Instruction Manual for the "M-DrAGON" LV8714TAGEVK



Figure 1. Setup for motor control



With the Daughter Board plugged into USB

Without the Daughter Board

Table1: Reference Equipment

Equipment	Specifications
DC Power supply	30V-3.0A
Oscilloscope	4 channel
Reference Stepper Motor	MSCA020A55 <sup>*2</sup> (Winding Res: 15±1.5Ω)
	/ Nidec Sankyo Corporation
Current probe	
LV8714TAGEVB	
Evaluation Board	
MOTOR DRIVER	
DAUGHTER BOARD	
USB Type A to Type mini-B cable	
PC with M-DrAGON* <sup>1</sup> GUI installed	32bit: Windows 7 /8
	64bit <sup>.</sup> Windows 7

\*1: It means "Motor- Driver And GUI produced by ON semiconductor".

\*2: In case of using the stepper motor "MSCA020A55".

When you continuously energized the 200mA at  $25^{\circ}$ C ambient temperature, temperature of the motor windings will be  $25 + 84.4 = 109.4^{\circ}$ C. Because the guaranteed temperature of the motor windings is  $115^{\circ}$ C, upper limit of the allowable current is 200mA.

In case of the other motor, please refer to the specification of it.



Figure 3. Temperature-rise characteristic of the motor winding

## **Allowable Operating Ratings**

Motor supply voltage (VM1/2/3/4): 4.0 to 16.5V Reference voltage for constant current (VREF1/2/3/4): 0 to 1.5V

Detection current setting method

Based on the voltage input to the VREF pin and the resistance between RCS and GND. The output current is set using the following calculation formula:

 $lout(A) = (VREF/3)/RCS \times 4000$  ("3" and "4000" are the fixed compression rate of the IC.)

### **Operation Procedure**

- Connect the peripheral equipment as shown Figure 1.
- Connect the motor wires to the screw socket like below.

Red:	OUT1(3)A
Yellow:	OUT1(3)B
Blue:	OUT2(4)A
Orange:	OUT2(4)B

- It is important to follow the order shown for starting the system: •
  - 1. Plug the USB cable into the Daughter Board.

  - Start up the GUI for LV8714TA.
     Apply input voltage to the terminal "VM"=12V.
  - 4. Apply drive signals with GUI.

If the MCU is used to drive the LV8714TA the USB Daughter board should be removed and input signal into IN1-4, ENA1-4 and VREF1-4 from MCU.

## **GUI** Operation

🕦 M-DrAGON (USB (	Connected)	
File Help		If the daughter board is unplugged, the message is "USB Disconnected".
Motor Steper	Driver -> LV8714TA(S	tepper) 🔻
	ОК	Cancel

Figure 4. Motor type and Driver setting window 1

When you double click the icon the above window appears.

- 1. Select "Stepper" in Motor Type.
- 2. Select "LV8714TA" in Driver type. When Driver type which you expected is not displayed, please check whether it is a suitable evaluation board.
- 3. Click the "OK" button. The windows of next page should appear:

p Enable/Disable Enable Start Same Time Stop Same Time EFI/VREF2 Voltage VREF4 Voltage VREF3/VREF4 Voltage 0.162 S resistance 1500 ohm 0.168 V resistance 1500 ohm 0.168 V RCS resistance 1500 ohm 0.162 S resistance 0.148 A tit mode Fixed V p Signal Auto Stop V Transfer Time 1 sec Stop Signal Auto Stop V Transfer Time 1 sec Stop Signal Auto Stop V Transfer Time 1 sec Note 2 × Transfer Time 1 sec V Stop Signal Auto Stop V Transfer Time 1 sec V Stop Signal Auto Stop V Transfer Time 1 sec V Stop Signal Auto Stop V Transfer Time 1 sec V Stop Signal Auto Stop V Transfer Time 1 sec V Stop Signal Auto Stop V Transfer Time 1 sec V V V V V V V V V V V V V V V V V V V	e neip												
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Figure 5. GUI windows for LV8714TA



### **Controller window 1**

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1 st       1/16 Step ▼ 7.8125kHz ▼ CW ▼       1 st       1/16 Step ▼ 7.8125kHz ▼ CW ▼         2 nd       1/16 Step ▼ 7.8125kHz ▼ CW ▼       2 nd       1/16 Step ▼ 7.8125kHz ▼ CW ▼         3 rd       1/16 Step ▼ 7.8125kHz ▼ CW ▼       3 rd       1/16 Step ▼ 7.8125kHz ▼ CW ▼         4 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼       3 rd       1/16 Step ▼ 7.8125kHz ▼ CW ▼         5 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼       4 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼         6 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼       5 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼         6 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼       6 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼         7 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼       6 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼         8 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼       7 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼         8 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼       8 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼         8 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼       8 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼         8 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼       8 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼         8 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼       8 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼         8 th       1/16 Step ▼ 7.8125kHz ▼ CW ▼       8 th       1/16 Step ▼ 7.8125k	ndex	Excitatio	n Mode	Frequ	uency	2	Directi	on		Index	Excitat	tion Mo	ode	Frequ	iency	*	Direct	tion	
2nd       1/16 Step + 7.8125kHz + CW +       2nd       1/16 Step + 7.8125kHz + CW +         3rd       1/16 Step + 7.8125kHz + CW +       3rd       1/16 Step + 7.8125kHz + CW +         4th       1/16 Step + 7.8125kHz + CW +       4th       1/16 Step + 7.8125kHz + CW +         5th       1/16 Step + 7.8125kHz + CW +       5th       1/16 Step + 7.8125kHz + CW +         6th       1/16 Step + 7.8125kHz + CW +       6th       1/16 Step + 7.8125kHz + CW +         7th       1/16 Step + 7.8125kHz + CW +       6th       1/16 Step + 7.8125kHz + CW +         8th       1/16 Step + 7.8125kHz + CW +       8th       1/16 Step + 7.8125kHz + CW +         *: Frequency which changes VREF voltage       *: Frequency which changes VREF voltage       *: Frequency which changes VREF voltage	1st	1/16 Ste	p 🔻	7.812	5kHz	•	CW	-		Ist	1/16 S	itep	-	7.8125	ikHz	•	CW	•	
3rd       1/16 Step + 7.8125kHz + CW +       3rd       1/16 Step + 7.8125kHz + CW +         4th       1/16 Step + 7.8125kHz + CW +       4th       1/16 Step + 7.8125kHz + CW +         5th       1/16 Step + 7.8125kHz + CW +       5th       1/16 Step + 7.8125kHz + CW +         6th       1/16 Step + 7.8125kHz + CW +       5th       1/16 Step + 7.8125kHz + CW +         7th       1/16 Step + 7.8125kHz + CW +       6th       1/16 Step + 7.8125kHz + CW +         8th       1/16 Step + 7.8125kHz + CW +       7th       1/16 Step + 7.8125kHz + CW +         8th       1/16 Step + 7.8125kHz + CW +       8th       1/16 Step + 7.8125kHz + CW +         *: Frequency which changes VREF voltage       *: Frequency which changes VREF voltage       *: Frequency which changes VREF voltage	2nd	1/16 Ste	p –	7.812	5kHz	-	CW	$\sim \pi r$		2nd	1/16 S	tep		7.8125	ikHz	*	CW		
4th       1/16 Step + 7.8125kHz + CW +       4th       1/16 Step + 7.8125kHz + CW +         5th       1/16 Step + 7.8125kHz + CW +       5th       1/16 Step + 7.8125kHz + CW +         6th       1/16 Step + 7.8125kHz + CW +       6th       1/16 Step + 7.8125kHz + CW +         7th       1/16 Step + 7.8125kHz + CW +       6th       1/16 Step + 7.8125kHz + CW +         8th       1/16 Step + 7.8125kHz + CW +       7th       1/16 Step + 7.8125kHz + CW +         8th       1/16 Step + 7.8125kHz + CW +       8th       1/16 Step + 7.8125kHz + CW +         *: Frequency which changes VREF voltage       *: Frequency which changes VREF voltage       *: Frequency which changes VREF voltage	3rd	1/16 Ste	p –	7.8125	5kHz	-	CW	-		🔄 3rd	1/16 S	tep	: <b>T</b>	7.8125	ikHz	×	CW	-	
5th       1/16 Step + 7.8125kHz + CW +       5th       1/16 Step + 7.8125kHz + CW +         6th       1/16 Step + 7.8125kHz + CW +       6th       1/16 Step + 7.8125kHz + CW +         7th       1/16 Step + 7.8125kHz + CW +       6th       1/16 Step + 7.8125kHz + CW +         8th       1/16 Step + 7.8125kHz + CW +       7th       1/16 Step + 7.8125kHz + CW +         8th       1/16 Step + 7.8125kHz + CW +       8th       1/16 Step + 7.8125kHz + CW +         *: Frequency which changes VREF voltage       *: Frequency which changes VREF voltage       *: Frequency which changes VREF voltage         Start       Stop       Polling Stop       Start       Stop       Polling Stop	4th	1/16 Ste	p –	7.8125	5kHz	-	CW			4th	1/16 S	itep		7.8125	ikHz	×	CW		
6th       1/16 Step * 7.8125kHz * CW *       6th       1/16 Step * 7.8125kHz * CW *         7th       1/16 Step * 7.8125kHz * CW *       7th       1/16 Step * 7.8125kHz * CW *         8th       1/16 Step * 7.8125kHz * CW *       8th       1/16 Step * 7.8125kHz * CW *         *: Frequency which changes VREF voltage       *: Frequency which changes VREF voltage       *: Frequency which changes VREF voltage         Start       Stop       Polling Stop       Start       Stop       Polling Stop	5th	1/16 Ste	p –	7.8125	5kHz	-	CW			5th	1/16 S	itep	1	7.8125	ikHz	*	CW	-	
7th       1/16 Step + 7.8125kHz + CW +       7th       1/16 Step + 7.8125kHz + CW +         8th       1/16 Step + 7.8125kHz + CW +       8th       1/16 Step + 7.8125kHz + CW +         *: Frequency which changes VREF voltage       *: Frequency which changes VREF voltage       *: Frequency which changes VREF voltage         Start       Stop       Polling Stop       Start       Stop       Polling Stop	6th	1/16 Ste	p –	7.812	5kHz	-	CW			6th	1/16 S	itep	-	7.8125	ikHz	×	CW		
8th     1/16 Step     7.8125kHz     CW     Image: Start     8th     1/16 Step     7.8125kHz     CW       *: Frequency which changes VREF voltage     *: Frequency which changes VREF voltage     *: Frequency which changes VREF voltage       Start     Stop     Polling Stop     Start     Stop     Polling Stop	7th	1/16 Ste	p –	7.8125	5kHz	-	CW			[]] 7th	1/16 S	itep		7.8125	ikHz	*	CW	-	
*: Frequency which changes VREF voltage           Start         Stop         Polling Stop         Start         Stop         Polling Stop	8th	1/16 Ste	p –	7.8125	5kHz	-	CW	-		🔄 8th	1/16 S	itep		7.8125	ikHz	*	CW		
Start Stop Polling Stop Start Stop Polling Stop		*: Freque	ency w	hich cha	anges	VRE	F voltag	ge	-		*: Freq	uency	wh	nich cha	nges	VRE	F volta	ge	_
	St	art		Stop			Pollin	g Stop		Sta	rt			Stop			Pollin	ng Stop	

Figure 6. Controller window 1

This GUI can control two stepper motors independently. <Motor 1> of GUI is the motor connected to OUT1 and OUT2. <Motor 2> of GUI is the motor connected to OUT3 and OUT4.

- <u>Chip Enable / Disable</u>: Switching the signal to the terminal PS of LV8714TA.
   IC will be enable state by clicking "Enable" button, and the indicator shows "Disable" from "Enable".
   IC will be disable state by clicking "Disable" button, and the indicator shows "Enable" from "Disable".
- <u>VREF1/2/3/4 Voltage</u>: For setting the reference voltage of the output current. PWM signal (0 – 3.3V) comes from the Daughter board then the signal is smoothed on the main board. Smoothed DC voltage is displayed in the text box after "Polling Start" button at the bottom of GUI is clicked. Caution: The VREF voltage sets 1.5V or less
- <u>**RCS Resistance**</u>: For setting the resistance value of the detection resistor of the output current. Default set value is 1500Ω.
- <u>lout</u>: This lout is calculated by set VREF Voltage and RCS resistance after "PollingStart" button is clicked. This value is not actual value but calculated value. Since an attached motor becomes high temperature at over 200 mA, if this value exceeds 200 mA, it will change to a red character for cautions.





- <u>Test mode</u>: Selection of signal sending method for motor operation.
   "<u>Fixed</u>": Sending fixed signal (one pattern only) means sending one Excitation Mode, one Frequency, and one Direction.
   "Sequence": Sending conjugation pattern means conding the three perspectation.
  - "<u>Sequence</u>": Sending sequential pattern means sending the three parameters (Excitation Mode, Frequency and Direction) at maximum of 8 patterns. To reset all parameters back to default values, select "File" in the menu bar at the top of GUI, then select "Rollback to Initial value".
- <u>**Transfer Time**</u>: For setting the value of the motor drive time. A unit is a second. Select the value from drop-down list or select "others" 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.
- <u>Stop Signal</u>: Selection of conditions "Auto Stop" or "Stop Button".
   "<u>Auto</u>": An input signal is stopped automatically when the set Transfer Time is completed.
   "<u>Stop Button</u>": The drive of a motor stops by "Stop" button located at the bottom of the GUI, and "Stop Same Time" button located at the top of the GUI.
   Clicking "Stop" button, 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 in the last stage.
- <u>**Repeat**</u>: "<u>On</u>": sequence pattern repeats while test mode is in "Sequence" mode. "<u>Off</u>": last set sequence stage will be kept until the signal transfer is manually stop. A repeat function can set up when "Sequence" mode and "Stop button" are chosen.
- <u>Excitation Mode</u>: Selection of the excitation mode. (1/16,1/32,1/64,1/128Step) A motor rotates more smoothly and more slowly by changing VREF voltage smaller. 1/128 Step is the smoothest of the four step(1/16, 1/32, 1/64, 1/128 Step)
- <u>Frequency</u>: The velocity of stepper motor is usually described by [pps] pulse per second. In other words, the number of steps per second. VREF voltage changes at this frequency, and the motor current changes by changing VREF voltage.
   When quicker Frequency was selected, the change speed of VREF voltage is quicker, and the rotary speed of the motor is fast. The setting of the frequency is seven varieties.
- **Direction**: Selection of the direction of motor rotation. CW (clockwise) and CCW (counterclockwise).

<u>Start</u>: Sending the set parameters to IN1-4, ENA1-4 and VREF1-4. The "Start" button of <Motor 1> sends the signal of IN1-2, ENA1-2 and VREF1-2. The "Start" button of <Motor 2> sends the signal of IN3-4, ENA3-4 and VREF3-4. This button can not update the parameter while a motor is operating.

**Stop**: Regardless of "Fixed" mode and "Sequence" mode, IN1-4, ENA1-4 and VREF1-4 signal transfer is stopped by this button. The "Stop" button of <Motor 1> stops the signal of IN1-2, ENA1-2 and VREF1-2. The "Stop" button of <Motor 2> stops the signal of IN3-4, ENA3-4 and VREF3-4. These signals become all Low state and a motor doesn't keep its position.

- <u>Start Same Time</u>: Sending the set parameters to IN1-4, ENA1-4 and VREF1-4 at the same time. This button can not update the parameter while a motor is operating.
- <u>Stop Same Time</u>: Regardless of "Fixed" mode and "Sequence" mode, IN1-4, ENA1-4 and VREF1-4 signal transfer is stopped by this button at the same time.
- <u>Polling Start/Stop</u>: Update VREF1/2/3/4 Voltage, Graph and Indicator. These three are updated in real-time when "Polling Start" button is clicked. Default setting is "Polling Start", and the button shows "Polling Stop".



### **Controller window2**

File Help	þ																
Save	parameter	set	ting		1			Start Same Ti	ime		S	top Sa	ame T	ime	]		
Expo	rt Speed gr	aph	data								< M	otor 2	>				;
Rollb	ack to Initia	al va	lue					VREF3/VREF	4 Volta	age							÷
Class		01.05				0.238	۷								-	0.235	V
Close	e window				Į.			RCS resistar	nce	3	1500	)	ohm				
lout =		0.3	211	A				lout =			0.20	9	А				
Test mode	Fixe	d	•					Test mode		Fixed		•					
Stop Signa	Auto	Sto	p 🔻	Transf	er Time	1 sec	•	Stop Signal		Auto S	top	•	Tra	nsfe	er Time	1 sec	1
Repeat	Off		-			8		Repeat		Off		Ŧ				8	
Index	Excitation M	ode	Freque	ency *	Direct	ion		Index	Excitat	tion Mod	е	Frequ	ency	*	Direc	tion	
1st	1/16 Step		7.8125	kHz 🔻	CW	-		Ist	1/16 S	Step	• 7	.8125	kHz	•	CW	-	
2nd	1/16 Step		7.8125	kHz 👻	CW			2nd	1/16 S	Step	+ 7	.8125	kHz	-	CW	-	
3rd	1/16 Step		7.8125	kHz ⇒	CW			3rd	1/16 S	Step	+ 7	.8125	kHz	-	CW	-	
4th	1/16 Step		7.8125	kHz ⇒	CW			4th	1/16 S	Step	- 7	.8125	kHz	×	CW	-	
5th	1/16 Step	Ŧ	7.8125	kHz 👻	CW			5th	1/16 S	Step	- 7	.8125	kHz	×	CW	-	
6th	1/16 Step	T	7.8125	kHz 👻	CW			6th	1/16 S	Step	- 7	.8125	kHz	-	CW	-	
7th	1/16 Step	Ŧ	7.8125	kHz 👻	CW	-		7th	1/16 S	Step	- 7	.8125	kHz	×	CW	-	
8th	1/16 Step	Ŧ	7.8125	kHz 👻	CW			🗌 8th	1/16 S	Step	- 7	.8125	kHz	-	CW	-	
1922	*: Frequence	y wł	nich char	nges VRE	EF volta	ge	23		*: Freq	uency v	whic	h char	nges	VRE	F volta	ge	1
St	art		Stop		Pollin	g Stop		Sta	rt		St	top			Pollin	ng Stop	

### Figure 7. Controller window 2



Figure 8. Motor type and Driver setting window2

- <u>Save parameter setting</u>: Output the setting data 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".
- <u>Load parameter setting</u>: Load the file which you saved by "Save parameter setting". Select "File" in the menu bar at Motor and Driver setting window, then select "Load parameter setting".
- **<u>Rollback to Initial value</u>**: All parameters of the Controller window is returned to an initial value.
- <u>Export Speed graph data</u>: Output the Excel data of "Time" "Motor Rotational speed (Frequency)". When the file which already exists is chosen, newest data is saved under a previous data. 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.



## Indicator window

Motor 1	Motor 2
0 pps	0 pps
Graph range	

Figure 9. The indicator window

- Current PPS: The indicator for pulse rate which is controlled by microcontroller. The pulse rate of LV8714TA is the same as the change timing of VREF voltage. Therefore, the value displays Frequency of GUI.
- Graph range: To adjust maximum value for Graph.



# Graph window

- This graph shows relationship between elapsed time(X-axis) and motor pulse rate(the change timing of VREF voltage: Y-axis).
- Pulse rate(Y-axis) is the same as the value of the indicator window, Maximum level of Y-axis is adjusted by "Graph range".
- The scale of X-axis is 500msec/div. Graph is automatically scrolled according to elapsed time.



# • The example of setting

- 1. Plug the USB cable into the Daughter Board.
- 2. Start up the GUI for LV8714TA.
- 3. Apply input voltage to the terminal "VM"=12V.
- 4. GUI setup as below.

# Table2: Example of a GUI setup

INPUT	OUTPUT
VREF1/VREF2≈0.23V	lout≈0.2A
Test mode: Fixed	
Stop Signal: Auto Stop	
Transfer Time: don't care	
Excitation Mode: 1/16 Step	
Frequency: 7.8125kHz	
Direction: CW	
Clicking "Enable" button	Indicator shows "Disable"
Clicking "Start" button	indicator shows "Stop"

File Help												
Chip Enable/Disable	$\subset$	Enable	$\rightarrow$		Start Same T	ime		Stop S	ame Tim	e		
	= <	Motor 1 >					<	Motor 2	2 > =			
VREF1/VREF2 Voltag	•		5	$\frown$	VREF3/VRE	F4 Voltag	ge				1453100.09 M	T.com
			(	0.236 V	/U-						0.235	V
RCS resistance	15	i00 ohm			RCS resista	nce	1	500	ohm			
lout =	0.3	209 A			lout =		0	.209	А			
Test mode	ixed	•			Test mode		Fixed	•				
Stop Signal 🛛 🗍	uto Sto	p 🔻 Tran	sfer Time	1 sec 🔹	Stop Signal		Auto Sto	op 👻	Trans	fer Time	1 sec	•
Repeat	ff	-		8	Repeat	6	Off	Ŧ			8	
Index Excitatio	1 Mode	Frequency *	Direc	tion	Index	Excitatio	on Mode	Frequ	iency *	Direc	tion	
1st 1/16 Ste	• •	7.8125kHz	- CW		1st	1/16 St	ep 🗸	7.8125	ikHz •	CW	-	
2nd 1/16 Ste	- v	7.8125kHz	- CW	-	2nd	1/16 St	ep –	7.8125	ikHz ·	- CW		
3rd 1/16 Ste	- v	7.8125kHz	- CW	-	🔄 3rd	1/16 St	ep –	7.8125	ikHz ·	- CW		
4th 1/16 Ste	- c	7.8125kHz	- CW	-	4th	1/16 St	ep	7.8125	ikHz ·	CW	w	
5th 1/16 Ste	- v	7.8125kHz	- CW	-	5th	1/16 St	ep 👻	7.8125	5kHz ·	- CW		
6th 1/16 Ste	- v	7.8125kHz	- CW	-	6th	1/16 St	ep	7.8125	5kHz ·	r C₩		
7th 1/16 Ste	- v	7.8125kHz	- CW	-	7th	1/16 St	ep	7.8125	ikHz ·	- CW		
8th 1/16 Ste	- v	7.8125kHz	- CW		8th	1/16 St	ep	7.8125	ikHz ·	CW	*	
*: Freque	ncy wh	nich changes \	/REF volta	age	hand of the second	*: Frequ	ency w	hich cha	inges Vi	REF volta	age	
Start		Stop	Polli	ng Stop	Sta	rt		Stop		Polli	na Stop	

Figure 11. The example of controller window





The motor connected to OUT3 and OUT4 rotates with same waveform by setting of GUI < Motor 2>.

Figure 12. The image of waveforms for example

Schematic for the LV8714TA Demonstration





### Cautions

- This system is intended for an initial evaluation of LV8714TA. Since this evaluation board is not supporting all drive modes, we appreciate your understanding. We will not guarantee measured values as full evaluation and validation must be performed on your system independently.
- Never hold the motor with the lead wire or shaft. The motor should be affixed to a stand prior to operation.
- Depending on the conditions of use or installation, the motor produces excessive heat when it runs. Install a heatsink, cooling fan or take other measures against excess heat.
- Before turning on the power supply, we recommend that you connect all motor leads.

### Safety

- Do not touch the rotating part when the motor is powered. Doing so may result in injury.
- Do not touch conductive parts such as connectors when the motor is powered. Doing so may result in electric shocks.



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- Консультации по применению компонента;
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- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный) Факс: 8 (812) 320-02-42 **Электронная почта:** <u>org@eplast1.ru</u> **Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.