

ON Semiconductor®

LV8716QAGEVK Evaluation Kit User Guide



NOTICE TO CUSTOMERS

The LV8716QA Evaluation Kit is intended to be used for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by ON SEMICONDUCTOR to be a finished end product fit for general customer use. Information contained in this document regarding the device application and the like is provided only for your convenience.

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WARNING

The LV8716QA Evaluation Kit is referenced to the DC supply ground and is not earthed. Hence, it carries a risk of electric shock. Caution is required when the power is applied to the kit. Only qualified technicians and/or engineers should handle the kit. When the power is applied to the kit, it is absolutely must that users only probe provided test points and do not touch any other point on the kit.



1. Introduction

The LV8716QA Evaluation Kit is designed to provide an easy and quick development platform for a stepper motor and brush DC motor control applications using LV8716QA. The kit enables users to develop their customized system solution by utilizing various features of LV8716QA and provides real-time development capabilities. The kit consists of:

• LV8716QA Evaluation Board :

LV8716QAGEVB with on-board microcontroller circuit (Daughter board)

- USB cable
- Stepper motor : MSCA020A55 (Bipolar Type)



LV8716QAGEVB top view

LV8716QAGEVB bottom view



USB cable



Stepper motor





2. Features

The kit provides an integrated development platform to drive a stepper motor and brush DC motor. Following are key features of the kit.

LV8716QA Evaluation Board: LV8716QAGEVB with the Daughter board

- LV8716QA for a stepper motor advancement of a step position, system control and drive or a brush DC motor drive system control and drive.
- Daughter board for communication with the PC based Graphical User Interface.
- Protections for safe operation (Thermal shout down, Under voltage lockout)

Graphical User Interface (GUI)

• Enables users to set/modify LV8716QA parameters in real-time

3. LV8716QA Evaluation Board (EVK) and attached motor Overview

The EVB consists of one connector to connect a motor as shown in Figure 3, and a daughter board to control signal. Refer Appendix A for the LV8716QAEVB schematic.

VM: DC power supply

The LV8716QAGEVB requires external power supply between VM (VM1, VM2) and GND for its operation. C1 is used as a bypass capacitor for the VM power supply.

Pin Name	Min [V]	Max [V]
VM1, VM2	2.7	10.5

VM1 (pin 15) and VM2 (pin 6) are connected on a board, and GND (pin 14) and PGND (pin5, pin16) are also connected on a board.



Figure 2. DC power supply

Motor winding connector

The LV8716QA can drive one stepper motor or two brush DC motors. Connect the motor wires to motor connector as shown in Figure 3.



Stepper motor

Brush DC motor

Figure 3. Motor winding connector

USB connector

The regulator on the Daughter board generates VDD=3.3V output from USB power. When the external microcontroller is used, remove the Daughter board, and apply control signals to each pin.



Figure 4. USB connector



R1, R2: RF resistance

The output current is determined by the RF resistance, the reference voltage (Vref) and constant value for the current setting in LV8716QA based on the following equation. RF resistance is connected between RCS1 (2) pin and GND.

$$I_{OUT} = \frac{0.2[V]}{R_{RF}[\Omega]} \times 4000....(1)$$

Where,

 I_{OUT} : Motor current [A] 0.2: Reference voltage for current detection (Vref) [V] 4000: The constant value for the current setting in LV8716QA R_{RF}: Resistance between RCS1 (2) and GND [Ω] (Default setting value is 4300Ω.)

$$I_{OUT} = \frac{0.2}{4300} \times 4000 \approx 0.186[A]$$

 4300Ω resistance is installed to RCS1 and RCS2 individually. It is not required of high-power resistor. Vref is a reference voltage which is determined by the IC, and cannot be changed.

The motor current can be adjusted by changing the resistance between RCS1 (2) and GND.



Figure 5. RF resistor

Stepper motor: MSCA020A55 (Bipolar Type) Winding Res: 15±1.5Ω Nidec Sankyo Corporation

Stepper motor MSCA020A55 is attached in the LV8716QAGEVK. LV8716QA has current drivability up to 1.0A per channel, the current limit of this evaluation board is set to 186mA to maintain the bundled reference stepper motor MSCA020A55 capability. The guaranteed temperature of MSCA020A55 motor windings is 115°C. In case of 25°C ambient temperature for example, the temperature-rise must be less than 90°C (115 – 25). From the plots below, 200mA or less is suitable for this motor. Figure 6 shows the winding temperature-rise characteristics of the motor, which is supplied by LV8716QAGEVK.

The current limit should be changed to appropriate value to match an actual target motor.



Figure 6. Temperature-rise characteristic of the motor winding

4. Graphical User Interface (GUI) Installation

An easy-to-use GUI is provided (*free of cost*) for real-time LV8716QA based solution development. Perform following steps to get started with the GUI. This GUI will work with the Windows 7 (32bit, 64bit) and Windows 8 (32bit).

(1) Unpack the zip file "LV8716QAGEVK_SOFTWARE.zip", and confirm files as shown in below.

"M-DrAGON_version1135.exe", "M-DrAGON_driver.inf", and "LV8716QAGEVK_USER_GUIDE-D.rev0.pdf".

(2) Connect the LV8716QAGEVB to the PC using the USB cable.

Steps (3) to (11) show the USB driver installation procedure that refers to an expression on Windows 8 (32bit). This layout and procedure may vary with other operating system version. It is required only for the first time when the Daughter board of LV8716QAGEVK is connected to the USB port.

- (3) The Windows OS will try to install driver on its own. Wait for a few minutes. Installation will fail.
- (4) Click on the Start Menu, and open the Control Panel.
- (5) Open the Device Manager.
- (6) Either under "Ports (COM & LPT)" or "Other Devices", see an open port named "USB-Miconl/ O Controller".

4	Device Manager						
File Action View Help							
 Other devices Base System Device USP Miconl/O Control 							
Ports (COM & LPT)	Update Driver Software						
Print queues							
Processors Software devices	Uninstall						
 Sound, video and game co 	Scan for hardware changes						
 Storage controllers Image System devices 	Properties						

Figure 7. Device Manager 1



(7) Right click on the "USB-Miconl/ O Controller" port and choose the "Update Driver Software" option.

If the update driver software option is not available, then the Windows OS is still trying to install the driver on its own. Wait till the OS finishes self-try.

- (8) Next, choose the "Browse my computer for Driver software" option.
- (9) Finally, navigate to and select the driver file named "**M-DrAGON_driver.inf**", located in the "M-DrAGON_driver" folder. And click "Next".
- (10) Windows will finish up the driver installation from there.

Update Driver Software - USB-Miconl/O Controller	€
How do you want to search for driver software?	Browse for driver software on your computer
 Search automatically for updated driver software Windows will search your computer and the Internet for the latest driver software for your device, unless you've disabled this feature in your device installation settings. Browse my computer for driver software Locate and install driver software manually. 	Search for driver software in this location: (CA.M-DrAGON_driver V Browse Include subfolders
	Let me pick from a list of device drivers on my computer This list will show installed driver software compatible with the device, and all driver software in the same category as the device.
Cancel	<u>N</u> ext Cancel

Figure 8. USB-Miconl/ O Controller 1

Note: When "Windows security" is shown, select "Install this driver software anyway".



Figure 9. Windows Security

(11)When the installation is successful, the final window is shown. And the recognized M-DrAGON I/O Controller port with the port number is shown in the Device Manager.

×	4	Device Manager
Update Driver Software - M-DrAGON I/O Controller (COM3)	File Action View Help	
Windows has successfully updated your driver software	🗢 🄿 🗊 🖺 📓 🖬 🖏 👰 🚱	
Windows has finished installing the driver software for this device: M-DrAGON I/O Controller	 ON Semiconductor(SANYO) M-DrAGON M-DrAGON I/O Controller (COM3) Other devices Ports (COM & LPT) Print queues Processors Software devices Sound, video and game controllers Storage controllers System devices 	
Close		
Figure 10. USB-Miconl/ O Controller 2	Figure 11. Device Manager	2

(12)Start "M-DrAGON_version1135.exe". When driving a stepper motor, select "Stepper" in Motor type. Since the Driver type is displayed device that can drive the stepper motor by selecting "Stepper", select "LV8716QA(Stepper)" from the dropdown list of Driver type, and then click "OK".

When driving a brush DC motor, select "DC" in Motor type. Since the Driver type is displayed device that can drive the brush DC motor by selecting "DC", select "LV8716QA(DC)" from the drop-down list of Driver type, and then click "OK".

Stepper is selected	
M-DrAGON (USB Connected)	
File Help Motor Driver Stepper -> LV8716QA(Stepper) •	If the daughter board is not plugged, "USB Disconnected" is shown.
OK Cancel	

Figure 12. Motor type and Driver setting window 1

DC is selected	
M-DrAGON (USB Connected)	
File Help Motor Driver DC -> LV8716QA(DC)	If the daughter board is not plugged, "USB Disconnected" is shown.
OK Cancel	

Figure 13. Motor type and Driver setting window 2



(13)The following windows should appear when "Stepper" is selected

- Controller (Figure 14)
- Tachometer (Figure 15)
- Graph (Figure 16)

'Tachometer' and 'Graph' of sub window are displayed only in the stepper type.

Chip Enable/Disable Enable RF Resistance 4300 ohm out = 0.186 A Transfer Unit Seconds Transfer Time 1 Transfer Unit Seconds Transfer Time 8 (max:85535) ndex Excitation Mode Frequency Direction 1 st Full Step $+ 20Hz + CW +$ 3 rd Full Step $+ 20Hz + CW +$ 5 sth Full Step $+ 20Hz + CW +$ 6 sth Full Step $+ 20Hz + CW +$ 6 sth Full Step $+ 20Hz + CW +$ 8 sth Full Step $+ 20Hz + CW +$ 9 results 100 pps	ile H	elp							
RF Resistance 4300 ohmlout = 0.186 ATest modeFixed \checkmark Transfer UnitSeconds \checkmark Stop SignalAuto \checkmark RepeatOff \checkmark IndexExcitation Mode Frequency*Direction1 stFull Step \checkmark 20Hz \checkmark CW \checkmark 2ndFull Step \checkmark 20Hz \checkmark CW \checkmark 3rdFull Step \checkmark 20Hz \checkmark CW \checkmark 6thFull Step \checkmark 20Hz \checkmark CW \checkmark 8thFull Step \checkmark 20Hz \checkmark CW \checkmark	Chip Ena	ble/Disable		E	nable				
out = 0.186 ATest modeFixedTransfer Time1Transfer UnitSecondsTransfer Time1Stop SignalAuto 0 0 RepeatOff 0 0 IndexExcitation Mode Frequency*Direction1 stFull Step $20Hz$ CW $2nd$ Full Step $20Hz$ CW 3 rdFull Step $20Hz$ CW 4 thFull Step $20Hz$ CW 6 thFull Step $20Hz$ CW 7 thFull Step $20Hz$ CW 8 thFull Step $20Hz$ CW	RF Resis	tance		4300	0	hm			
Test mode Fixed Transfer Unit Seconds Stop Signal Auto Repeat Off 1st Full Step + 20Hz Stop Full Step + 20Hz Stop Signal Node Frequency * Direction 1st Full Step + 20Hz Stop Signal Step + 20Hz Stop Signal CW Stop Signal Step + 20Hz Stop Signal CW Stop Signal Step + 20Hz Stop S	out =			0.186	A	8088 87			
Test mode Fixed Transfer Unit Seconds Stop Signal Auto Auto 8 Repeat Off Off (max:65535) Index Excitation Mode Full Step 20Hz CW (max:65535) Index Index Full Step 20Hz CW (max:65535) Index Index Sth Full Step 20Hz CW Sth Full Step 20Hz CW Index Index Index Index Index Index Index Index Sth Full Step 20Hz CW Index Index Index Index Index Index Index Index Index Index Index Index Index Inde					_				
Transfer UnitSecondsTransfer Time1Stop SignalAuto8RepeatOff8IndexExcitation ModeFrequency*IndexExcitation ModeFrequency*Inde	lest mod	le	Fixed		-				
Stop Signal Auto 8 Repeat Off (max:65535) ndex Excitation Mode Frequency* Direction 1st Full Step 20Hz CW 2nd Full Step 20Hz CW 3rd Full Step 20Hz CW 3rd Full Step 20Hz CW \$th Full Step 20Hz CW	Transfer	Unit	Seco	nds •	-	Trans	fer Time	1	
RepeatOffImax cosso)IndexExcitation Mode Frequency*Direction1stFull Step $+$ 20Hz $+$ CW $+$ 2ndFull Step $+$ 20Hz $+$ CW $+$ 3rdFull Step $+$ 20Hz $+$ CW $+$ 4thFull Step $+$ 20Hz $+$ CW $+$ 5thFull Step $+$ 20Hz $+$ CW $+$ 6thFull Step $+$ 20Hz $+$ CW $+$ 7thFull Step $+$ 20Hz $+$ CW $+$ 8thFull Step $+$ 20Hz $+$ CW $+$	Stop Sig	nal	Auto	•	-			8 (max:65535)	
IndexExcitation Mode Frequency* Direction1stFull Step \star 20Hz \star CW \star 2ndFull Step \star 20Hz \star CW \star 3rdFull Step \star 20Hz \star CW \star 4thFull Step \star 20Hz \star CW \star 5thFull Step \star 20Hz \star CW \star 6thFull Step \star 20Hz \star CW \star 7thFull Step \star 20Hz \star CW \star 8thFull Step \star 20Hz \star CW \star	Repeat		Off		*			(max.05555)	
1stFull Step $20Hz$ CW2ndFull Step $20Hz$ CW3rdFull Step $20Hz$ CW4thFull Step $20Hz$ CW5thFull Step $20Hz$ CW6thFull Step $20Hz$ CW7thFull Step $20Hz$ CW8thFull Step $20Hz$ CW	ndex	Excitation	Mode	Frequer	ncy *	Direct	tion		
2nd Full Step 20Hz CW 4 3rd Full Step 20Hz CW 4 4th Full Step 20Hz CW 7 5th Full Step 20Hz CW 9 6th Full Step 20Hz CW 1 77th Full Step 20Hz CW 1 8th Full Step 20Hz CW 1	1st	Full Step	•	20Hz	•	CW	•		SALVEL IN THE
3rd Full Step 20Hz CW 8 4th Full Step 20Hz CW 9 5th Full Step 20Hz CW 9 6th Full Step 20Hz CW 100 pps 7th Full Step 20Hz CW 1 8th Full Step 20Hz CW 1	2nd	Full Step		20Hz	*	CW			4 7 7
4th Full Step 20Hz CW 9 5th Full Step 20Hz CW 9 6th Full Step 20Hz CW 100 pps 7th Full Step 20Hz CW 100 pps 8th Full Step 20Hz CW 1	3rd	Full Step		20Hz	*	CW			12
5th Full Step 20Hz CW = 2 6th Full Step 20Hz CW = 1 100 pps 7th Full Step 20Hz CW = 1 100 pps 8th Full Step 20Hz CW = 1 1	4th	Full Step		20Hz	*	CW	*		9-
6th Full Step 20Hz CW + 7th Full Step 20Hz CW + 8th Full Step 20Hz CW +	5th	Full Step		20Hz	*	CW			- 2
7th Full Step 20Hz CW Image: CW	6th	Full Step		20Hz	*	CW			1 100 pps
8th Full Step - 20Hz - CW -	7th	Full Step	-	20Hz	*	CW			
	8th	Full Step		20Hz	*	CW	*		
	S	art		0	Stop				Current PPS 0
Start Stop 0									

Figure 14. Controller window for stepper

Figure 15. Tachometer window







Figure 16. Graph window

(14) The following windows should appear when "DC" is selected

• Controller (Figure 17)

File Help								
PS: Chip Enable PWM Frequency	Enable	100	Hz					
Ch1 Motor(OUT1A WM mode On Duty	-OUT1B) Forward <-> Standby 💌	0.00	%	Ch2 Motor(OUT2A PWM mode On Duty	-OUT2B) Forward <	<-> Standby 💌	- 0.00 %	
RF-Resistance lout = Start/Stop	4300 ohm 0.186 A Start			RF-Resistance lout = Start/Stop	4300 0.186 Star	ohm A rt		

Figure 17. Controller window for brush DC



5. Usage of the GUI

(1) Stepper motor



Figure 18. GUI field description of stepper controller window 1-1

<u>Chip Enable / Disable</u>

"Enable": IC will be enabled state. The indicator changed to "Disable". "Disable": IC will be disabled state. The indicator changed to "Enable".

RF Resistance

Set the detection resistance value of the motor current. It must be same value between RCS1 and GND, RCS2 and GND. Default setting value is 4300Ω .

lout

lout is calculated by setting RF resistance after "Polling start" button is clicked. This value is calculated value from equation (1), not actual value.

lout will become the red characters at more than 0.2A for attention of attached motor in LV8716QA Evaluation Kit.

Test mod	e	Fixed		•			
Transfer	Unit	Seconds -			Transf	er Time	1
Stop Sigr	nal	Auto		•			8
Repeat		Off		-			(max:65535)
Index	Excitation	Mode	Frequ	ency *	Direct	ion	
1st	Full Step	•	20Hz	•	CW	-	
2nd	Full Step	-	20Hz	-	CW	-	
3rd	Full Step	-	20Hz	-	CW	-	
4th	Full Step	-	20Hz	-	CW	-	
5th	Full Step	-	20Hz	-	CW	-	
6th	Full Step	-	20Hz	-	CW	-	
7th	Full Step	-	20Hz	-	CW	-	
8th	Full Step	-	20Hz	-	CW	-	
	*: Frequ	iency	is one s	step per	iod con	version	
St	art			Stop			

Figure 19. GUI field description of stepper controller window 1-2



Test mode

"Fixed": Sending fixed signal (one pattern only) means sending one Excitation Mode, one Frequency, and one Direction.

"Sequence": Sending sequential pattern means sending the three parameters (Excitation Mode, Frequency and Direction) at maximum of eight patterns.

To reset all parameters back to default values, select "File" in the menu bar at the top of GUI, and then select "Rollback to Initial value".

LV8716QA(Stepper) Controller (USB Connected)							
File Help							
Save parameter setting Export Speed graph data							
Rollback to Initial value							
Close window							

Figure 20. GUI field description of stepper controller window 1-3

Transfer Unit

"Seconds": A unit is a second. A motor is driven during the number of seconds set in "Transfer Time".

"Steps": A unit is a step. A motor is driven the number of steps set in "Transfer Time". When "Steps" is selected, start motor rotation from the previous step of the initial position. Refer to the Figure 21 and Figure 22 concerning initial position.



Transfer Time

The value can be selected from drop-down list or select "other..." and input the value into the textbox. The maximum value that can be set is up to 65535. This set value is common value for all sequence stage.

Stop Signal

"Auto": An input signal is stopped automatically when the set "Transfer Time" is completed, and the last step will be continued.

"Stop Button": The drive of a motor stops by "Stop" button. Clicking "Stop" button, the signal transfer will stop immediately. In case of "Fixed" Test mode, "Transfer Time" text box will gray out after "Stop Button" is selected in the Stop Signal. In case of "Sequence" Test mode, "Stop" button must be clicked to stop the signal transfer at the end of the last stage. IN1, IN2, IN3 and IN4 input signal becomes all Low state by clicking "Stop" button.

Repeat

"On": Sequence pattern repeats while test mode is selected "Sequence" mode. "Off": Last set sequence stage will be kept until the signal transfer is manually stopped. A repeat function can set up when "Sequence" mode and "Stop button" are chosen.

Excitation Mode

The step resolution can be selected from Full Step and Half Step, and can update the parameter while a motor is operating in "Fixed" mode by clicking "Start" button.

Frequency

The frequency can be selected from 20Hz to 1200Hz by drop-down list and can update the parameter while a motor is operating in "Fixed" mode by clicking "Start" button. In case of start-up or acceleration of motor drive, pay attention to the frequency rapid variation.

This frequency is expressed as equivalent to one step of each excitation.

Direction

"CW": Clockwise (CW).

"CCW": Counter-clockwise (CCW).

The direction can update the parameter while a motor is operating in "Fixed" mode by clicking "Start" button.

<u>Start</u>

When "Start" button is clicked, send stepper control signals to IN1, IN2, IN3 and IN4 pin. "Transfer time" is reset each time the "Start" button is pressed, and "Excitation Mode", "Frequency" and "Direction" can be set again at that time.

<u>Stop</u>

Regardless of the test mode, transfer of stepper control signals is stopped by this button. IN1, IN2, IN3 and IN4 signals become all Low state and a motor doesn't keep its position.

Start	Stop
Record Graph Data	Record Start
Polling Timer	Polling Stop

Figure 23. GUI field description of stepper controller window 1-4

Record Graph Data

It is necessary to choose a file to save Excel data.

When "Record Start" button is clicked after a file was chosen, the Excel data of "Time" - "Motor Rotational speed (Clock frequency: pps)" is outputted to selected file. When "Record End" button is clicked, this GUI stops the output of Excel data. Refer to "Export Speed graph data" for the details.

Polling Timer

When "Polling Start" button is clicked, "Tachometer" and "Graph" are updated in real-time. The default setting is that the polling operation works, and the button changed to "Polling Stop".

Figure 24. GUI field description of tachometer window

Current PPS/ Tachometer Max PPS

When "Polling Start" button is clicked, "Tachometer" and "Graph" are updated in real-time. The default setting is that the polling operation works, and the button changed to "Polling Stop".

The velocity of stepper motor is usually described by [pps] pulse per second. In other words, it is the number of steps per second.

Figure 25. GUI field description of graph window

This graph shows the relationship between elapsed time (X-axis) and motor pulse rate (Y-axis). Pulse rate value is as same as tachometer value.

Maximum level of Y-axis is adjusted by "Tachometer Max PPS" with tachometer. The scale of X-axis is 500msec/div. Graph is automatically scrolled according to elapsed time.

(2) Brush DC motor

LV8716QA(DC) (Controller (USB Connected)					×
File Help						
PS: Chip Enable PWM Frequency	Enable	- 100	Hz			
Ch1 Motor(OUT1A PWM mode On Duty	-OUT1B) Forward <> Standby 🔻	- 0.00	%	Ch2 Motor(OUT2A PWM mode On Duty	-OUT2B) Forward <-> Standby 🔻	- 0.00 %
RF-Resistance lout = Start/Stop	4300 ohm 0.186 A Start Sequence Test			RF-Resistance lout = Start/Stop	4300 ohm 0.186 A Start	

Figure 26. GUI field description of DC controller window 2-1

Chip Enable

"Enable": IC will be enabled state. The indicator changed to "Disable". "Disable": IC will be disabled state. The indicator changed to "Enable".

PWM Frequency

This value is PWM frequency to drive brush DC motor. It can be selected from 100Hz to 10000Hz by slider, and is common value in Ch1 Motor and Ch2 Motor.

PWM mode

PWM mode can be selected four modes as shown in below by drop-down list:

- Forward <-> Standby
- Forward <-> Brake
- Reverse <-> Standby
- Reverse <-> Brake

It can be selected Ch1 Motor and Ch2 Motor individually.

On Duty

This value is the period of "Forward" or "Reverse" to drive brush DC motor. The value can be selected from 0% to 100% by slider of Ch1 Motor and Ch2 Motor individually.

RF Resistance

Set the detection resistance value of the motor current. It can be set different value between RCS1 and GND, RCS2 and GND. Both default values are 4300Ω .

<u>lout</u>

lout is calculated by setting RF resistance after "Polling start" button is clicked. This value is calculated value from equation (1), not actual value. lout will become the red characters at more than 0.2A for attention of attached motor in LV8716QA Evaluation Kit.

Start / Stop

"Start": When "Start" button is clicked, sending the set parameter with PWM signal, and then a motor rotate. The indicator changed to "Stop".

"Stop": When "Stop" button is clicked, PWM signal transfer is stopped. PWM signal corresponding to the motor channels become Low level. The indicator changed to "Start". Ch1 motor and Ch2 motor can be driven individually by each "Start" and "Stop" button.

Sequence Test

Controller window for DC Motor sequence test will come up the picture as shown in below when "Sequence Test" button is clicked.

h1 Control sequence All Check/Uncheck PWM mode ON-Duty Duration Time							
V Phase-1	Forward <> Standby	•		50.00%	5sec 👻		
V Phase-2	Reverse <> Standby	•		70.70%	5sec 👻		
Phase-3	Standby	-			5sec 🔻		
Phase-4	Forward <> Standby	-			5sec 🔻		
Phase-5	Forward <> Standby	-	Ū		5sec 👻		
Phase-6	Forward <> Standby	-			5sec 👻		
1 11400 0			_				
Phase-7	Forward <> Standby	-	Π		5sec 👻		
Phase-7 Phase-8 Control sequ	Forward <> Standby Forward <> Standby	-	0	— 0.00% — 0.00%	5sec v		
Phase-7 Phase-8 Control sequ	Forward <> Standby Forward <> Standby Jence Juncheck PWM mode	*	ON-Duty	— 0.00% — 0.00% — Ena	5sec v 5sec v		
Phase-7 Phase-8 Control sequ All Check/l	Forward <> Standby Forward <> Standby Jence Jncheck PWM mode Forward <> Standby	v	ON-Duty		5sec v 5sec v ble loop Duration Time		
Phase-7 Phase-8 Control sequ All Check/I Phase-1 Phase-2	Forward <> Standby Forward <> Standby Jacheck PWM mode Forward <> Standby Forward <> Standby		ON-Duty		Ssec * Ssec * ble loop Juration Time Ssec *		
Phase-7 Phase-8 Control sequ All Check/0 Phase-1 Phase-2 Phase-2 Phase-3	Forward <> Standby Forward <> Standby Jacheck PWM mode Forward <> Standby Forward <> Standby Forward <> Standby		ON-Duty		Ssec * Ssec * ble loop Duration Time Ssec * Ssec * Ssec * Ssec *		
Phase-7 Phase-8 Control sequ All Check/I Phase-1 Phase-2 Phase-2 Phase-3 Phase-4	Forward <> Standby Forward <> Standby Jacheck PWM mode Forward <> Standby Forward <> Standby Forward <> Standby Forward <> Standby		ON-Duty	 0.00% 0.00% Ena 0.00% 0.00% 0.00% 0.00% 0.00% 0.00% 	Ssec * Ssec * ble loop Juration Time Ssec * Ssec * Ssec * Ssec * Ssec *		
Phase-7 Phase-8 2 Control sequ All Check/0 Phase-1 Phase-2 Phase-3 Phase-4 Phase-4	Forward <> Standby Forward <> Standby Jence Jncheck PWM mode Forward <> Standby Forward <> Standby Forward <> Standby Forward <> Standby Forward <> Standby Forward <> Standby		ON-Duty	 0.00% 0.00% Ena 0.00% 0.00% 0.00% 0.00% 0.00% 0.00% 0.00% 	5sec * 5sec * ble loop buration Time 5sec *		
Phase-7 Phase-8 Control sequ All Check/I Phase-1 Phase-2 Phase-2 Phase-3 Phase-4 Phase-5 Phase-6	Forward <> Standby Forward <> Standby		ON-Duty ON-Duty	 0.00% 0.00% Ena 0.00% 0.00% 0.00% 0.00% 0.00% 0.00% 0.00% 0.00% 	Ssec * Ssec * ble loop Ssec Juration Time Ssec Ssec *		
 Phase-7 Phase-8 2 Control sequ All Check/II Phase-1 Phase-2 Phase-3 Phase-3 Phase-4 Phase-5 Phase-6 Phase-7 	Forward <> Standby Forward <> Standby Jence Jocheck PWM mode Forward <> Standby Forward <> Standby		ON-Duty	 0.00% 0.00% Ena 0.00% 	5sec * 5sec * bbe loop buration Time 5sec * 5sec *		

Figure 27. GUI field description of DC controller window 2-2

Ch1/ Ch2 Control sequence

Sequence test can send PWM signal of CH1 and Ch2 individually by setting PWM mode, ON Duty and Duration time with maximum of eight patterns. It is possible to select from phase-1 to phase-8 by clicking the check box. Last set sequence stage will be kept until the signal transfer is manually stopped. To reset all parameters back to default values, select "File" in the menu bar at the top of GUI, and then select "Rollback to Initial value".

LV8716QA(DC) Controller (USB Connected)									
File Help									
Save parameter setting Export Speed graph data									
Rollback to Initial value	100 Hz								
Close window									

Figure 28. GUI field description of DC controller window 2-3

PWM mode/ ON Duty/ Duration time

"PWM mode" can be selected six modes (Forward <-> Standby, Forward <-> Brake, Reverse <-> Standby, Reverse <-> Brake, Standby and Brake) It can be selected in Ch1 Motor and Ch2 Motor individually.

The value of "ON Duty" is the period of "Forward" or "Reverse" to drive brush DC motor. The value can be selected from 0% to 100% by slider in Ch1 Motor and Ch2 Motor individually. When standby and Brake is chosen, it is 100% Standby or Brake state regardless of the number of "ON Duty".

"Duration time" can be selected from 5sec to 60sec by drop-down list.

When "Forward -> Reverse" or "Reverse -> Forward" has been set, Brake or Standby state is added for 200ms in the switching timing of the "Forward" and "Reverse". Standby state or Brake state is selected by the next Phase.

All Check/ Uncheck

When this check box is checked, all phases are selected. When this check box is unchecked, all phases aren't selected.

Enable loop

When this check box is checked, selected sequence pattern is repeated until "Stop" button is pressed.

(3) Other functions

Figure 29. GUI field description of stepper controller window 1-5

M-DrAGON (USB Connected)	
File Help	
Load parameter setting Save parameter setting	A(Stepper)
Exit Application	(Groppor)

Figure 30. GUI field description of stepper controller window 1-5

Save parameter setting

Output the setting data of GUI. Select "File" in the menu bar at the top of GUI Controller window (Figure 29) or Motor and Drivers setting window (Figure 30), then select "Save parameter setting".

This is not effective in Sequence Test of DC mode.

Export Speed graph data (Only Stepper mode)

Output the Excel data of "Time" - "Motor Rotational speed (Clock frequency: pps)". Select "File" in the menu bar at the top of GUI Controller window, then select "Export Speed graph data", and then input file name, and start preservation of data after "Record Start" is clicked, and stop it when "Record End" is clicked. When the file which already exists is chosen, newest data is appended under a previous data. The data format is CSV as follows; "time", "raw data" and "pps". The data of "rpm" is not outputted.

Load parameter setting

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

Rollback to Initial value

When "Rollback to Initial value" is clicked, all parameters of the Controller window are returned to initial values.

6. Operation

(1) Stepper motor drive by parallel control

Following steps describe a typical operating procedure. It is assumed that the device driver has been already installed.

Step 1. Connect the LV8716QAGEVB to the PC using the USB cable. Step 2. Connect a motor to motor winding connector and power supply to VM pin.

Figure 31. Setup for a stepper motor

Step 3. Turn-on VM=7.2V (2.7V: min to 10.5V: max) power supply. Step 4. Run "**M-DrAGON_version1135.exe**".

Step 5. Set "Motor" type and "Driver" setting window as shown in below figure.

Motor		Driver
Stepper	▼ ->	LV8716QA(Stepper) -

Figure 32. Motor type and Driver setting window 1-1

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INF	<u>9 00. p</u> PUT			40 011	<u>o</u>		IPUT	gare for example			
RF	resistanc	ce: 4300	Ω			lout	≈0.186	A			
Tra	ansfer Tim	ne: 5									
Ex	xcitation Mode: Full or Half Step										
Fre	requency: 100Hz										
Dir											
	LV8716Q/	A(Steppe	er) Co	B Conn	ected)						
	File He	lp									
	Chip Enab	ole/Disable		E	nable						
	RF Resist	ance		4300	0	hm					
	lout =			0.186	4	λ					
	Test mode		Fixed								
	Transfor	5	Seco	nde -		Transfe	r Timo	5 I			
	Chan Circ	unit	Auto	Auto -		Transfe	rime	8			
	Stop Sign	aı	Auto					(max:65535)			
	Repeat		Off		P						
	Index	Excitation	Mode	Frequer	icy *	Directio	n l				
	1st	Hair Step) –	100HZ	•	CW	-				
	2nd	Full Step		20Hz	-	CW	-				
	3rd	Full Step	-	20Hz	-	CW	-				
	4th	Full Step	_	20Hz	*	CW	-				
	5th	Full Step		20Hz	-	CW	-				
	6th	Full Step	-	20Hz	-	CW	-				
	7th	7th Full Step		20Hz		CW	*				
	8th	Full Step	-	20Hz	-	CW	-				
		*: Frequ	lency	is one ste	ep per	iod conv	ersion				
	Sta	art			Stop						
	Record G	raph Data		Reco	ord Sta	art					
	Polling Tim	ner		Polli	ng Sto	p					
l											

Step 6. Set the GUI parameters as shown in below figure for example.

Figure 33. Setting parameter of GUI for Stepper mode

Step 7. Click "Enable" button. The indicator changed to "Disable". Step 8. Click "Start" button and then the motor begin to rotate.

• Monitor IN1 and IN2 terminal voltages using CH1 and CH2 of the scope. Monitor OUT1A and OUT2A output current using CH3 and CH4.

Step 9. Click "Stop" button and then the motor stop. Step 10. Click "Disable" button. The indicator is changed to "Enable". (2) Brush DC motor by PWM control

Following steps describe a typical operating procedure. It is assumed that the device driver has been already installed. Refer to "6-(1) Stepper motor drive by parallel control" for Step 1-4.

Figure 36. Setup for a brush DC motor

Step 5. Set "Motor" type and "Driver" setting window as shown in below figure.

ïle Help		
Motor		Driver
DC	▼ ->	LV8716QA(DC)
	_	

Figure 37. Motor type and Driver setting window 2-1

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	INPUT	OUTPUT	
	PWM Frequency: 2000Hz	lout≈0.186A	
	PWM mode:		
	Forward <-> Standby or		
	Forward <-> Brake		
	On Duty: 50%		
	RF resistance: 4300Ω		
LV8716QA(D	C) Controller (USB Connected)		X
File Help			
PS: Chip Enab	e Enable		
PWM Frequen	2000 Hz		
Ch1 Motor(OU	T1A-OUT1B)	Ch2 Motor(OUT2A-OUT2B)	
PWM mode	Forward <-> Standby 👻	PWM mode Forward <-> Standby	
On Duty	50 %	On Duty	0.00 %
RF-Resistance	e 4300 ohm	RF-Resistance 4300 ohm	
lout =	0.186 A	lout = 0.186 A	
Start/Stop	Start	Start/Stop Start	
	Sequence Test		

Step 6. Set the GUI parameters as shown in below figure for example.

Figure 38. Setting parameter of GUI for brush DC motor

Step 7. Click "Enable" button. The indicator changed to "Disable".

Step 8. Click "Start" button and then the motor begin to rotate. The indicator changed to "Stop".

• Monitor IN1 and IN2 terminal voltages using CH1 and CH2 of the scope. Monitor OUT1A and ONT1B output voltage using CH3 and CH4.

Step 9. Click "Stop" button and then the motor stop. The indicator changed to "Start". Step 10. Click "Disable" button. The indicator changed to "Enable".

APPENDIX B. BILL OF MATERIAL - LV8716QAGEVK

Lead Free	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Substitution Allowed	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Manufacturer Part Number	LV8716QA	RK73B1JT432J	RK73B1JT432J	50ME10HC	•	PM-61	MPT 0,5/4-2,54	ST-1-3		MSCA020A55
Manufacturer	ON semiconductor	KOA	KOA	SUN Electronic Industries	ON semiconductor	MAC8	PHOENIX CONTACT	MAC8	I	NIDEC SANKYO Corporation
Footprint	QFN16(3.0*3.0)	1608(0603lnch)	1608(0603lnch)							
Tolerance		+5%	+5%	±20%	•	•	•	•	•	•
Value		4.3kΩ,0.1W	4.3kΩ,0.1W	10µF, 50V	•	•	•	•	•	
Description	Motor Driver	Ch1 output current detective Resistor	Ch2 output current detective Resistor	VM bypass Capacitor	Interface board	Female Socket	Motor Connector	Test Point	A-MiniB	Stepper Motor
Quantity	٦	-	٢	-	-	З	-	5	-	1
Designator	IC1	R1	R2	G	Daughter Board	CN-A1,A2,B	CON1	TP1-5	USB cable	Ref Motor

Bill of Materials for the LV8716QAGEVK Evaluation Board

ON Semiconductor^{\circ} ON