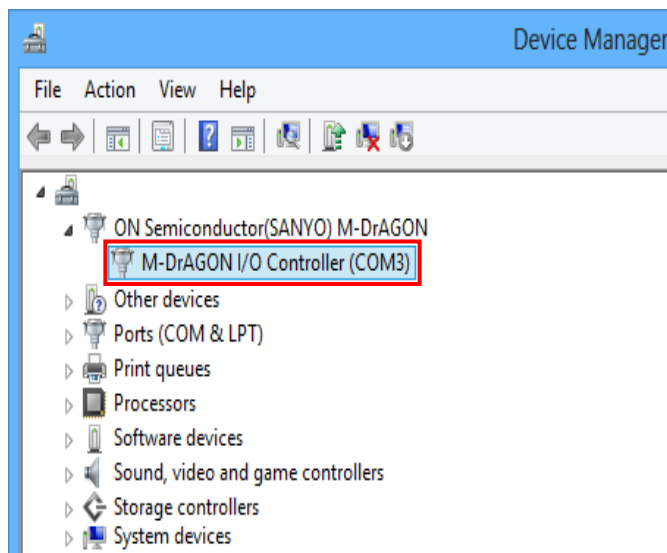   Figure 11. USB-MiconI/ O Controller-2   Figure 11. Device Manager-2

(10) Run "M-DrAGON_version1136.exe". Select "BLDC" in Motor type and "LV8824QA" in Driver type and click "OK".
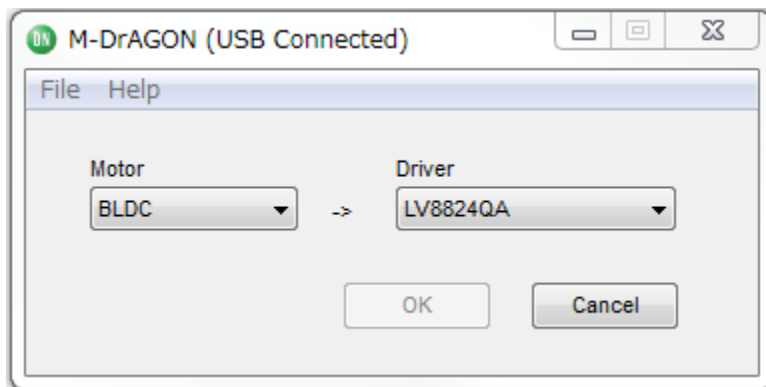

Figure 12. Motor type and Driver setting window

(11) If the following window comes up, be sure to select "No".
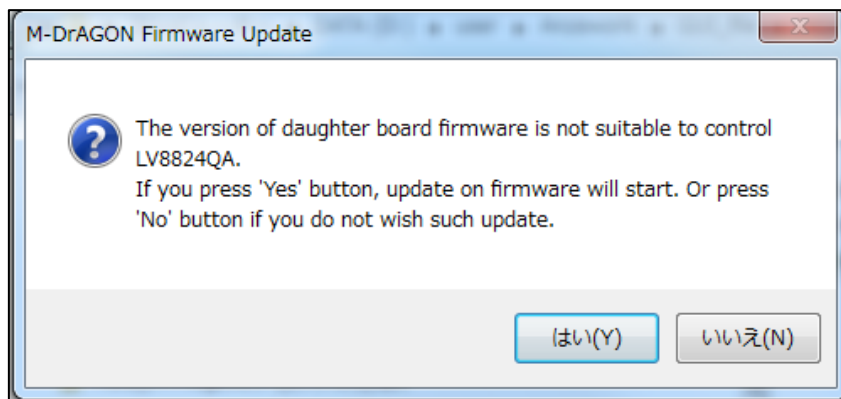
Note)
  a.   If the daughter board is not connected, the message "USB Disconnected" is shown.
  b.   When the selected "Driver" is not displayed, please check whether it is suitable for that kind of evaluation board.

Then the following windows appear.

- Controller window   (Figure 13)
- Tachometer window (Figure 14)
- Graph window   (Figure 15)

Figure 13. Controller window   Figure 14. Tachometer window

Figure 15. Graph window

5. Description of windows

(1) Controller window 1-1
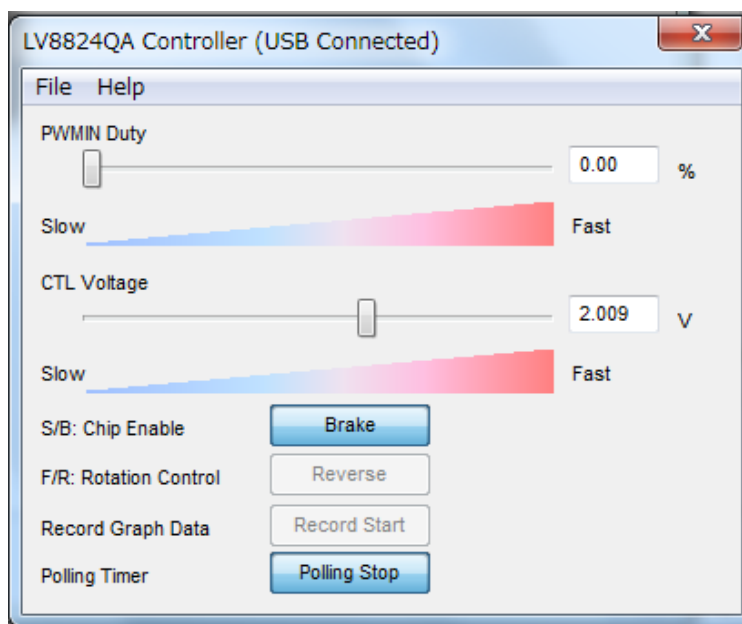
Figure 16. Controller window 1-1

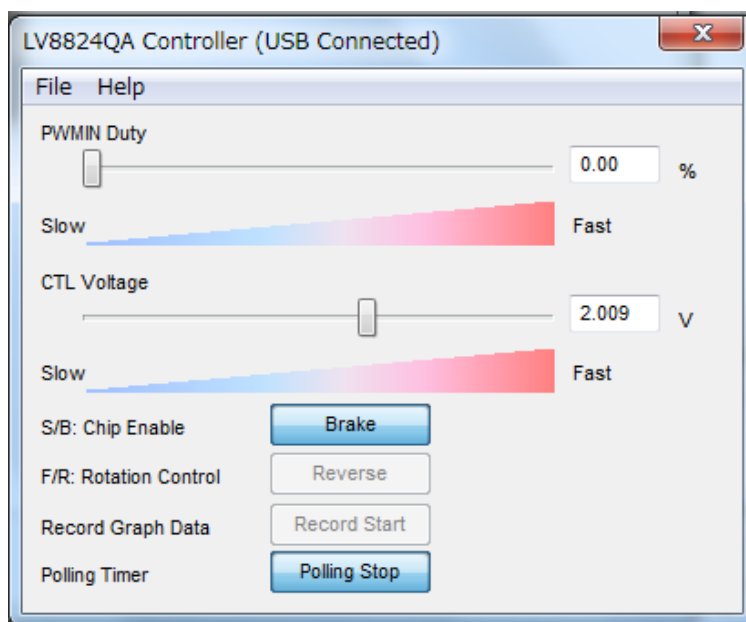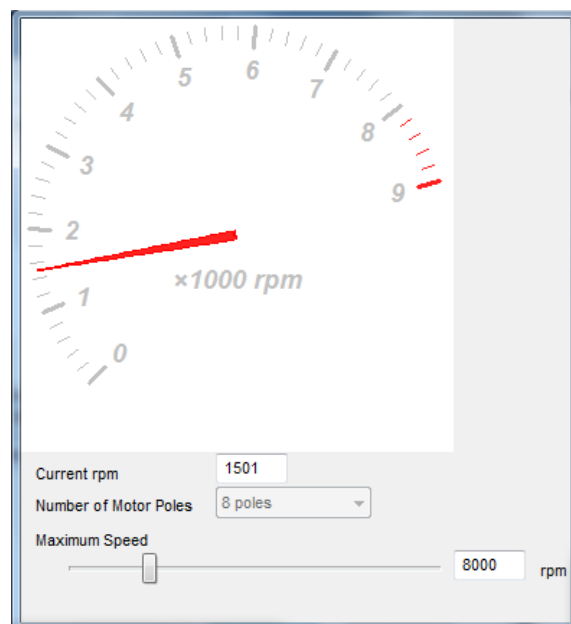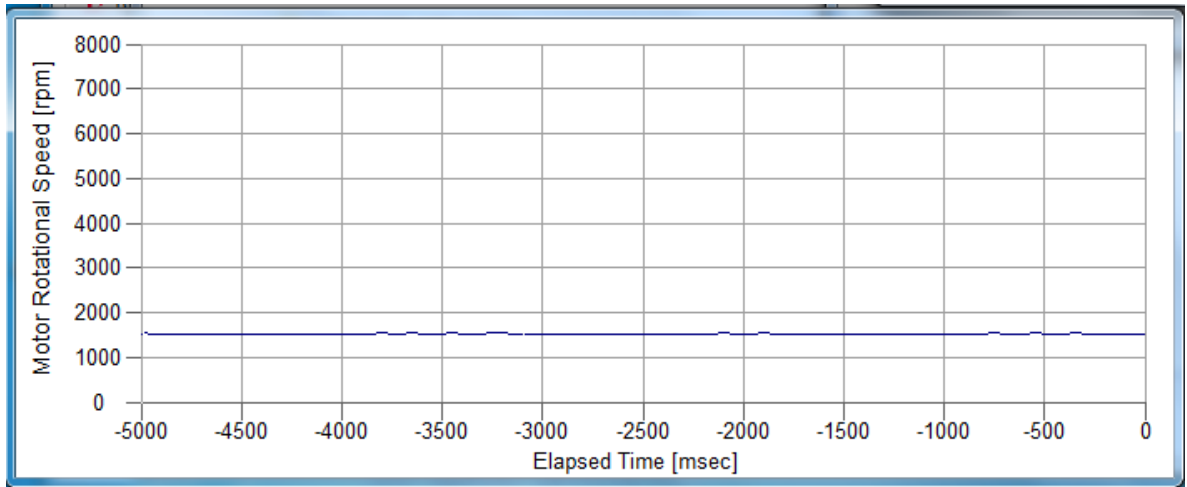- **PWMIN Duty**
  Indicate the input duty of Pin29; PWMIN (Range: 0-100%).
  The slider bar can change the duty and the chip goes to analog control mode automatically.

- **CTL Voltage**
  Indicate input voltage of Pin30; CTL (Range: 0-3.3V).
  The slider bar can change the input voltage and the chip goes to analog control mode automatically.

- **S/B: Chip Enable**
  It controls "Start" and "Brake" and outputs the control signal of Pin26; S/B. When "Start" is clicked, the chip enables motor to rotate and the button changes to "Brake".

- **F/R: Rotation Control**
  It controls "Forward" and "Reverse" and outputs the control signal of Pin28; F/R. When "Reverse" is clicked, Pin28 is "High" level and the button changes to "Forward".

- **Polling Timer**
  It controls Tachometer and Graph window. "Polling Stop" button doesn't allow to indicate the current speed to Tachometer and Graph window.

(2) Controller window 1-2
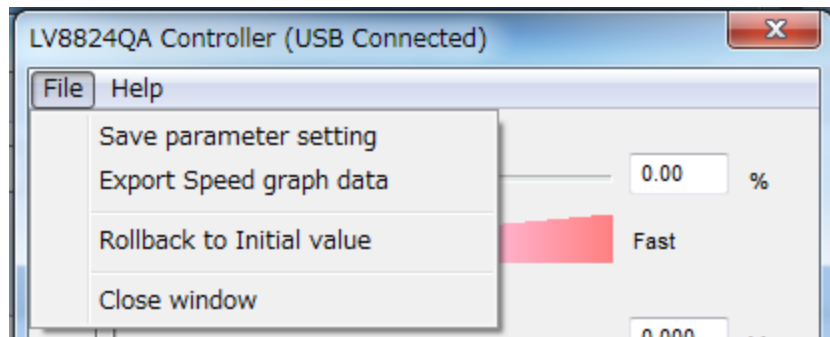
Figure 17. controller window 1-2

● **Save parameter setting**
Save the parameter setting of GUI. Select "File" in the menu bar at the top of GUI Controller window or Motor and Driver setting window, then select "Save parameter setting".

● **Export Speed graph data**
This function is not available.

● **Rollback to Initial value**
When "Rollback to Initial value" is clicked, all parameters of the Controller window return to an initial value.

● **Load parameter setting**
Load the GUI setting saved with "Save parameter setting".
Select "File" in the menu bar at the top of Motor and Driver setting window, then select "Load parameter setting".

(3) Tachometer window
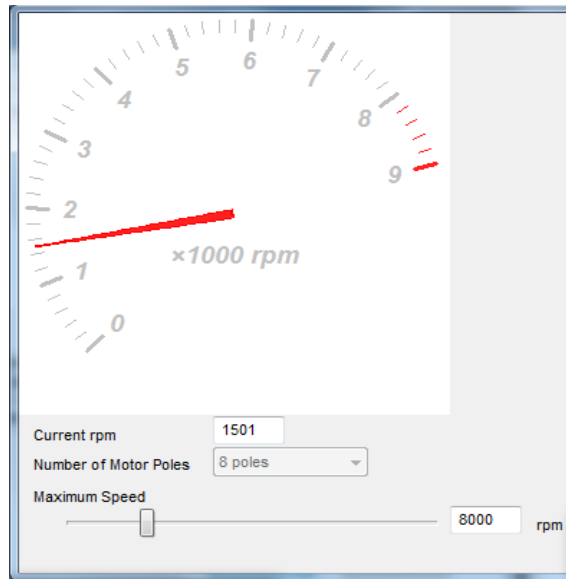
Figure 18. Tachometer window
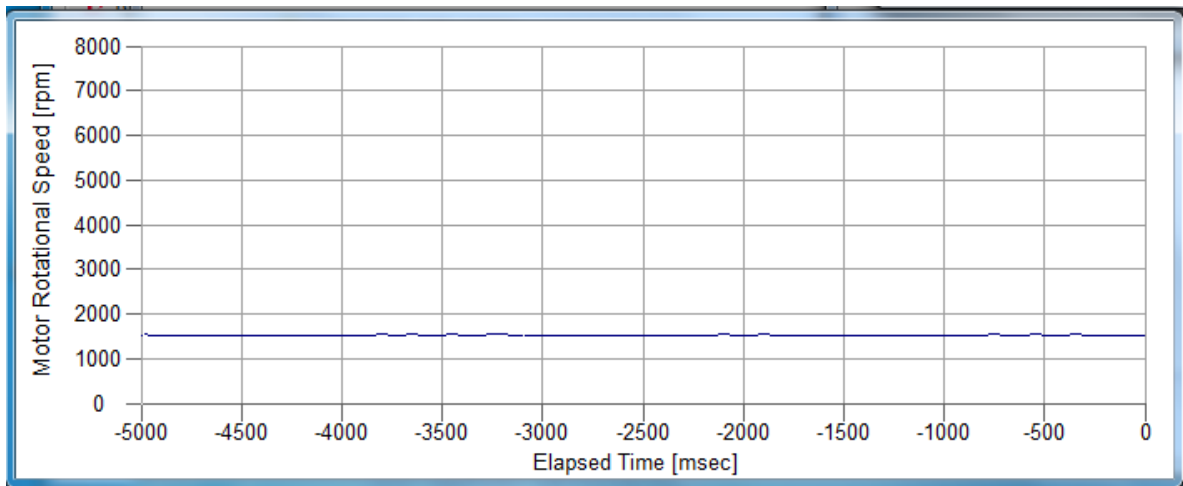
Figure 19. Graph window

Tachometer window and Graph window indicate the current motor rotation speed; rpm. Input the number of motor poles to "number of motor poles". The slider bar of "Maximum speed" can change the max. speed.

Note) Please refer to LV8824QA data sheet for the detailed explanation of the GUI's function.

APPENDIX A. Electrical Operation Check (Reference) – LV8824QAGEVK V1.0

1. Connect LV8824QAGEVK to the PC with the USB cable.
2. Connect the motor to J1 and J3 and power supply to J2(VCC=24V).
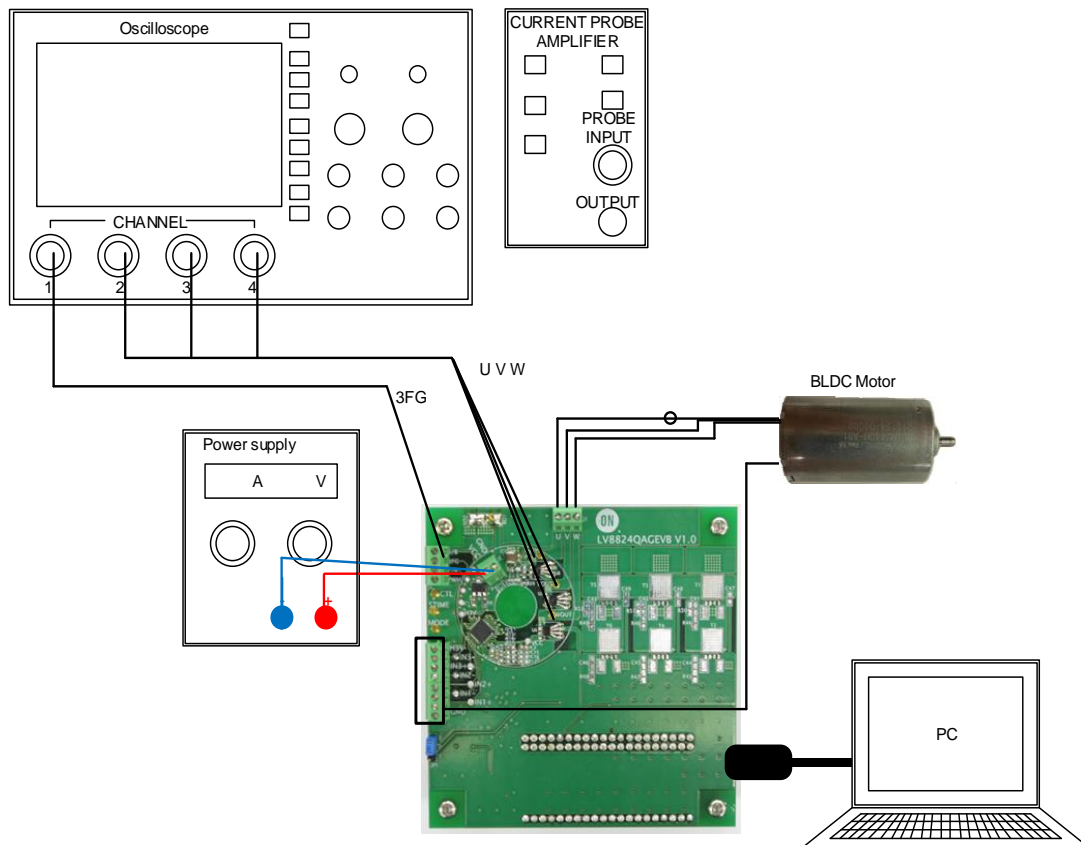
Figure 19. Setup for LV8824QA Evaluation Board

3. Turn-on the power supply.
4. Run "**M-DrAGON_version1136.exe**".
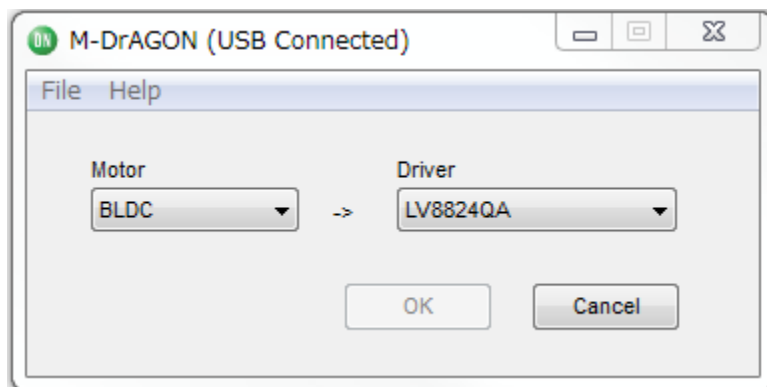
Figure 19. Motor type and Driver setting window

5. Set the following parameters in the GUI (please see below example).
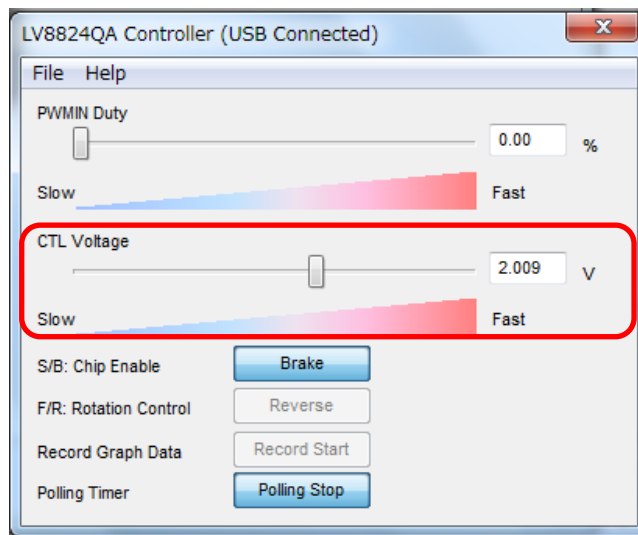
Figure 20. Setting parameters in the GUI

6. Click "Start" button and then the motor begin to rotate. The indicator changes to "Brake".

7. Click "Brake" button and then the motor stop. The indicator changes to "Start".

● Monitor **3FG** and **U/V/W** OUT waveforms.

APPENDIX B. SCHEMATIC – LV8824QAGEVK V1.0

APPENDIX C. BILL OF MATERIAL - LV8824QAGEVK V1.0

Bill of Materials for the LV8824QAGEVK Evaluation Board V1.0

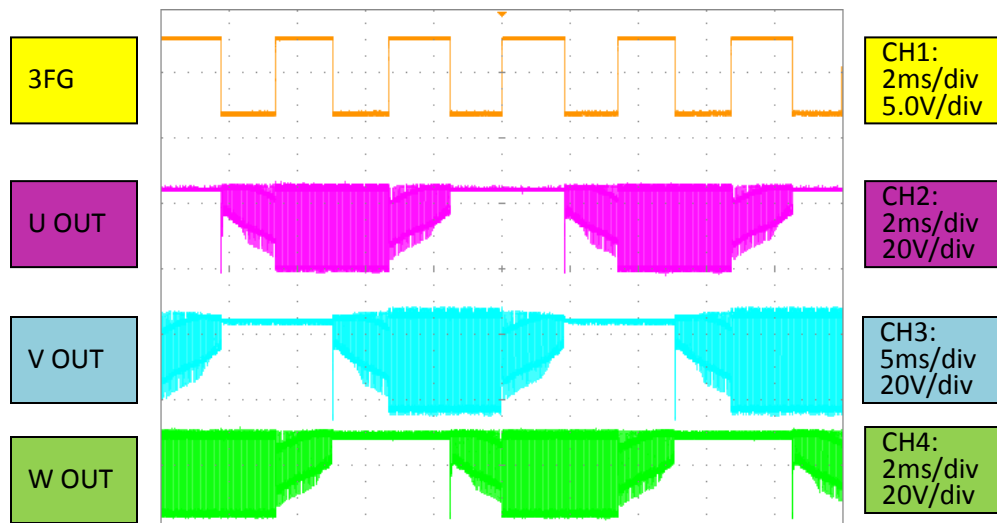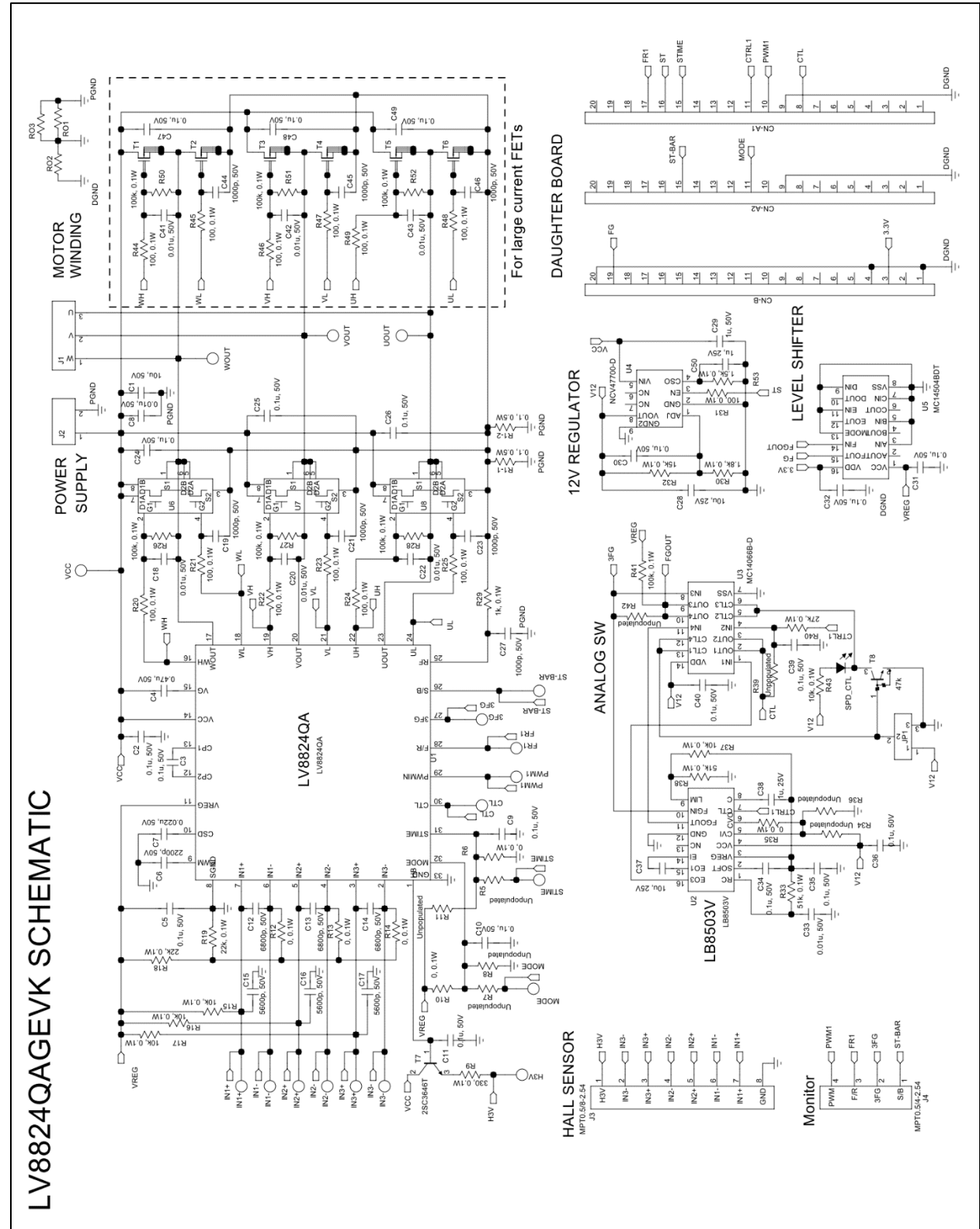| Designator	QTY.	Description	Value	Tolerance	Footprint	Manufacturer	Part Number	Substi-tution Allowed	In-stalled	Lead Free
U1	1	PWM Motor driver			VQFN32U	ON Semiconductor	LV8824QA	No	Yes	Yes
U2	1	Speed controler			SSOP16	ON Semiconductor	LB8503V	No	Yes	Yes
U3	1	Analog switch			TSSOP-14	ON Semiconductor	MC14066BDTR2G	Yes	Yes	Yes
U4	1	12V Regulator			SOIC-8 EP	ON Semiconductor	NCV4700PDAJR2G	Yes	Yes	Yes
U5	1	Level shifter			TSSOP-16	ON Semiconductor	MC14504BDTR2G	Yes	Yes	Yes
U6-8	3	N-Channel Power MOSFET			ECH8	ON Semiconductor	ECH8657	Yes	Yes	Yes
J1	1	Motor winding connector			Pitch 2.54mm	TE connectivity	282834-3	Yes	Yes	Yes
J2	1	DC power supply connector			Pitch 2.54mm	TE connectivity	282834-2	Yes	Yes	Yes
J3	1	Hall sensor connector			Pitch 2.54mm	TE connectivity	282834-4 x2	Yes	Yes	Yes
J4	1	Monitor connector			Pitch 2.54mm	TE connectivity	282834-4	Yes	Yes	Yes
CN-A1-2	2	Female socket			Pitch 2.54mm	USECONN	FH-2x20	Yes	Yes	Yes
CN-B	1	Female socket			Pitch 2.54mm	USECONN	FH-1x20	Yes	Yes	Yes
T1-6	6	Nch Power MOSFET			TP-FA	ON Semiconductor	SFT1450-TL-H	Yes	No	----
T7	1	NPN Transistor			PCP	ON Semiconductor	2SC3646T	Yes	Yes	Yes
T8	1	Digital Transistor (47kΩ)			SOT-23	ON Semiconductor	SMMUN2213LT3G	Yes	Yes	Yes
SPD_CTL	1	LED	GREEN		1608 BIG	STANLEY	YBG1111C-TR	Yes	Yes	Yes
JP1	1	Switch for SPD-CTL			Pitch 2.54mm	USECONN	PH-1x03SG	Yes	Yes	Yes
C1	1	VCC Bypass Capacitor	10u, 50V	±10%	3225	MURATA	GRM32ER71H106K	Yes	Yes	Yes
C2-3 C5 C11 C24-26	7	Capacitor	0.1u, 50V	±10%	1608	MURATA	GRM188B31H104K	Yes	Yes	Yes
C4	1	Capacitor	0.47u, 50V	±10%	3225	MURATA	GRM32BM11H474K	Yes	Yes	Yes
C6	1	Capacitor	2200p, 50V	±10%	1608	MURATA	GRM188B11H222K	Yes	Yes	Yes
C7	1	Capacitor	0.022u, 50V	±10%	1608	MURATA	GRM188B11H223K	Yes	Yes	Yes
C8 C18 C20 C22	4	Capacitor	0.01u, 50V	±10%	1608	MURATA	GRM188B11H103K	Yes	Yes	Yes
C9-10 C30-32 C34-36 C39-40	10	Capacitor	0.1u, 50V	±10%	1608 BIG	MURATA	GRM188B11H104K	Yes	Yes	Yes
C12-14	3	Capacitor for Hall sensor	6800p, 50V	±10%	1608	MURATA	GRM188B11H682K	Yes	Yes	Yes
C15-17	3	Capacitor for Hall IC	5600p, 50V	±10%	1608	MURATA	GRM188B11H562K	Yes	No	----
C19 C21 C23 C27	4	Capacitor	1000p, 50V	±10%	1608	MURATA	GRM188B11H102K	Yes	Yes	Yes
C28 C37	2	Capacitor	10u, 25V	±10%	3216 BIG	MURATA	GRM31CR71E106K	Yes	Yes	Yes
C29	1	Capacitor	1u, 50V	±10%	2012 BIG	MURATA	GRM21BR71H105K	Yes	Yes	Yes
C33	1	Capacitor	0.01u, 50V	±10%	1608 BIG	MURATA	GRM188B11H103K	Yes	Yes	Yes
C38 C50	2	Capacitor	1u, 25V	±10%	1608 BIG	MURATA	GRM188B31E105K	Yes	Yes	Yes
C41-43	3	Capacitor for large current FET	0.01u, 50V	±10%	1608 BIG	MURATA	GRM188B11H103K	Yes	No	----
C44-46	3	Capacitor for large current FET	1000p, 50V	±10%	1608 BIG	MURATA	GRM188B11H102K	Yes	No	----
C47-49	3	Capacitor for large current FET	0.1u, 50V	±10%	1608 BIG	MURATA	GRM188B11H104K	Yes	No	----

Designator	QTY.	Description	Value	Tolerance	Footprint	Manufacturer	Part Number	Substi-tution Allowed	In-stalled	Lead Free
R1-1~2	2	Sense resistor	0.1, 0.5W	±1%	3216 BIG	SUSUMU	RL1632R-R100-F	Yes	Yes	Yes
R5 R7~8 R11 R34 R36	6	Resistor	***	±5%	1608 BIG	KOA	RK73B1JTxxxJ	Yes	No	---
R6 R10 R35	3	Resistor	0, 0.1W	±5%	1608 BIG	KOA	RK73B1JTxxxJ	Yes	Yes	Yes
R9	1	Resistor	330, 0.1W	±5%	1608	KOA	RK73B1JTxxxJ	Yes	Yes	Yes
R12~14	3	Resistor for Hall IC	0, 0.1W	±5%	1608	KOA	RK73B1JTxxxJ	Yes	No	---
R15~17	3	Resistor for Hall IC	10k, 0.1W	±5%	1608	KOA	RK73B1JTxxxJ	Yes	No	---
R18~19	2	Resistor for Hall IC	22k, 0.1W	±5%	1608	KOA	RK73B1JTxxxJ	Yes	No	---
R20~25	6	Resistor	100, 0.1W	±5%	1608	KOA	RK73B1JTxxxJ	Yes	Yes	Yes
R26~28	3	Resistor	100k, 0.1W	±5%	1608	KOA	RK73B1JTxxxJ	Yes	Yes	Yes
R29	1	Resistor	1k, 0.1W	±5%	1608	KOA	RK73B1JTxxxJ	Yes	Yes	Yes
R30	1	Resistor	1.8k, 0.1W	±5%	1608 BIG	KOA	RK73B1JTxxxJ	Yes	Yes	Yes
R31	1	Resistor	100, 0.1W	±5%	1608 BIG	KOA	RK73B1JTxxxJ	Yes	Yes	Yes
R32	1	Resistor	15k, 0.1W	±5%	1608 BIG	KOA	RK73B1JTxxxJ	Yes	Yes	Yes
R33 R38	2	Resistor	51k, 0.1W	±5%	1608 BIG	KOA	RK73B1JTxxxJ	Yes	Yes	Yes
R37 R43	2	Resistor	10k, 0.1W	±5%	1608 BIG	KOA	RK73B1JTxxxJ	Yes	Yes	Yes
R39 R42	2	Resistor	0, 0.1W	±5%	1608 BIG	KOA	RK73B1JTxxxJ	Yes	No	---
R40	1	Resistor	27k, 0.1W	±5%	1608 BIG	KOA	RK73B1JTxxxJ	Yes	Yes	Yes
R41	1	Resistor	100k, 0.1W	±5%	1608 BIG	KOA	RK73B1JTxxxJ	Yes	Yes	Yes
R44~49	6	Resistor for large current FET	100, 0.1W	±5%	1608 BIG	KOA	RK73B1JTxxxJ	Yes	No	---
R50~52	3	Resistor for large current FET	100k, 0.1W	±5%	1608 BIG	KOA	RK73B1JTxxxJ	Yes	No	---
R53	1	Resistor	1.5k, 0.1W	±5%	1608 BIG	KOA	RK73B1JTxxxJ	Yes	Yes	Yes
RO1~3	3	Solder JP			4030			Yes	Yes	---

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