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Technical Specification of Servo Motor & Mini Cheetah Driver

Part One: Product Feature

1. CAN Communication (SmartCan protocol, Rate 1M)
2. 15bit absolute encoder, one circle pulse up to 32768.
3. Multipole DD motor with high torque output.
4. Integrated servo motor with compact design and plug & play concept.
5. Position control mode, accessible to velocity and acceleration setting.

Part Two: Data Sheet

Product Parameters		
Power Supply	(Voltage)	36VDC ± 10%
	(Current)	7A
Details	(Torque)	1.27NM
	(Rated speed)	1500RPM
	(Max speed)	2000RPM
	(Power)	200W
(Signal feedback)		32768 (15bit absolute encoder , One circle pulse up to 32768)
(Cooling mode)		(Natural cooling)
(Weight)		480g
Position control mode	Position sampling frequency	2KHz
保护功能 (Protection)		(Locked-rotor warning)
(Communication interface)		Smartcan (CAN protocol, Rate 1M Hz)
Environment	Ambient temperature	0~40°
	Maximum permissible temperature	85°C
	Humidity	5~95%

Part Three: Status Indicator and Warning

Both Red and Green lights will turn on and off once to check if they work properly after power on. Afterwards, if the Green light is on and the Red is off, it means the motor is in normal status. Otherwise, the Red light will flash to warn specific

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abnormal situations. The warning code can also be read through modbus as follows:

Warning code	Flashing Pattern	Warning reason	How to solve
0x14	One long-term flash and four short-term flash	Locked rotor	Stop working

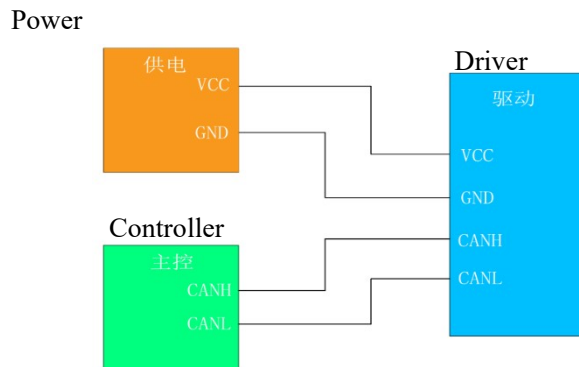
Note: the default warning time of locked-rotor is 6 seconds. You can set it to 9 seconds or NO warning. However, the output torque will be forcefully reduced to 30% of nominal level anyway.

: Part Four: Wiring Diagram and Control Method

How to connect to the driver

Part Five: CAN Communication Protocol

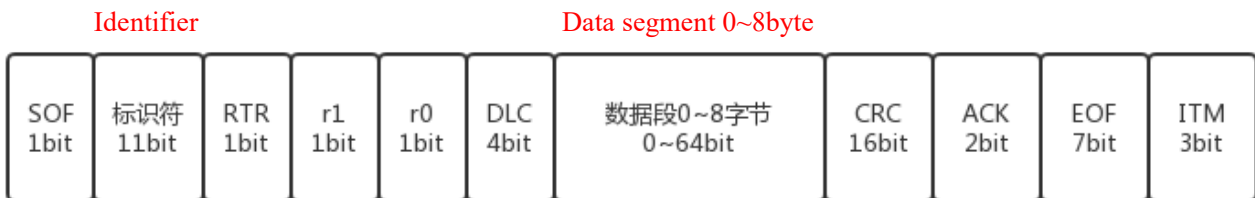
How to connect



Add two parallel resistances (each 120 Ohm) along the CAN bus wire, one on the controller side, one on the driver side.

SmartCan Comm Format (Position control)

SmartCan comm protocol uses the standard format of data frame as follows:



SOF: Frame interval

SIGN: Range 0~255, Represents the address of the target device, Host sends data to slave, The identifier is slave address, If the slave sends data to host, the identifier is host address.

RTR: 0: Data frame. (1: Remote frame). SmartCan only uses Data frame.

r1 : 0: Standard identifier. (1: extended identifier). SmartCan only uses standard identifier.

r0 : Receiving bit.

DLC:
Data Length Code.

Data segment: please refer to the following table for the detailed protocol.

The format for host to write and slave to reply (Function code 01)

The host writes a control instruction. The host address: 0xff. The slave address: 0x1.

The host writes a control instruction (Function code 01)									
Arbitration segment	Control segment	Data segment							
CAN identifier (Slave address)	DLC(Data segment length)	Host address	Function code	Retain	Acceleration	Retain	Target speed	Target location low 8bit	Target location high 8bit
0x01	0x08	0xff	0x01	0x00	0x64	0x00	0x80	10	27

Acceleration: the actual acceleration of the motor = acceleration*256 (RPM/S)

Target speed: Setting the motor speed, Range 0~256RPM.

Target location: Setting the motor position (absolute position), Range 0~36000 (Corresponding to the actual angle 0~360°)

The Slave response									
Arbitration segment	Control segment	Data segment							
CAN identifier (host address)	DLC(Data segment length)	Slave address	Function code	Current Torque Symbol Bit	Current Torque Data Bit	Current speed low 8bit	Current speed high 8bit	Current position low 8bit	Current position high 8bit
0xFF	0x08	0x01	0x01	0x00	0x10	0xC8	0x00	0x05	0x10

Current Torque Symbol Bit: When the motor stopped, the force direction of the motor.

Current Torque Data Bit: When the motor stopped, the force magnitude of the motor.

Current speed: the motor speed (Symbol number) Range -256~+256RPM

Current position: the motor current position, Range 0~36000(Corresponding reality 0~360°)

Note: Slave response. If no warning, the function code should be 0x01, otherwise 0x11. The actual warning reason should be analyzed by reading the warning code.

The format for host to read and slave to reply (function code 02)

Host reads the motor parameter, Host address 0xff. Slave address 0x01.

The Host reads the motor parameter (function code 02)									
Arbitration segment	Control segment	Data segment							
CAN identifier (Slave address)	DLC(Data segment length)	The host address	Function code						
0x01	0x08	0xff	0x02	0x00	0x00	0x00	0x00	0x00	0x00

The response from slave									
Arbitration segment	Control segment	Data segment							
CAN identifier (host address)	DLC(Data segment length)	The slave address	Function code	Current torque Symbol bit	Current torque data bits	Current temperature	Retain	Current position low 16bit	Current position high 16bit
0xFF	0x08	0x01	0x02	0x00	0x10	0x19	0x00	0x05	0x10

Current torque Symbol bit: When the motor stopped, the force direction of the motor.

Current Torque Data Bit: When the motor stopped, the force magnitude of the motor.

Current temperature: The internal temperature of the motor, Range 0~100 (Corresponding to 0~100°C in reality)

Current position: the motor current position, Range 0~36000 (Corresponding to 0~100° in reality)

Note: Slave response. If no warning, the function code should be 0x01, otherwise 0x11. The actual warning reason should be analyzed by reading the warning code.

How to change to Speed Mode

A: Write mode register 0x19

The host writes a 16-bit register (function code 06)							
Arbitration segment	Control segment	Data segment					
CAN identifier (Slave address)	DLC(Data segment length)	The host address	Function code	Register address	Data length	Data low 8bit	Data high 8bit
0x01	0x06	0xff	0x06	0x19	0x01	03	00

The response from slave							
Arbitration segment	Control segment	Data segment					
CAN identifier (host address)	DLC(Data segment length)	The slave address	Function code	Register address	Data length	Data low 8bit	Data high 8bit
0xFF	0x06	0x01	0x06	0x19	0x01	03	00

Note: Write “3” to the register address 0x19 is speed mode, and write “0” to the register address 0x19 is position mode

序号	系统时间	时间标识	CAN通道	传输方向	ID号	帧类型	帧格式	长度	数据
00000	10:23:53.325	无	ch1	发送	0x0001	数据帧	标准帧	0x08	x FF 06 19 01 03 00 00 00
00001	10:23:53.348	0x400D8BB	ch1	接收	0x00FF	数据帧	标准帧	0x06	x 01 06 19 01 03 00

B: Write parameter save bit

The host writes a 16-bit register (function code 06)							
Arbitration segment	Control segment	Data segment					
CAN identifier (Slave address)	DLC(Data segment length)	The host address	Function code	Register address	Data length	Data low 8bit	Data high 8bit
0x01	0x06	0xff	0x06	0x14	0x01	01	00

The response from slave							
Arbitration segment	Control segment	Data segment					
CAN identifier (host address)	DLC(Data segment length)	The slave address	Function code	Register address	Data length	Data low 8bit	Data high 8bit
0xFF	0x06	0x01	0x06	0x14	0x01	01	00

Note: The Register address is 0x14, Save registers for parameters, Write 0x1 is Execute Save command.

: Actual transmission picture

序号	系统时间	时间标识	CAN通道	传输方向	ID号	帧类型	帧格式	长度	数据
00000	09:48:37.050	无	ch1	发送	0x0001	数据帧	标准帧	0x08	x FF 06 14 01 01 00 00 00
00001	09:48:37.058	0x2BE58C1	ch1	接收	0x00FF	数据帧	标准帧	0x06	x 02 06 14 01 01 00

C: Turn on electricity take effect new address

D: If Re-change to position mode, just need write "0" into 0x19 and Save bit is "1"

SmartCan Comm Format (Speed control mode)

A: (0x02) Write Speed Register (0x02)

The host writes a 16-bit register (function code 06)							
Arbitration segment	Control segment	Data segment					
CAN identifier (Slave address)	DLC(Data segment length)	The host address	Function code	Register address	Data length	Data low 8bit	Data high 8bit
0x01	0x06	0xff	0x06	0x02	0x01	0x50	00

The response from slave							
Arbitration segment	Control segment	Data segment					
CAN identifier (host address)	DLC(Data segment length)	The slave address	Function code	Register address	Data length	Data low 8bit	Data high 8bit
0xFF	0x06	0x01	0x06	0x2	0x01	0x50	00

0x02 0x50 80RPM1500RPM.

6. Note: Address 0x02 is target Speed Register, Write 0x50 Corresponding Speed 80RPM, the Max speed is 1500RPM, Pls note that is motor Speed not the gear box speed, the gear box speed is 1/6 of the motor speed.

: Actual transmission picture

序号	系统时间	时间标识	CAN通道	传输方向	ID号	帧类型	帧格式	长度	数据
00000	10:37:29.507	无	ch1	发送	0x0001	数据帧	标准帧	0x08	x FF 06 02 01 50 00 00 00
00001	10:37:29.528	0x47D3AAE	ch1	接收	0x00FF	数据帧	标准帧	0x06	x 01 06 02 01 50 00

: If you need the speed is negative, the calculation method is as follows:

$$-80RPM = -0x50RPM \ 0x10000 - 0x50 = 0xFFB0$$

The host writes a 16-bit register (function code 06)							
Arbitration segment	Control segment	Data segment					

Arbitration segment	Control segment	Data segment					
CAN identifier (Slave address)	DLC(Data segment length)	The host address	Function code	Register address	Data length	Data low 8bit	Data high 8bit
0x01	0x06	0xff	0x06	0x02	0x01	0xB0	0xFF

The response from slave							
Arbitration segment	Control segment	Data segment					
CAN identifier (host address)	DLC(Data segment length)	The slave address	Function code	Register address	Data length	Data low 8bit	Data high 8bit
0xFF	0x06	0x01	0x06	0x2	0x01	0xB0	0xFF

: Actual transmission picture

序号	系统时间	时间标识	CAN通道	传输方向	ID号	帧类型	帧格式	长度	数据
00000	10:42:51.255	无	ch1	发送	0x0001	数据帧	标准帧	0x08	x FF 06 02 01 B0 FF 00 00
00001	10:42:51.278	0x4AE4315	ch1	接收	0x00FF	数据帧	标准帧	0x06	x 01 06 02 01 B0 FF

How to change the address of the equipment.

If the equipment address is “1”, and we need change it to “2”, the command as follows:

The host writes a 16-bit register (function code 06)							
Arbitration segment	Control segment	Data segment					
CAN identifier (Slave address)	DLC(Data segment length)	The host address	Function code	Register address	Data length	Data low 8bit	Data high 8bit
0x01	0x06	0xff	0x06	0x15	0x01	02	00

The response from slave							
Arbitration segment	Control segment	Data segment					
CAN identifier (host address)	DLC(Data segment length)	The slave address	Function code	Register address	Data length	Data low 8bit	Data high 8bit
0xFF	0x06	0x01	0x06	0x15	0x01	02	00

0x15, 0x2

Note: The Register address “0x15” is equipment address register, write “0x2” into it is the address that need change. (The amendment will not take effect immediately, and then Continue with the following operations):

Actual transmission picture

序号	系统时间	时间标识	CAN通道	传输方向	ID号	帧类型	帧格式	长度	数据
00000	09:43:47.804	无	ch1	发送	0x0001	数据帧	标准帧	0x08	x FF 06 15 01 02 00 00 00
00001	09:43:47.828	0x2924454	ch1	接收	0x00FF	数据帧	标准帧	0x06	x 01 06 15 01 02 00

Write parameter save bit

The host writes a 16-bit register (function code 06)							
Arbitration segment	Control segment	Data segment					
CAN identifier (Slave address)	DLC(Data segment length)	The host address	Function code	Register address	Data length	Data low 8bit	Data high 8bit
0x01	0x06	0xff	0x06	0x14	0x01	01	00

The response from slave							
Arbitration segment	Control segment	Data segment					
CAN identifier (host address)	DLC(Data segment length)	The slave address	Function code	Register address	Data length	Data low 8bit	Data high 8bit
0xFF	0x06	0x01	0x06	0x14	0x01	01	00

0x14, , 0x1

Note: The register address "0x14" is Parametric Save Register, Write "0x1" into it is Execute Save command.

: Actual transmission picture

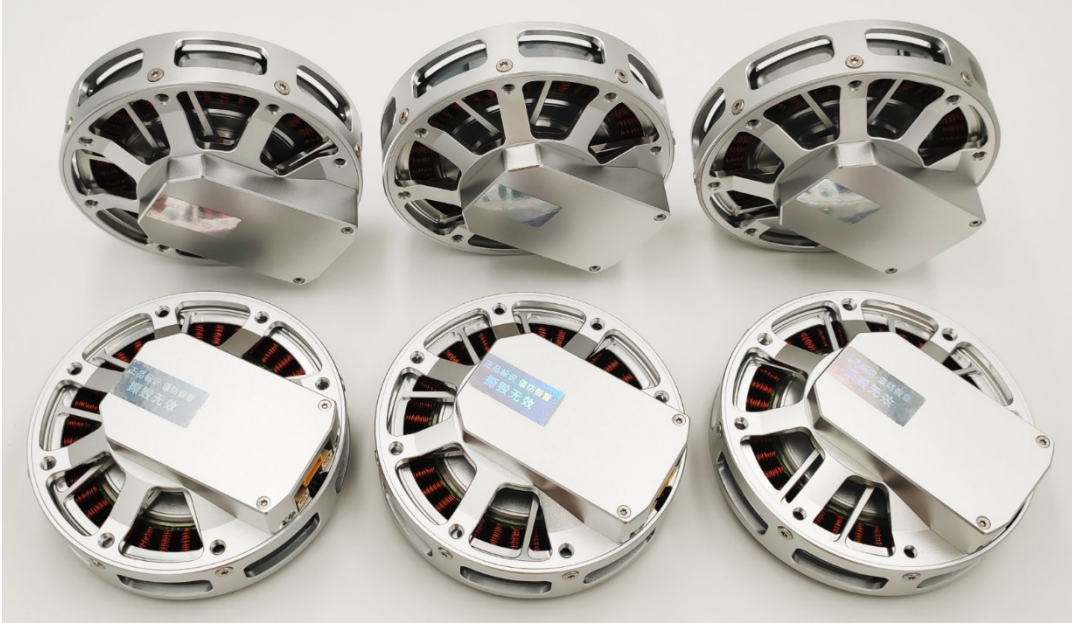
序号	系统时间	时间标识	CAN通道	传输方向	ID号	帧类型	帧格式	长度	数据
00000	09:48:37.050	无	ch1	发送	0x0001	数据帧	标准帧	0x08	x FF 06 14 01 01 00 00 00
00001	09:48:37.058	0x2BE58C1	ch1	接收	0x00FF	数据帧	标准帧	0x06	x 02 06 14 01 01 00

Turn on electricity take effect new address

Part Six: Wrong Comm code.

Slave response (The wrong code)				
Arbitration segment	Control segment	Data segment		
CAN identifier (host address)	DLC(Data segment length)	The slave address	Function code	Wrong code
0xFF	0x03	0x01	0x90	0x00

Wrong code	Warning reason	How to solve Warning
0x02	Illegal address	Read or write address exceeds maximum address
0x03	Illegal function code	Legal function codes only include 0x3 and 0x6
0x04	Illegal data length	Maximum writing length is 2*16 bit
0x05	2ms 2ms / Communication interpolation frequency is too high	2ms 2ms / send one interpolation absolute encoder



THE END