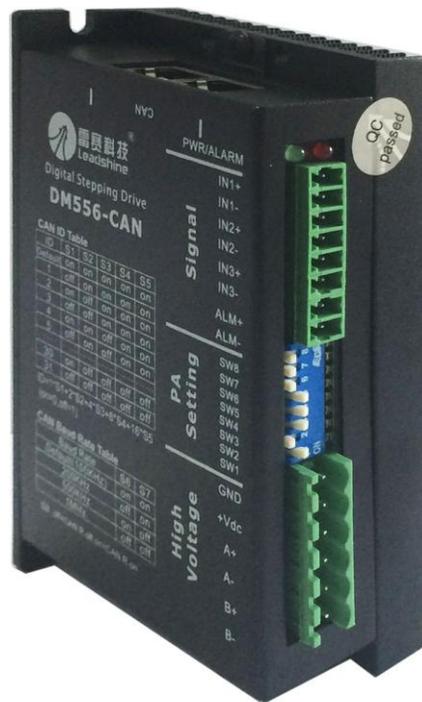


## User Manual

# EM556-CAN

2-Phase Field Bus Stepper Drive



Revision 1.0

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## Notice

Read this manual carefully before any assembling and using. Incorrect handling of products in this manual can result in injury and damage to persons and machinery. Strictly adhere to the technical information regarding installation requirements.

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## Record of Revisions

<b>Revision</b>	<b>Date</b>	<b>Description of Release</b>
<i>1.0</i>	<i>Mar, 2017</i>	<i>Initial Release</i>

# Preface

Thank you for you choose EM556-CAN stepper drive system of Leadshine Technology Co.,.Ltd. This manual gives required knowledge & precautions for using EM556-CAN.

**Improper operation may cause an accident, please read this manual carefully before operation.**

- Manual content may change due to product improvement, please forgive without prior notice.
- Leadshine will not undertake any responsibility in case of user's unauthorized product changes, product warranty will be invalid.

Please pay attention to the following reminders:

## CAUTION



- Only the technical personnel to install,debug or maintain the product.
- To ensure correct wiring before power-on test.
- Incorrect voltage or power polar can cause damage to drive or other accidents

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## 1. Introduction

### 1.1 Overview

EM556-CAN is one of the new high performance stepper drive which can support CANopen communication protocol. By implementing latest 32-bit DSP technology, this stepper drive is able to power 2 phase and 4 phase stepper motors. It can configure drive parameters and motor operation in real time via CANopen commander. Especially in multi-axis linkage of applications, can greatly reduce the wiring, enhance the drive running reliability.

### 1.2 Features

- Power supply 20~50VDC, recommended 36VDC
- Output current 0.1~5.6A(peak), default value 3.2A(peak)
- Support CAN field bus control, meet CANopen standard protocol of DS301 V4.02 and DSP 402 V2.01
- Setting address and the baud rate via DIP switch
- Operates in velocity, position or home mode
- 3 opto-isolation differential digital inputs, max. frequency 20KHz, and wide input voltage +5~24VDC
- 1 opto-isolation differential digital output, max. current 100mA, largest external pull-up voltage 24VDC
- Protections for over-voltage and over-current,etc.

### 1.3 Application

Suitable for all kinds of multi-axis linkage control of small and medium-sized automation equipment and instrumentation: such as manipulator, packaging machinery etc.

## 2. Specification

### 2.1 Electrical Specification

Parameters	EM556-CAN			
	Min	Typical	Max	Unit
Output Current	0.1	-	5.6 (4.0 RMS)	A
Supply Voltage	20	24 - 48	50	VDC
Input signal current	6	10	16	mA
Input signal voltage	5	-	24	VDC
Over voltage Value	-	90	-	VDC
Isolation resistance	500			MΩ

### 2.2 Environment

Cooling	Natural Cooling or Forced cooling	
Operating Environment	Environment	Avoid dust, oil fog and corrosive gases
	Ambient Temperature	0 °C — 65 °C (32 °F - 149 °F)
	Humidity	40%RH—90%RH
	Operating Temperature	0 °C — 50 °C (32 °F - 122 °F)
	Vibration	10-50Hz / 0.15mm
Storage Temperature	-20 °C — 65 °C (-4 °F - 149 °F)	
Weight	Approx. 227g (8 oz)	

## 2.3 Mechanical Specification

(unit: mm [1inch=25.4mm])

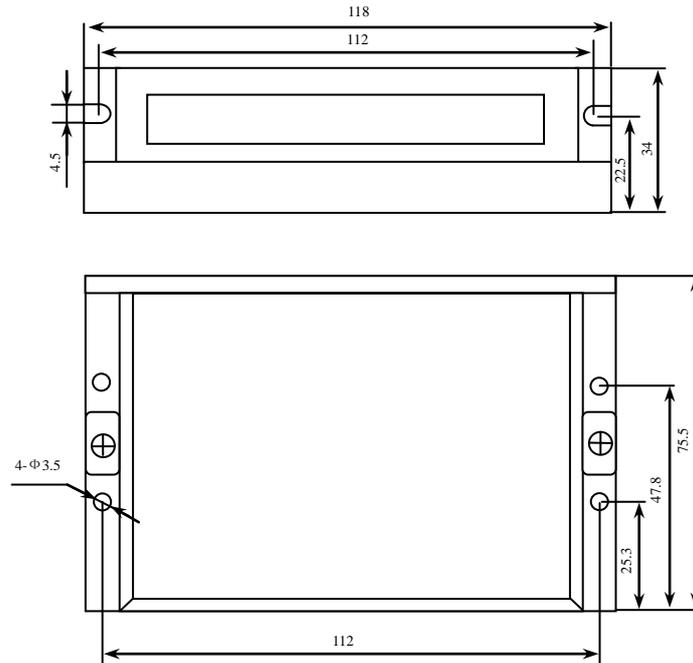


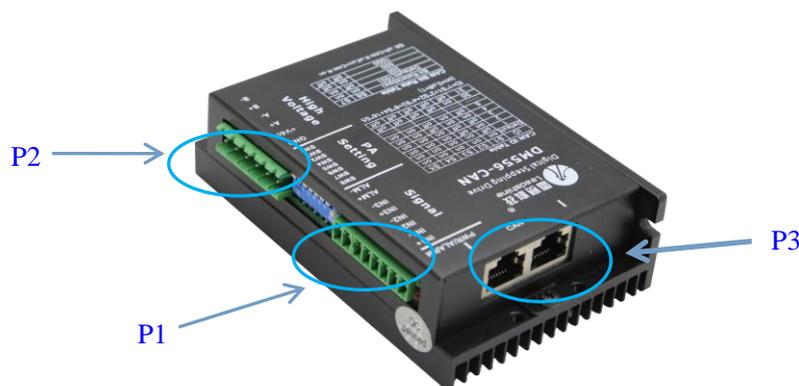
Figure 1: Mechanical specifications

**\* Side mounting recommended for better heat dissipation**

## 2.4 Elimination of Heating

- EM556-CAN reliable working temperature should be  $< 60^{\circ}\text{C}$  ( $140^{\circ}\text{F}$ ) and stepper motor should be  $< 120^{\circ}\text{C}$  ( $248^{\circ}\text{F}$ )
- It is recommended to use automatic idle-current mode to reduce drive and motor heating. That means output current will be reduce to 50% when the motor at standstill.
- It is recommended to mount the drive vertically to maximize heat sink area. Use forced cooling method to cool if necessary.

## 3. Connection Pin Assignment & DIP Switch & LED Indication



The EM556-CAN has three connector blocks P1&P2&P3 (see above picture). P1 is for IO signals connections, P2 is for power and motor connections, and P3 is for CAN communication connection. The following tables are brief descriptions of the two connectors. More detailed descriptions of the pins and related issues are presented in section 4, 5, 9.

### 3.1 Connection Pin Assignment

#### 3.1.1 Connector P1

Pin Function	Details
--------------	---------

IN1+	Opto-isolation differential input signals (5~24V compatible)
IN1-	
IN2+	
IN2-	
IN3+	
IN3-	
ALM+	Opto-isolation differential output signal is for alarm function. maximum output current 100mA, maximum pull-up voltage 24VDC
ALM-	



**Notes:** (1) The function of input signals can be configured by controller

### 3.1.2 Connector P2

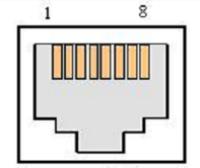
Pin Function	Details
GND	Power supply ground connection.
+VDC	Power supply positive connection. Suggest 24-48VDC power supply voltage
A+, A-	Motor Phase A connections. Connect motor A+ wire to A+ Pin; motor A- wire to A-
B+, B-	Motor Phase B connections. Connect motor B+ wire to B+ Pin; motor B- wire to B-



**Warning:** (1) Don't plug or unplug the P2 terminal block to avoid drive damage or injury when EM556-CAN is powered on; (2) Don't connect the power supplier to motor connection terminal, and don't connect +VDC and GND inversely, otherwise, drive will be damaged.

### 3.1.3 Connector P3

CAN port of EM556-CAN adopt shield doublet RJ45 terminal (standard RJ45 specification).

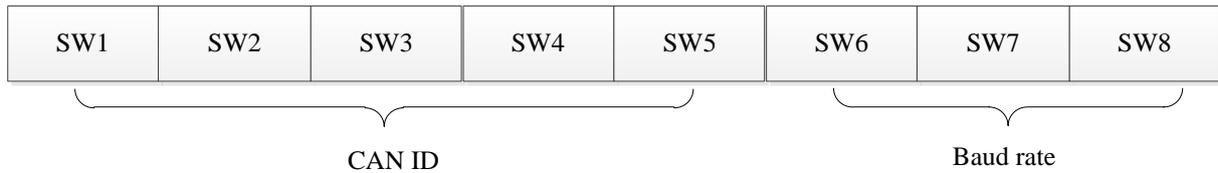
PIN definition	PIN	Signal	Details
	1	CAN_H	Differential signal of CAN
	2	CAN_L	
	3	CAN_GND	CAN ground
	4~8	NC	-



**Notes:** (1) shielding cable and reliable grounding is suggested; (2) CAN\_H and CAN\_L should not connect inversely; (3) Two interfaces of RJ45 without order.

## 3.2 DIP Switch

EM556-CAN field bus stepper drive uses an 8-bit DIP switch to set CAN ID, baud rate, as shown below:



### 3.2.1 CAN ID Setup

Low 5 bits of CAN ID are set by DIP switch SW1~SW5, and high 5 bits of CAN ID are set by controller, as shown in the following table.

CAN address ID(low 5 bits)	SW1	SW2	SW3	SW4	SW5
1	off	on	on	on	on
2	on	off	on	on	on
3	off	off	on	on	on
4	on	on	off	on	on
5	off	on	off	on	on
6	on	off	off	on	on
7	off	off	off	on	on
8	on	on	on	off	on
9	off	on	on	off	on
10	on	off	on	off	on
11	off	off	on	off	on
12	on	on	off	off	on
13	off	on	off	off	on
14	on	off	off	off	on
15	off	off	off	off	on
16	on	on	on	on	off
17	off	on	on	on	off
18	on	off	on	on	off
19	off	off	on	on	off
20	on	on	off	on	off

21	off	on	off	on	off
22	on	off	off	on	off
23	off	off	off	on	off
24	on	on	on	off	off
25	off	on	on	off	off
26	on	off	on	off	off
27	off	off	on	off	off
28	on	on	off	off	off
29	off	on	off	off	off
30	on	off	off	off	off
31	off	off	off	off	off



**Notes:** (1) SW1~SW5 set to "on" all will be invalid ID; (2) Should restart the power after modifying CAN ID.

### 3.2.2 CAN Baud Rate Setup

CAN baud rate can be set by DIP switch SW6~SW8, as shown below:

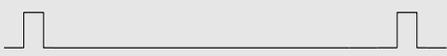
Baud rate(Kbps)	SW6	SW7	SW8
20	on	on	on
50	off	on	on
100	on	off	on
125	off	off	on
250	on	on	off
500	off	on	off
1000	on	off	off



**Notes:** (1) Should restart the power after modifying baud rate.

### 3.3 LED Light Indication

There are two LED lights for DM56-CAN. The GREEN one is the power indicator which will be always on generally. The RED one is a protection indicator which will flash 1-2 times in a 3-second period, when protection enabled for a EM556-CAN. Different number of flashes indicates different protection type ,as shown following table.

Priority	Time(s) of Blink	Sequence wave of red LED	Description
1st	1		Over-current protection activated when peak current exceeds the limit.
2nd	2		Over-voltage protection activated when drive working voltage is greater than 90VDC
3rd	8		EEPROM Fault(need to configure parameter )
4th	12		Operational Amplifier Fault (need to configure parameter )



**Notes:** (1) The protections for detecting fault of EEPROM fault and Operational Amplifier need to turn on manually via configuring parameter, read section 4.4 for detail; (2) When one of the protection is active, the motor shaft will be free and the red LED blinks. Restart the power to make it function properly after removing above problems.

## 4. Getting Started

### 4.1 Wiring Instruction

#### 4.1.1 Power supply & motor cable

- Wire diameter: +VDC, GND, A+, A-, B+, B- terminal wire diameter $\geq 0.3\text{mm}^2$  (AWG15-22)
- Recommend to connect a noise filter between power supply and drive, can improve anti-interference performance.

#### 4.1.2 I/O signal cable

- Wire diameter: IN1+, IN1-, IN2+, IN2-, IN3+, IN3- terminal wire diameter $\geq 0.12\text{mm}^2$  (AWG24-26)
- Recommended to adopt shielded twisted pair cable, cable length as short as possible, suggest no more than 3 meters
- Wiring: As far as possible away from the power line wiring, in order to prevent interference
- Please connect surge absorber to inductive device, such as anti-parallel diode for DC coil, parallel RC-snubbers circuit for AC coil.

#### 4.1.3 CAN communication cable

There are coupling relationship between CAN bus cable length, guide line cross sectional area, terminal resistance and communication rate, recommended combinations as below:

Length (m)	Bus cable		Terminal resistance ( $\Omega$ )	Communication rate
	Resistance per unit length(m $\Omega$ /m)	Cross-sectional area(mm <sup>2</sup> )		
0~40	70	0.25~0.34	120	1 Mbit/s
40~300	<60	0.34~0.6	150~300	<500 Kbit/s
300~600	<40	0.7~0.75	150~300	<100 Kbit/s
600~1000	<26	0.75~0.8	150~300	<50 Kbit/s



**Notes:** (1) shielding and twisted-pair cable is suggested.

#### 4.1.4 Terminal resistance

Note	Terminal resistance
It must to connect an 120 $\Omega$ resistance if the drive on the end of bus, and customer need to order the terminal resistance as shown right	

#### 4.2 Typical Connection

EM556-CAN adopt CANopen protocol, typical schematic wiring topology structure as below:

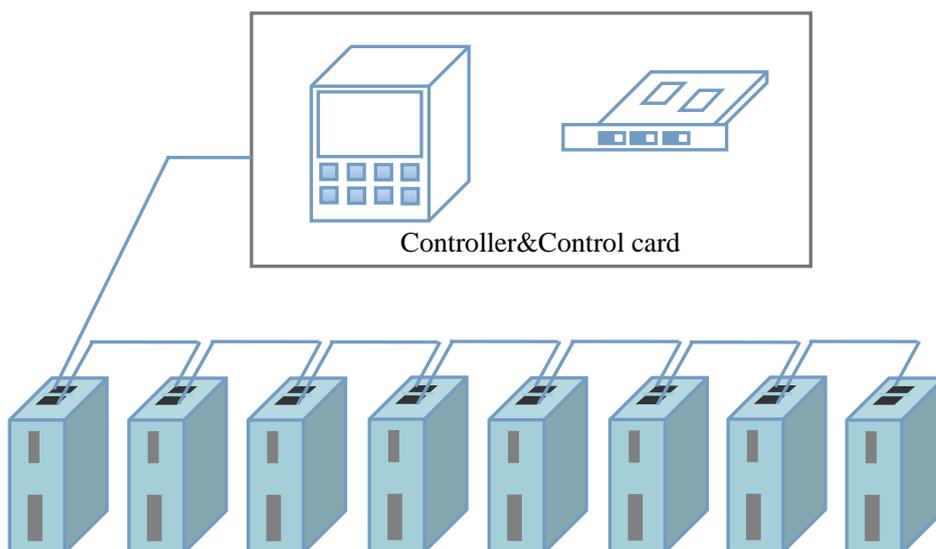


Figure 2: The topology of the CAN network

Each EM556-CAN of the CAN network wiring diagram:

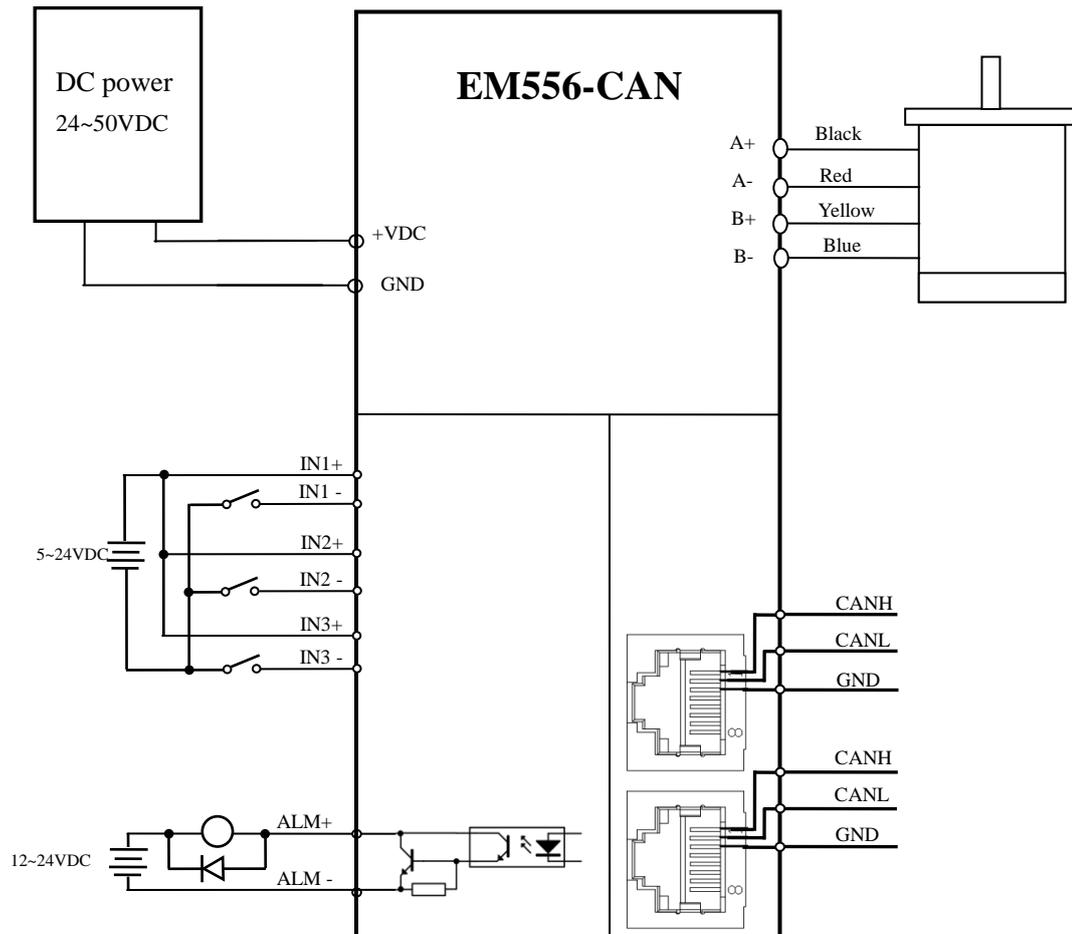


Figure 3: The wiring diagram of each EM556-CAN



**Notes:** (1) The EM556-CAN at the end of the network need to plug a terminal resistance in any one of the P3 interface(RJ45); (2) In order to avoid bad insulation performance as heating, cable and wire should be fixed well and keep away from motors and drives.

### 4.3 Motor Connection

The EM556-CAN can drive 2-phase and 4-phase bipolar hybrid stepper motors with 4, 6, or 8 wires (frame size from NEMA17 to 24).

#### 4.3.1 Connections of 4-lead Motor

The 4 lead motors are the least flexible and easy to connect. And the Speed – torque of motor depends on winding inductance. The output current from drive that is multiply the specified phase current by 1.4 to determine the peak output current.

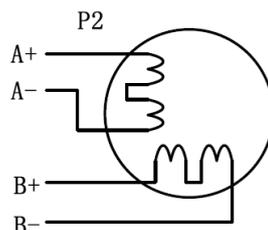


Figure 4: 4-lead Motor Connections

### 4.3.2 Connections of 6-lead Motor

Like 8 lead stepping motors, 6 lead motors have two configurations available for high speed or high torque operations. The higher speed configuration, or half coil, is described, because it uses one half of the motor's inductor windings. The higher torque configuration, or full coil, uses the full coil windings.

#### (1) Half Coil Configuration

As previously stated, the half coil configuration uses 50% of the motor phase windings. This gives lower inductance, hence, lower torque output. Like the parallel connection of 8 lead motor, the torque output will be more stable at higher speeds. This configuration is also referred to as half chopper. In setting the drive output current multiply the specified per phase (or unipolar) current rating by 1.4 to determine the peak output current.

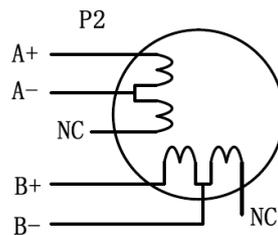


Figure 5: 6-lead motor half coil (higher speed) connections

#### (2) Full Coil Configuration

The full coil configuration on a six lead motor should be used in applications where higher torque at lower speed is desired. This configuration is also referred to as full copper. In full coil mode, the motors should be run at only 70% of their rated current to prevent overheating.

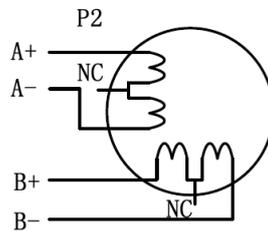


Figure 6: 6-lead motor full coil (higher torque) connections

### 4.3.3 Connections of 8-lead Motor

8 lead motors offer a high degree of flexibility to the system designer in that they may be connected in series or parallel, thus satisfying a wide range of applications.

#### (1) Series Connection

A series motor configuration would typically be used in applications where a higher torque at lower speed is required. Because this configuration has the most inductance, the performance will start to degrade at higher speed. In series mode, the motors should also be run at only 70% of their rated current to prevent overheating.

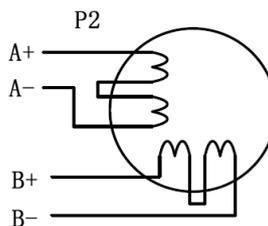


Figure 7: 8-lead motor series connections

## (2) Parallel Connection

An 8 lead motor in a parallel configuration offers a more stable, but lower torque at lower speeds. But because of the lower inductance, there will be higher torque at higher speeds. Multiply the phase (or unipolar) current rating by 1.96, or the bipolar current rating by 1.4, to determine the peak output current.

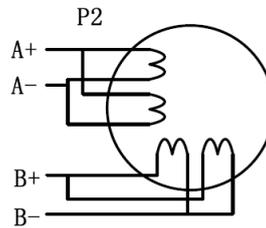


Figure 8: 8-lead motor parallel connections

## 4.4 Power Supply Selection

The EM556-CAN can power medium and small size stepping motors (frame size from NEMA17 to 24) made by Leadshine or other motor manufacturers. To get good driving performances, it is important to select supply voltage and output current properly. Generally speaking, supply voltage determines the high speed performance of the motor, while output current determines the output torque of the driven motor (particularly at lower speed). Higher supply voltage will allow higher motor speed to be achieved, at the price of more noise and heating. If the motion speed requirement is low, it's better to use lower supply voltage to decrease noise, heating and improve reliability.

### 4.4.1 Regulated or Unregulated Power Supply

Both regulated and unregulated power supplies can be used to supply the drive. However, unregulated power supplies are preferred due to their ability to withstand current surge and fast response for current change. If you prefer to a regulated power supply, it is suggested to choose such a power supply specially designed for stepper/servo controls such as Leadshine RPS series (<http://www.leadshine.com/producttypes.aspx?producttype=regulated-switching>). Or, in the case when only normal switching power supplies are available, it is important to use "OVERSIZE" high current output rating power supplies (for example, using a 4A power supply for 3A stepper motor) to avoid problems such as current clamp. On the other hand, if unregulated supply is used, one may use a power supply of lower current rating than that of motor (typically 50%~70% of motor current). The reason is that the drive draws current from the power supply capacitor of the unregulated supply only during the ON duration of the PWM cycle, but not during the OFF duration. Therefore, the average current withdrawn from power supply is considerably less than motor current. For example, two 3A motors can be well supplied by one power supply of 4A rating.

### 4.4.2 Power Supply Sharing

Multiple EM556-CAN drives can share one power supply to reduce cost, if that power supply has enough power capacity. To avoid cross interference, connect each stepper drive directly to the shared power supply separately. To avoid cross interference, DO NOT daisy-chain connect the power supply input pins of the Drivers. Instead connect them to power supply separately.

### 4.4.3 Selecting Supply Voltage

The EM556-CAN is designed to operate within +20 - +50VDC voltage input. When selecting a power supply, besides voltage from the power supply power line voltage fluctuation and back EMF voltage generated during motor deceleration needs also to be taken into account. Ideally it is suggested to use a power supply with the output range of +24 - +48 VDC, leaving room for power line voltage fluctuation and back-EMF.

Higher supply voltage can increase motor torque at higher speeds, thus helpful for avoiding losing steps. However, higher voltage may cause bigger motor vibration at lower speed, and it may also cause over-voltage protection or even drive damage.

Therefore, it is suggested to choose only sufficiently high supply voltage for intended applications.

#### 4.5 Object Dictionary Introduction

Object Dictionary is an organized group of objects, which maps the stepper drive related parameters and variables. Parameters of EM556-CAN can be configured via CAN to USB adaptor and Leadshine CANopen software or PLC & controller & control card, use SDO communication mode to modify the drive parameters. Corresponding ESD file and Leadshine CANopen software can be free download in Leadshine official website: <http://www.leadshine.com>.

##### 4.5.1 Common list objects

###### (1) Factory parameters

CANopen Address	Parameter Name	Property	Default Value	Range	Description
2000+00	Peak current	R/W/S	3200	100~maximum current	Current Accuracy 100mA, maximum current is due to peak current output of drive (mA).
2001+00	Motor resolution	R/W/S	50000	200~51200	Required pulse for each rotation circle of motor
2002+00	Stand-by time	R/W/S	500	100~10000	unit: ms
2003+00	Standby current percentage	R/W/S	50	0~100	unit: %
2005+01	Digital output IO function Selection	R/W/S	1	0~32768	1: Alarm output 4: Arrive output  16: Master station controls the output port(set by 60FEH )
2008+00	ALM output impedance setting	R/W/S	0	0/1	0: Optocoupler conduction when alarm activated 1: Optocoupler shut off when alarm activated
2013+00	Enable current loop auto-tuning	R/W/S	1	0/1	0:Enable 1:Disable
2015+00	Current loop Kp	R/W/S	1000	200~32767	Only can be read when enable auto-tuning, can be wrote when disable auto-tuning
2016+00	Current loop Ki	R/W/S	200	0~32767	Only can be read when enable auto-tuning, can be wrote when disable auto-tuning
2020+00	Motor resistance	R/W/S	1000	1~20000	Unit: mOhms
2021+00	Motor inductance	R/W/S	1	1~6000	Unit: uH
2039+00	External position amount high 16 bit	R			Received location instruction accumulated value high 16bit
2040+00	External position amount low 16 bit	R/W			Received location instruction accumulated value low 16bit
2043+00	Speed reference	R			Unit: r/s
2051+00	Motor running direction	R/W/S	0	0/1	0:Motor running direction is constant

					1:Motor running direction reverse
2056+00	Alarm detection selection (this parameter Enable over-current and over-voltage by default)	R/W/S	0x03	0~0xffff	Alarm detection selection: 1:Enable.0:Disable bit0: Over-current (error code:1, red LED flashes 1 time) bit1:Over-voltage (error code:2, red LED flashes 2 times) bit2:EEPROM (error code:8, red LED flashes 8 times) bit11: Operational amplifier fault (error code:9, red LED flash 12 times)
2060+00	First anti-vibration amplitude values	R/W/S	0	0~100	First low speed resonance point inhibition amplitude values
2061+00	First anti-vibration phase A	R/W/S	0	0~255	First low speed resonance point inhibition phase A
2062+00	First anti-vibration phase B	R/W/S	0	0~255	First low speed resonance point inhibition phase B
2063+00	Second anti-vibration amplitude values	R/W/S	0	0~100	Second low speed resonance point inhibition amplitude values
2064+00	Second anti-vibration phase A	R/W/S	0	0~255	Second low speed resonance point inhibition phase A
2065+00	Second anti-vibration phase B	R/W/S	0	0~255	Second low speed resonance point inhibition phase B
2066+00	Third anti-vibration amplitude values	R/W/S	0	0~100	Third low speed resonance point inhibition amplitude values
2067+00	Third anti-vibration phase A	R/W/S	0	0~255	Third low speed resonance point inhibition phase A
2068+00	Third anti-vibration phase B	R/W/S	0	0~255	Third low speed resonance point inhibition phase B
2069+00	Fourth anti-vibration amplitude values	R/W/S	0	0~100	Fourth low speed resonance point inhibition amplitude values
2070+00	Fourth anti-vibration phase A	R/W/S	0	0~255	Fourth low speed resonance point inhibition phase A
2071+00	Fourth anti-vibration phase B	R/W/S	0	0~255	Fourth low speed resonance point inhibition phase B
2072+00	Z axis anti-vibration phase	R/W/S	0	0~255	Z axis low speed resonance point inhibition phase

2073+00	Motor auto-running when power on	R/W/S	0	0/1	0: Motor normal standby when power on 1: Motor turns 30 °and reverse 30 when power on, then standby
2150+00	CAN ID high 2 bit	R/W/S	0	0~3	Slave station address: Activate after repower
2151+00	CANopen baud rate	R/W/S	0	0~7	0:1000kBit/sec 1:Invalid 2:500 kBit/sec 3:250 kBit/sec 4:125 kBit/sec 5:100 kBit/sec 6:50 kBit/sec 7:20 kBit/sec
2152+01	Digital input IN1 function selection	R/W/S	1	0~32768	1:Home signal 2:Positive limit 4:Negative limit 32768:Emergency stop
2152+02	Digital input IN2 function selection	R/W/S	2	0~32768	1:Home signal 2:Positive limit 4:Negative limit 32768:Emergency stop
2152+03	Digital input IN3 function selection	R/W/S	4	0~32768	1:Home signal 2:Positive limit 4:Negative limit 32768:Emergency stop
2153+01	Digital input IN1 filter time	R/W/S	1000	50~60000	unit: us
2153+02	Digital input IN2 filter time	R/W/S	1000	50~60000	unit: us
2153+03	Digital input IN3 filter time	R/W/S	1000	50~60000	unit: us
2154+00	Level polarity of digital inputs IN1,IN2,IN3	R/W/S	0	0~7	0:Low level Optocoupler has no input, port is in free status; Optocoupler has no input , port is in trigger status  1: High level Optocoupler has no input, port is in trigger status; Optocoupler has no input , port is in free status  bit0: IN1 polarity setting; bit1: IN2 polarity setting; bit2: IN3 polarity setting.
2155+00	Digital input IN1,IN2,IN3 level	R/W/S	0	0~7	Read input IO port polarity Low 3 bits corresponding external 3 input IO port  0:Three digital input IN1,IN2,IN3 are low level  7:Three digital input IN1,IN2,IN3 are high level

60FD+00	Input port status display	R	0		bit0: Negative limit; bit1: Positive limit; bit2: Home signal bit3~bit15: Reserved; bit16: Emergency stop
60FE+01/02	Output port status display	R	0		When IO output function switch to main station control, master controller can use the combination of 60FE+01 and 60FE+02 to control IO output:  When bit16 of 60FE+01 and 60FE+02 are both "1", OUTPUT1 have output  When bit17 of 60FE+01 and 60FE+02 are both "1", OUTPUT2 have output  and so on.....  (EM556-CAN has only one output port)
1010+01	Save configuration	R/W			Write 1702257011 (0x65766173) to save configuration
1011+01	Reset to factory	R/W			Write 1684107116 (0x64616F6C ) to reset to factory
2093+00	Eliminate malfunction records	R/W			Write 1 to eliminate alarm records



**Notes:** (1) R/W/S means the parameter can be read/wrote/saved

#### 4.5.2 Model and control

CANopen Address	Name	property	Description
6040+00	Control word	R/W	Control the drive's status and operation
6041+00	Status word	R	Feedback current status of the drive
6060+00	Operational mode	RW	1: Position mode 3: Speed mode 6: Homing mode
6061+00	Mode query	R	Check the operation mode of the drive
607A+00	Target position	R/W	Target position under working mode 1
6064+00	The actual position	R	The actual position

6081+00	Maximum speed	R/W	Maximum speed under working mode 1 (Position mode)
60FF+00	Target Speed	R/W	Target speed under working mode 3 (Speed mode)
606C+00	Actual speed	R/W	The actual speed of the motor, unit: p/s
6083+00	Acceleration speed	R/W	Acceleration speed under working mode 1 (Position mode) and working mode 3 (Speed mode), unit: p/s <sup>2</sup>
6084+00	Deceleration speed	R/W	Deceleration speed under working mode 1 (Position mode) and working mode 3 (Speed mode), unit: p/s <sup>2</sup>
6085+00	Deceleration speed of emergency stop	R/W	Deceleration speed of emergency stop under all modes, unit: p/s <sup>2</sup>
6098+00	Method of back to home position	R/W	Method of back to original point
6099+01	Speed1 of back to home position	R/W	Back to home position in high speed
6099+02	Speed1 of back to home position	R/W	Back to home position in low speed
609A+00	Acceleration speed of back to home position	R/W	Acceleration speed of back to home position
607C+00	Home position offset	R/W	Home position offset

EM556-CAN can running under PP(position mode),PV(speed mode)and Homing(Back to the original point mode), 3 modes in total.(Specific protocol specification is in conformity with standard Canopen, specific operation can refer to 《DM-CAN series CANopen Technical instruction manual》 )

## 4.6 Parameters Configuration via Leadshine CANopen Software

### 4.6.1 Installing software

When you connect the CAN to USB adapter to the PC fist time, it will have a pop-up of installing the drive software, checking whether the installation is successful when the equipment manage of computer showing:



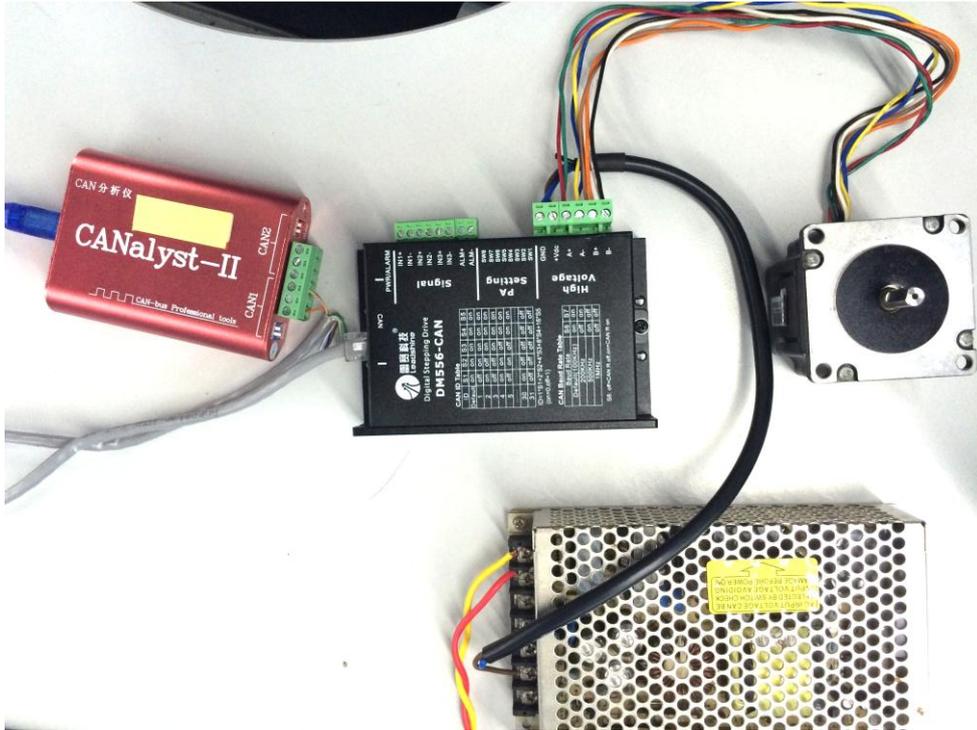
. Then please access <http://www.leadshine.com> to download Leadshine CANopen software



and unzip to use directly via clicking the icon

### 4.6.2 Connecting Leadshine CANopen software

Before connecting the EM556-CAN to PC through a CAN to USB adapter, please ensure the right wiring refer to the following figure:



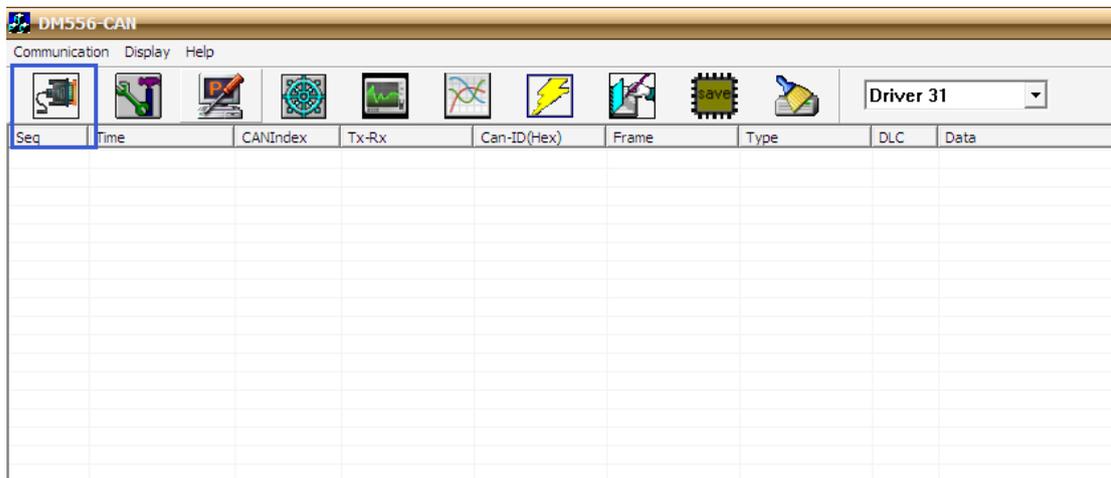
(1) Connect with PC software

Click the Leadshine CANopen software folder and double click the icon following picture.

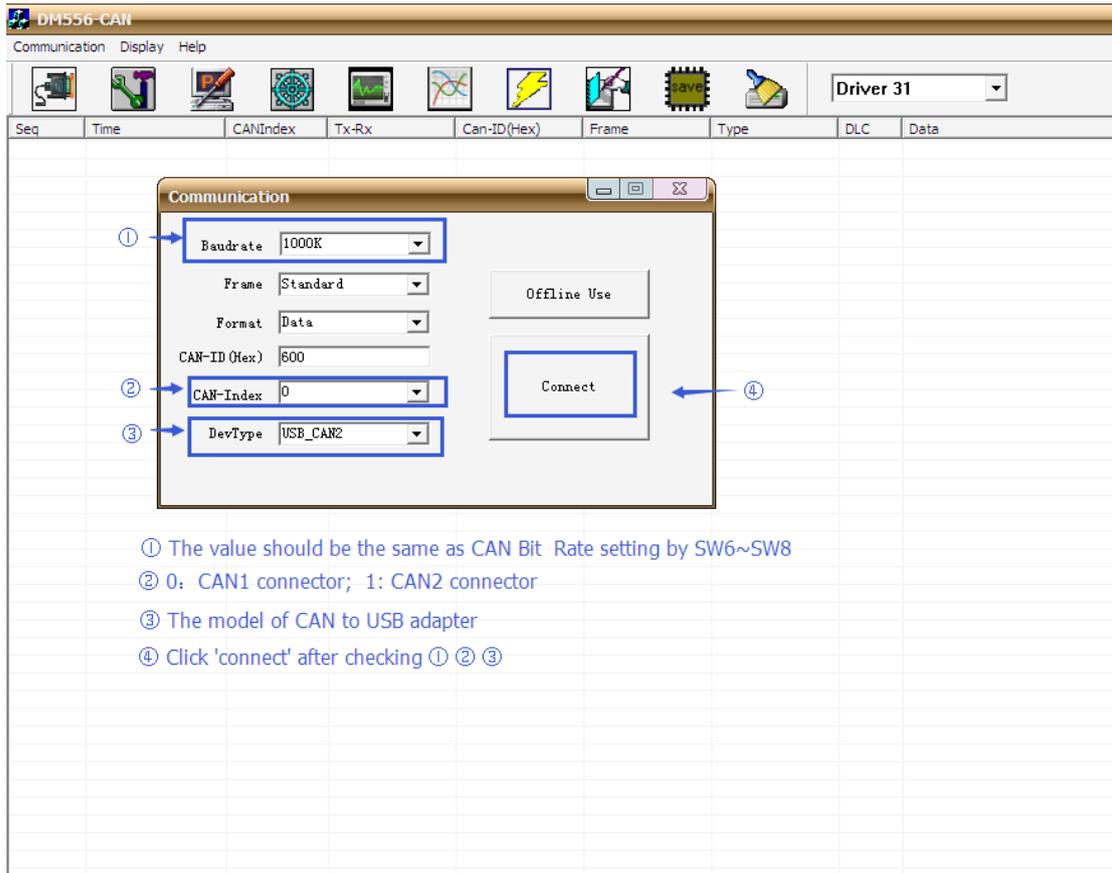


CanOpenEng.exe  
应用程序  
CanOpen Microsof

to open the software as



Then click the marked icon as above picture to open the connecting interface as following picture, setting the correct baud rate and CAN-Index on the adapter, and the design of Leadshine CANopen software is based on the USB\_CAN2 device. After setting the ①②③ step in the above picture, then clicking the button of ‘Connect’



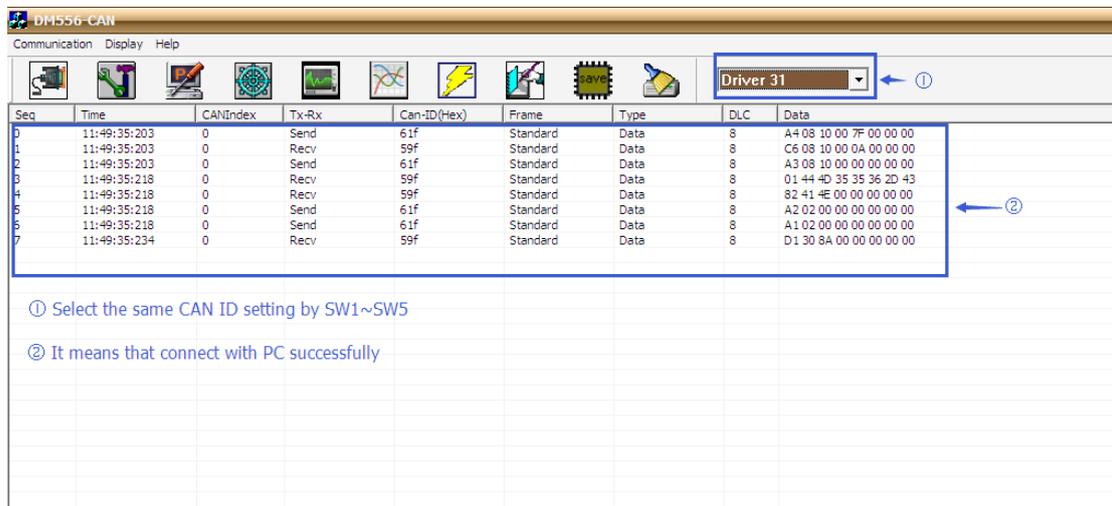
① The value should be the same as CAN Bit Rate setting by SW6~SW8

② 0: CAN1 connector; 1: CAN2 connector

③ The model of CAN to USB adapter

④ Click 'connect' after checking ① ② ③

Open another interface as following picture, please select the correct CAN ID setting by SW1~SW5, when showing the step ② character string, it means that the EM556-CAN connect with PC software successfully.



Seq	Time	CANIndex	Tx-Rx	Can-ID(Hex)	Frame	Type	DLC	Data
0	11:49:35:203	0	Send	61f	Standard	Data	8	A4 08 10 00 7F 00 00 00
1	11:49:35:203	0	Recv	59f	Standard	Data	8	C6 08 10 00 0A 00 00 00
2	11:49:35:203	0	Send	61f	Standard	Data	8	A3 08 10 00 00 00 00 00
3	11:49:35:218	0	Recv	59f	Standard	Data	8	01 44 4D 35 35 36 2D 43
4	11:49:35:218	0	Recv	59f	Standard	Data	8	82 41 4E 00 00 00 00 00
5	11:49:35:218	0	Send	61f	Standard	Data	8	A2 02 00 00 00 00 00 00
6	11:49:35:218	0	Send	61f	Standard	Data	8	A1 02 00 00 00 00 00 00
7	11:49:35:234	0	Recv	59f	Standard	Data	8	D1 30 8A 00 00 00 00 00

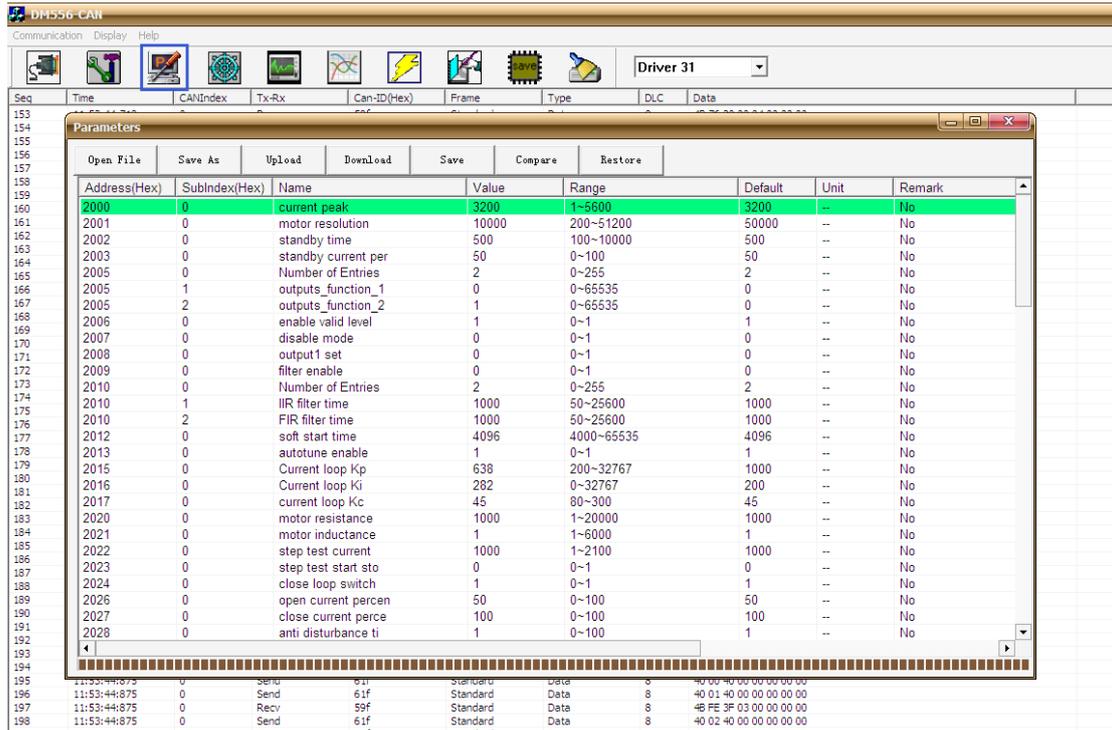
① Select the same CAN ID setting by SW1~SW5

② It means that connect with PC successfully

## (2) Parameters configuration



Click the icon of , it will upload the default parameter as following picture.



You also can import a configured file to cover the default parameter via clicking button ①, after modifying the parameters, you need to click button ③ and ④, then the parameters will be saved even if restart the power. After finishing setting parameter, you also can export the parameters file and save it by clicking button ②.

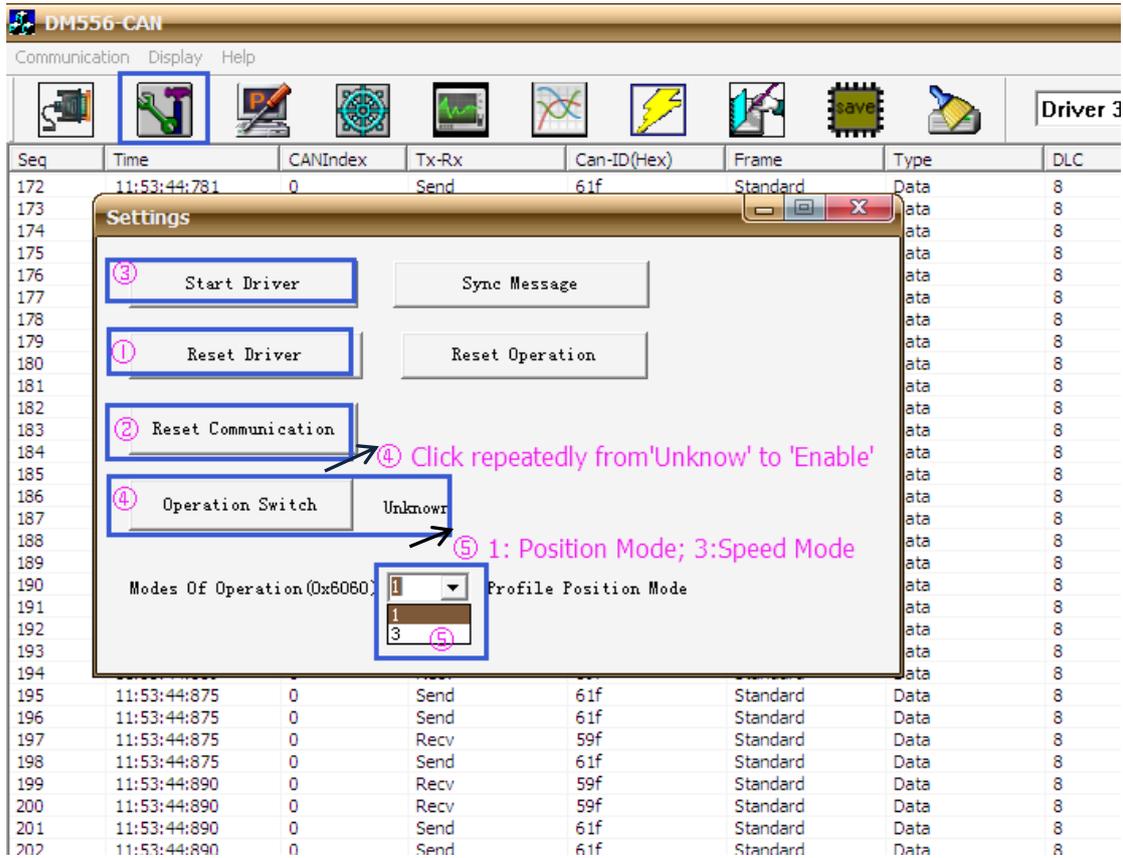


Key parameter:

Address	Name	Detail
2000	Current peak	Peak current output of the drive
2001	Motor resolution	Microstep
2002	Standby time	After the time, the holding current of the drive will decline
2003	Standby current per	The holding current is equal to the percent of dynamic current
2008	Output 1 set	The impedance-state output of the ALM
2152	Input io functions	The functions configuration of input1, input2, input3
2154	Input io configure	The level of the input1, input2, input3 ports

### (3) Run the motor

According to the steps in the following picture, the motor will be locked the motor shaft and ready to run.



**Settings**

Start Driver      Sync Message

Reset Driver      Reset Operation

Reset Communication

Operation Switch      Unknown

Modes Of Operation (0x6060): 1, 2, 3

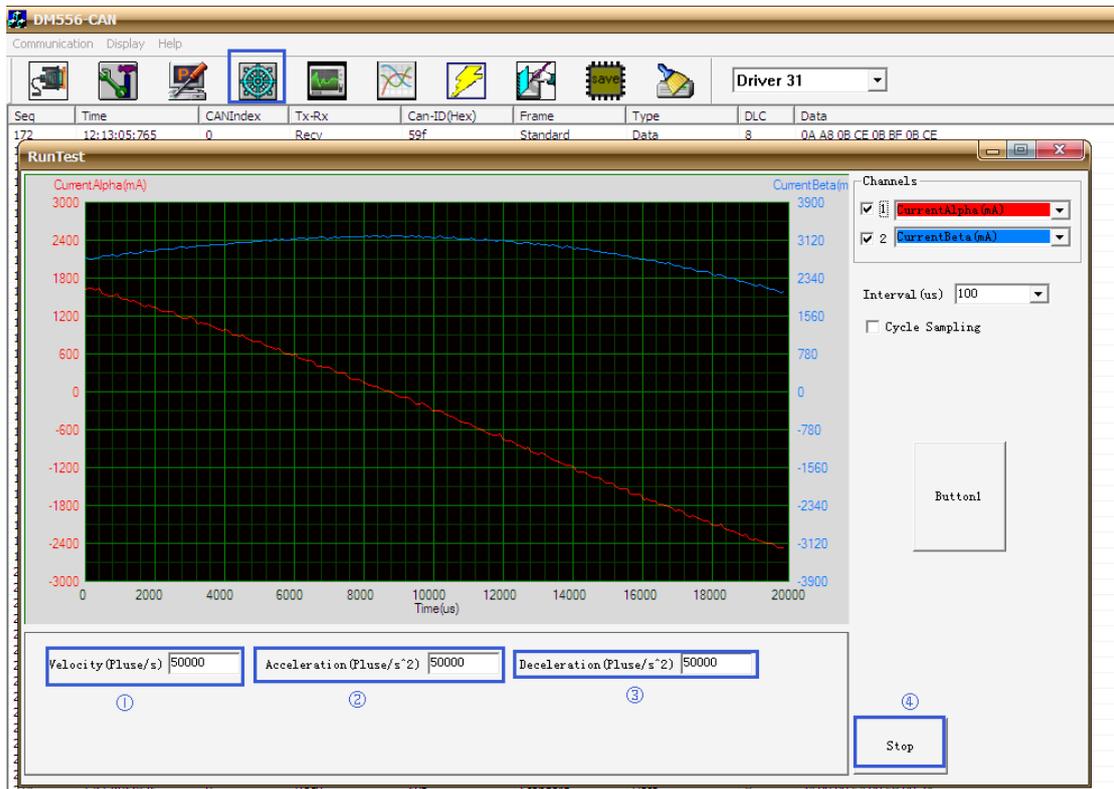
Profile Position Mode

Annotations:

- ①: Reset Driver
- ②: Reset Communication
- ③: Start Driver
- ④: Click repeatedly from 'Unknown' to 'Enable'
- ⑤: 1: Position Mode; 3: Speed Mode

Seq	Time	CANIndex	Tx-Rx	Can-ID(Hex)	Frame	Type	DLC
172	11:53:44:781	0	Send	61f	Standard	Data	8
173						Data	8
174						Data	8
175						Data	8
176						Data	8
177						Data	8
178						Data	8
179						Data	8
180						Data	8
181						Data	8
182						Data	8
183						Data	8
184						Data	8
185						Data	8
186						Data	8
187						Data	8
188						Data	8
189						Data	8
190						Data	8
191						Data	8
192						Data	8
193						Data	8
194						Data	8
195	11:53:44:875	0	Send	61f	Standard	Data	8
196	11:53:44:875	0	Send	61f	Standard	Data	8
197	11:53:44:875	0	Recv	59f	Standard	Data	8
198	11:53:44:875	0	Send	61f	Standard	Data	8
199	11:53:44:890	0	Recv	59f	Standard	Data	8
200	11:53:44:890	0	Recv	59f	Standard	Data	8
201	11:53:44:890	0	Send	61f	Standard	Data	8
202	11:53:44:890	0	Send	61f	Standard	Data	8

Configure the suitable motion parameter as following picture, the motor will turn up.



**RunTest**

Current Alpha (mA) vs Time (us) graph showing two curves: Current Alpha (red) and Current Beta (blue).

Channels:
 

- 1: Current Alpha (mA)
- 2: Current Beta (mA)

Interval (us): 100

Cycle Sampling:

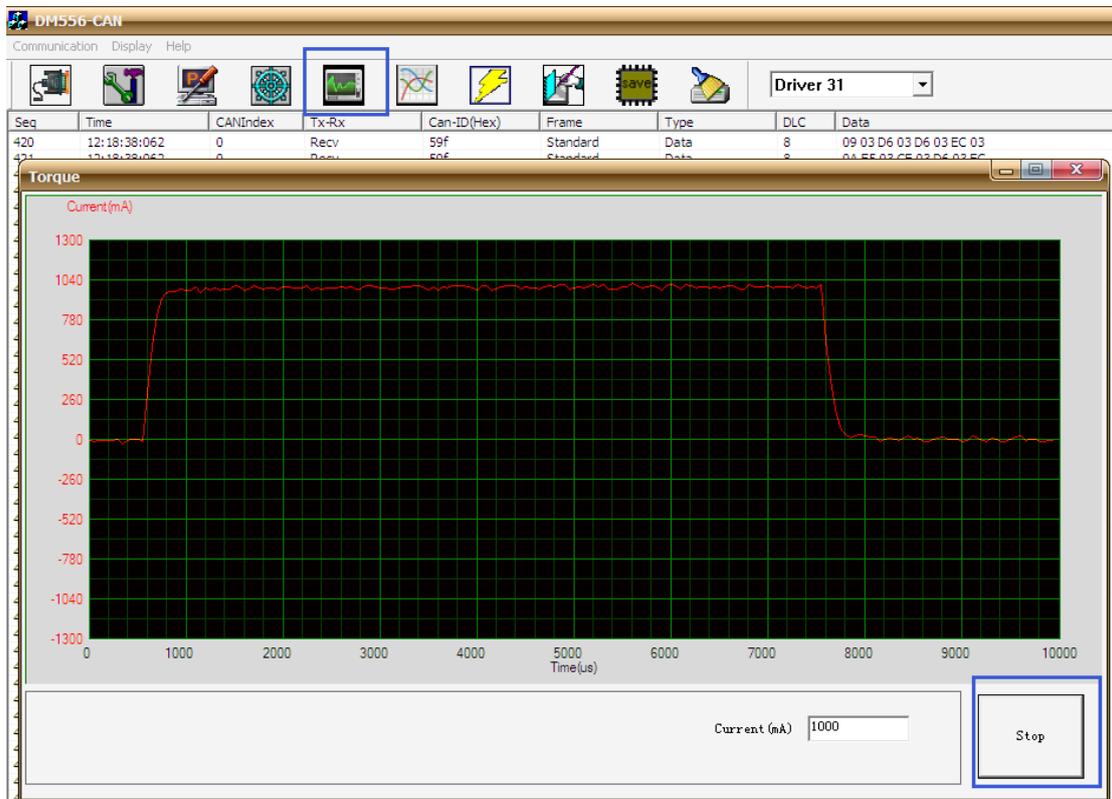
Button: [Button]

Velocity (Pluse/s): 50000      Acceleration (Pluse/s<sup>2</sup>): 50000      Deceleration (Pluse/s<sup>2</sup>): 50000

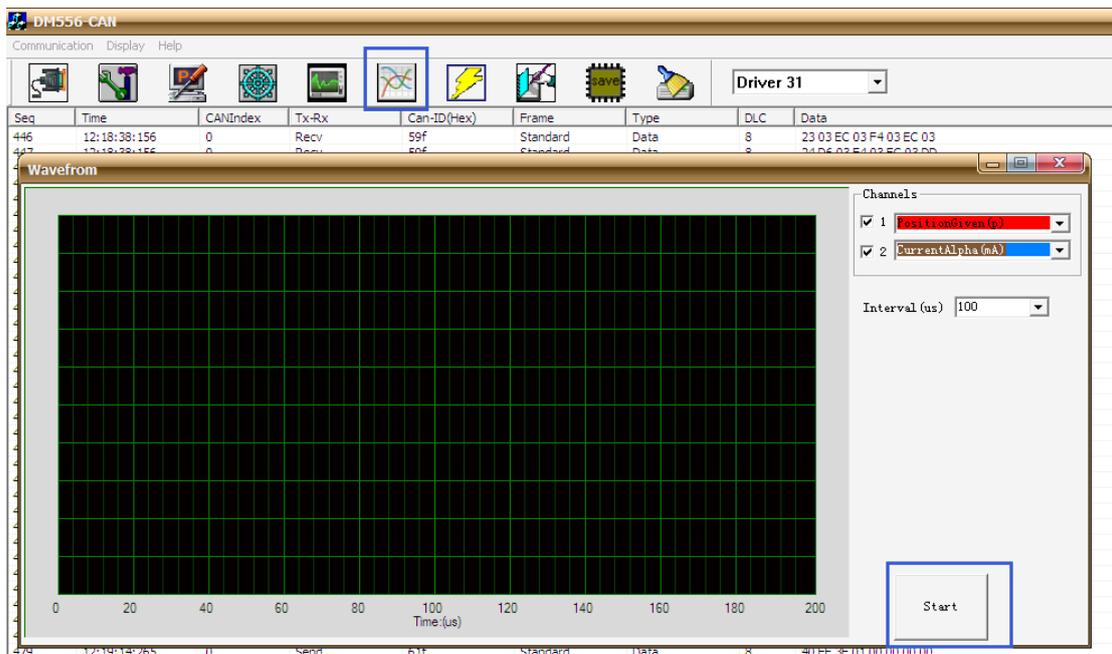
Stop

As usual, the drive will auto-tuning the motor to output its optimal performance, but if you prefer to tuning the Kp and Ki of

current loop through manual operation, please set the 2013H to '0' and click the

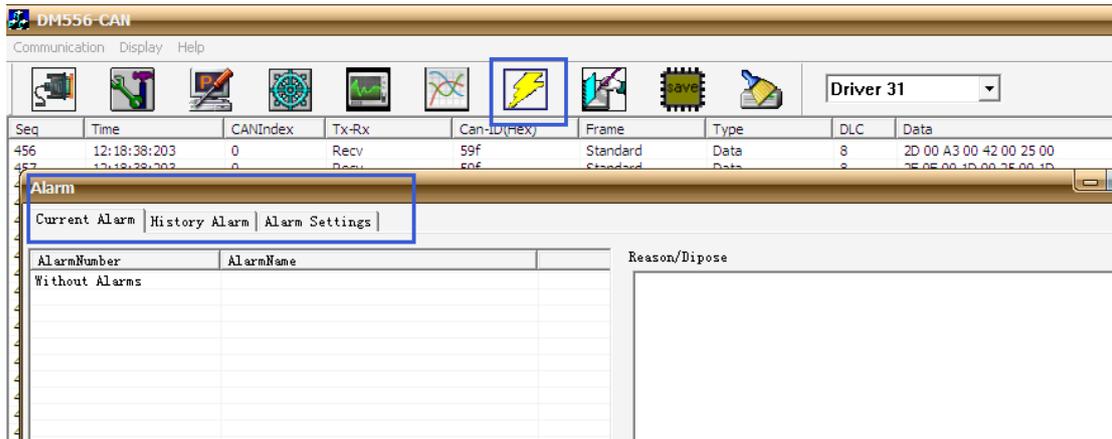


Click  icon to open this window. You can monitor the current wave in this window to check the performance.





You can click the  to check the the active error or the error log of the drive in this window.



## 5. CANopen Communication Overview

This chapter only briefly introduce frequently used concept and matters need attention when using EM556-CAN. In order to make the users can understand conventional method of DM-CAN series products in shortest time. If you need to know the DM - CAN series more detailed CANopen technical content, please refer to 《DM-CAN series CANopen Technical instruction manual》.

### 5.1 EM556-CAN Communication Standard

- Follow CAN 2.0A standard
- Conform to CANopen standard protocol DS 301 V4.02
- Conform to CANopen standard protocol DSP 402 V2.01

### 5.2 Explanation of Nouns

#### 5.2.1 Object dictionary

Object Dictionary is an organized group of objects, which maps the stepper drive related parameters and variables. Each object using a 16-bit index values to addressing. In order to allow access to the data structure of a single element, defines a 8 bits sub-index at the same time

For example:

- Object dictionary 2001H signify motor resolution.
- Object dictionary 607AH signify target position of position mode.
- Sub-index 01 of object dictionary 6099H signify back to the home position at high speed, Sub-index 02 signify back to the home position at low speed.



**Notes:** (1) As above, 2001H,6081H,6099H are 16 bits address index; (2) Some object dictionary's sub-index is 0 as pointing to a single data objects.

Detailed definition of object dictionary is described in electronic data sheets(EDS), you can download EM556-CAN's EDS in Leadshine official website(<http://www.leadshine.com>).

The EDS contains three main kinds object dictionary is shown as follow:

- Communication object dictionary, such as 1000H,1400H,1A00H etc. Please refer to 《DM-CAN series' CANopen technical instruction manual》 for detailed specification.
- The drive manufacturers custom object dictionary, such as 2000H~2130H, please refer to chapter 4 for relevant information of parameters.
- Part of CIA DSP402 object dictionary

### 5.2.2 Process data objects ( PDO)

#### (1) Definition

PDO Can be understood as an interface between stepper drive and external real-time data transmission, divided into transmitting PDO(TPDO) and receiving PDO (RPDO). Transmitting and receiving just relative to Leadshine CANopen drive (Such as the PDO which is transmitted from EM556-CAN is named TPDO), EM556-CAN can support 3 groups of TPDO and 3 groups of RPDO at present.

#### (2) PDO meaning

Each PDO can support maximum 8 bits data, and the meaning of object dictionary is configurable. For example the meaning of RPDO1's can be set different object dictionary such as control word(6040H) or target location(6081H). Specific setting method can refer to chapter 2.6 "Process data objects (PDO)" 《DM-CAN series' CANopen technical instruction manual》 .

RPDO	Address to Set RPDO meaning	TPDO	Address to set TPDO meaning
RPDO1	1600H	TPDO1	1A00H
RPDO3	1602H	TPDO3	1A02H
RPDO4	1603H	TPDO4	1A03H



**Notes:** (1) Recommend to reduce the quantity of using PDO unless it's necessary, in order to reduce the network load.

#### (3)PDO property

PDO need to configure multiple properties, including transport is synchronous or asynchronous, the length of prohibit time, they are configured by modify corresponding address of the following chart.

RPDO	Address to Set RPDO Properties	TPDO	Address to Set TPDO Properties
RPDO1	1400H	TPDO1	1800H
RPDO3	1402H	TPDO3	1802H
RPDO4	1403H	TPDO4	1803H

The suggestion for setting PDO properties:

### (1) Synchronous or asynchronous?

- Synchronous transport means that the corresponding data of PDO will update when synchronization frame emerge on data bus. It can bring stable data updating periodically, but can't receive real-time change data.
- Asynchronous transport means that update the data immediately once the data change, this way of transmission can quick response, but easy to have larger data load on the bus in case of data changing frequently( such as real-time position data). So you need to configure a prohibit time (the changing data can be updated in some time setting by prohibit time, not transmitting repeatedly) to reduce network load.
- Recommended to adopt synchronous PDO mode in case of the real-time data is necessary, but in the case of that he real-time request is necessary, to adopt asynchronous PDO mode ,and set suitable prohibit time to protect the network load from the shock.

### (2) Synchronous cycle and asynchronous prohibit time settings

Recommended to calculate according to empirical formula:

$$\text{Synchronizing cycle (ms)} = [\text{PDO amount}/9] / (40\%) + 2$$

Assume that a CANopen network with a total of 12 axis, each axis has a send and receive PDO. The total number of the PDO is  $12 * 2 = 24$ . In case of bus full load, can transmit 9 PDO in a millisecond, considering the bus load margin, To assume that the bus load is 40%(relatively reasonable load rate), the time required for transmit 24 PDO is:  $24/9/(40\%)=6.67(\text{ms})$ , considering the network expenditure time of SDO, synchronous frame, heartbeat packets, Emergency packets etc. Add extra 2 milliseconds, recommended configuration synchronization cycle to be 8.67 milliseconds.

Above empirical formula also apply to set asynchronous PDO prohibit time.

### 5.2.3 Service data object (SDO)

#### (1) SDO and PDO

SDO is a approach to access object dictionary. Compare with PDO which mapping fixed object dictionary, SDO can access any specified object dictionary, with greater flexibility. But each of the SDO data packet contains only 4 process data. And the SDO data interaction complement need 2 packets. So the transmission efficiency of SDO is lower than the PDO.

#### (2) Suitable object

Based on the transmission characteristics of SDO and PDO. PDO is suitable for real-time data transmission, Such as receiving real-time position and speed commands, transmit real-time speed and position data, etc. SDO is suitable for non-real-time data transmission (one-off operation). Such as modify a dictionary object.

#### (3) SDO transmission mode

There are 3 kinds of SDO transmission mode: Acceleration SDO transmission mode , Segmented transmission mode , Block transmission mode. Under the condition of data transmission less than 4 bytes, can transmit SDO data without segment , this kind of transmission mode is suitable for most of the objects. If the data is more than 4 bytes, must adopt segmented transmission mode. For a long packet, it has low efficiency if adopting segmented transmission, but block transmission has a better efficiency..

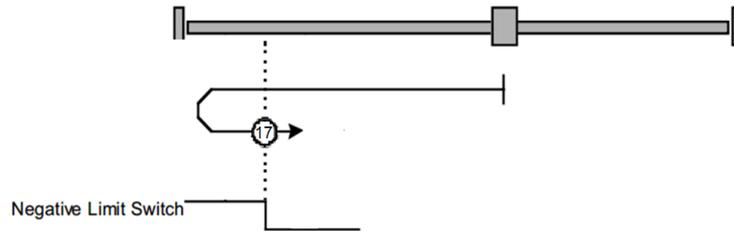
#### (4) The definitions of client and server

SDO Visitors are referred to as the client. A device whose object dictionary is accessed and shall provide the requested service are referred to as server. The customer CAN packet and the server' response CAN packet always contains 8 bytes of data (Although not all data bytes must be meaningful). A client's request must have a response from the server. Please refer to chapter "2.7 service data object(SDO)" of 《DM-CAN series CANopen technical instruction manual》

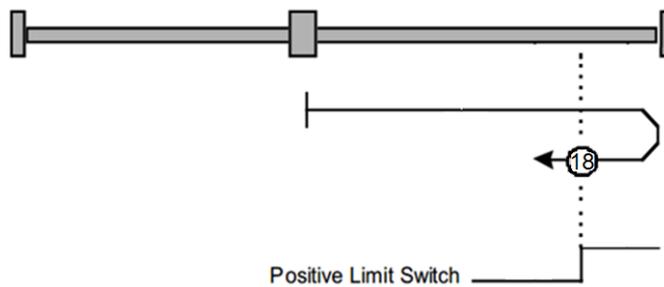
### 5.2.4 Homing mode

DM-CAN Series drives define various homing method according to the CANopen DS402 standard protocol. Because EM556-CAN is open loop stepper drive, supported 17~30 homing mode currently. Specific motion trail of various homing method is shown as below:

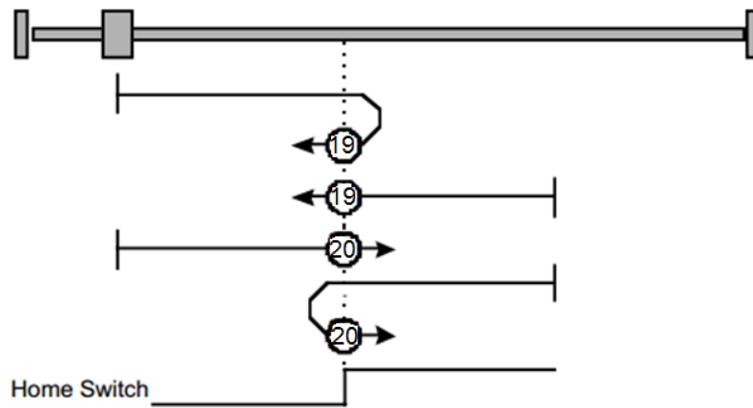
17:



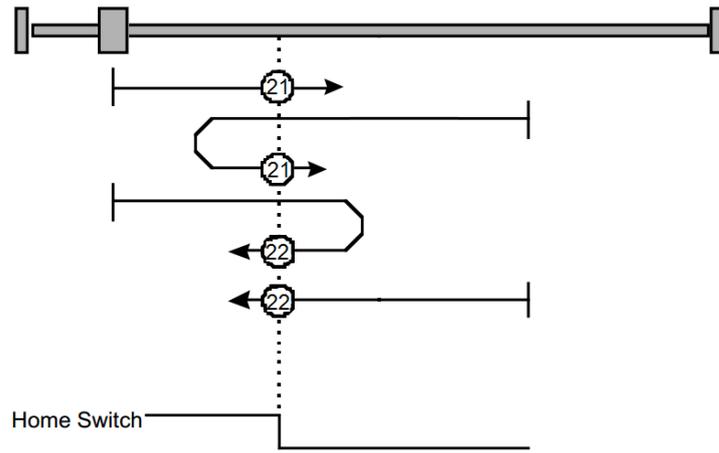
18:



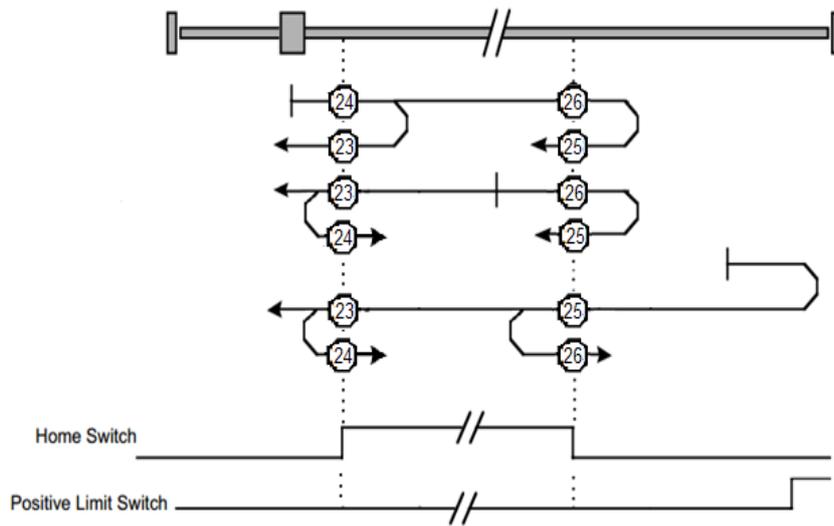
19~20:



21~22:



23~26:



27~30:

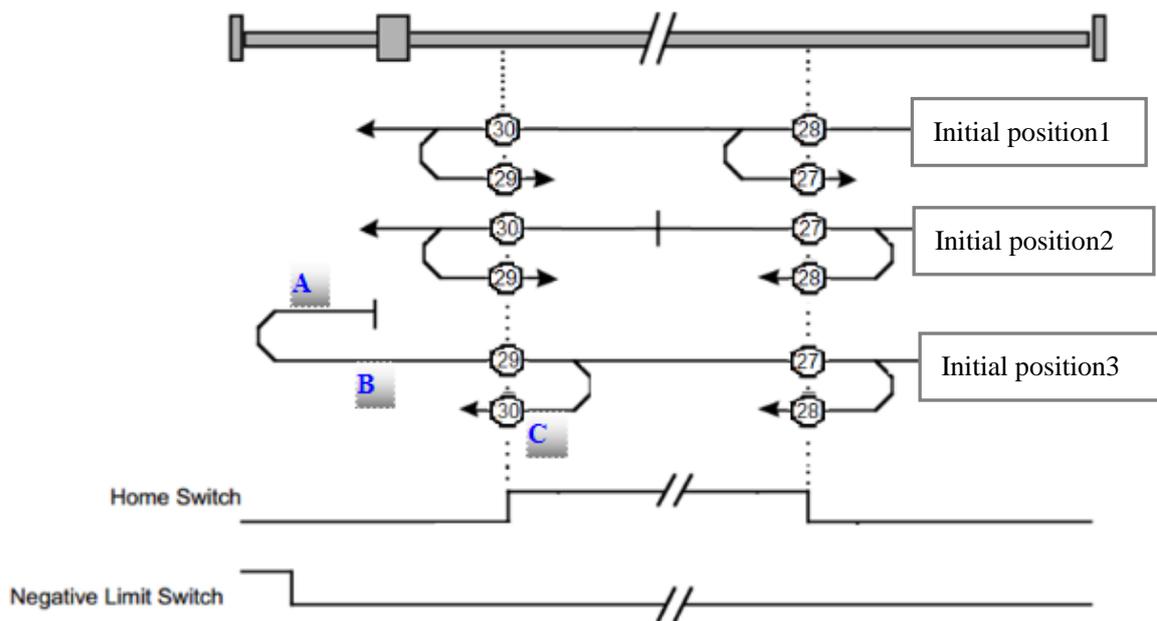


Figure9 No.17~30 homing method

### (1) Homing movement speed

Homing movement speed contains high speed and low speed. Take the direction of the last track in homing movement as a reference, which with the same direction is low speed movement and opposite is high speed movement.

Take No.30 for example, last track as show in figure9. C section which is the last track of homing movement, its direction is leftwards. Therefore, A/C section whose direction is leftwards are low speed. B section whose direction is rightwards are low speed.

### (2) Track description

Take No. 27~30 homing mode for example, above tracks in the same figure, is to facilitate describe similar track's homing mode, also facilitate compare differentials. As shown in figure 9, tracks can be divided into three segments according to the different initial position:

#### **Initial position 1 (between home switch and positive limit)**

Sliding block move from the right of the home switch to the left, after meeting the home switch,

- a. Under No.28 homing mode, the sliding block will stop immediately.
- b. Under No.27 homing mode, the sliding block will slow down to 0, then turn right to stop immediately when meeting the home switch again.
- c. Under No 29/30 homing mode, the sliding block will move left until leaving the home switch,
  - Under No.30 homing mode, the sliding block will stop immediately
  - Under No.29 homing mode, the sliding block will slow down to 0 , then turn right to stop immediately when meeting home switch again.

#### **Initial position 2 ( at home switch)**

Sliding block start to move at the status of home switch is triggered,

- a. Under No.27/28 homing mode, the sliding block will move right until leaving the home switch
  - Under No.27 homing mode, the sliding block will stop immediately
  - Under No.28 homing mode, the sliding block will slow down to 0, then turn left to stop immediately when meeting home switch again.
- b. Under No.29/30 homing mode, the sliding block will move left until leaving the home switch
  - Under No. 30 homing mode, the sliding block will stop immediately
  - Under No. 29 homing mode, the sliding block will slow down to 0 , then turn right to stop immediately when meeting home switch again.

#### **Initial position 3 (between home switch and negative limit)**

Sliding block move from the left of the home switch to the right, after meeting the negative limit, it will slow down to 0 and turn right until meeting home switch,

- a. Under No. 29 homing mode, the sliding block will stop immediately
- b. Under No. 30 homing mode, the sliding block will slow down to 0 and turn left, it will stop immediately when meeting home switch again.
- c. Under No.27/28 homing mode, the sliding block will move right until leaving the home switch,
  - Under No. 27 homing mode, the block will stop immediately
  - Under No. 28 homing mode, the block will slow down to 0, then turn left to stop immediately when meeting home switch again.

The rest of the various tracks of homing mode, please refer to definition of CANopen DSP 402 standard protocol. The

mode of comprehending is similar with above figures.

## 6. Trouble Shooting

Description	Likely cause	Recommended Actions
Motor is not rotating	Wrong wiring	Check power, motor and communication cables wiring
	Parameter configuration is wrong	Check the parameters configuration in object dictionary is wrong or not
	Drive is protected	Reset power
Motor rotates in the wrong direction	Wrong wiring	Exchange the two cables of any phase (Such as A+/A-)
	Parameter configuration is wrong	Check the parameters configuration in object dictionary is wrong or not
The drive in fault	Wrong wiring	Check the wiring of motor cable is short-circuit or not, and the polarity of power supply is inverse or not
	Over voltage	Check whether the power supply voltage is reached over voltage point
	Motor or drive damaged	Replace the motor or drive
Wrong position	Motor resolution setting is wrong	Set a correct motor resolution
	Output current of drive is too small	Increase the output current
Stall during motor acceleration	Acceleration time is too short	Increase the acceleration time
	Motor torque is too small	Choose high torque motor
	Power supply voltage or output current setting is too small	Appropriately increase voltage or current
Fail to connect with master station	Communication error	Refer to the manual of master station alarm and processing. Check the communication cable is normal or not, and remember plug a terminal resistance in the end node of the network.

## 7. Warranty

### Twelve Month Warranty

Leadshine Technology Co., Ltd. warrants its products against defects in materials and workmanship for a period of 12 months from shipment out of factory. During the warranty period, Leadshine will either, at its option, repair or replace products which proved to be defective.

### Exclusions

The above warranty does not extend to any product damaged by reasons of improper or inadequate handlings by customer, improper or inadequate customer wirings, unauthorized modification or misuse, or operation beyond the electrical specifications of the product and/or operation beyond environmental specifications for the product.

### Obtaining Warranty Service

To obtain warranty service, please contact your seller to obtain a returned material authorization number (RMA) before returning product for service.

### Shipping Failed Products

If your product fail during the warranty period, please contact your seller for how and where to ship the failed product for warranty or repair services first, you can also e-mail customer service at [tech@leadshine.com](mailto:tech@leadshine.com) to obtain a returned material authorization number (RMA) before returning product for service. Please include a written description of the problem along with contact name and address.

## 8. Contact Us

### China Headquarters

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86-755-2640-9254 (for Europe, America areas)

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