Communication manual

ESR SERIAL SOFTSTARTER

1、Parameters

1.1 General

The main starting / stopping parameters of ESR soft starter can be set by the panel potentiometer.
Other parameters have been set up at factory commissioning, users do not need to set them.
Other parameters can be adjusted by RS485 communication.

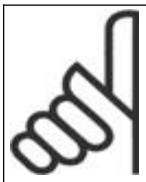
1.1.1 Main parameter

Parameter	MODBUS address	Setting range	Default
Full Load Amps FLA	40002	1-1600(A)	Rated current of softstarter According to lectotype. Factory setting

1.1.2 Protection parameter

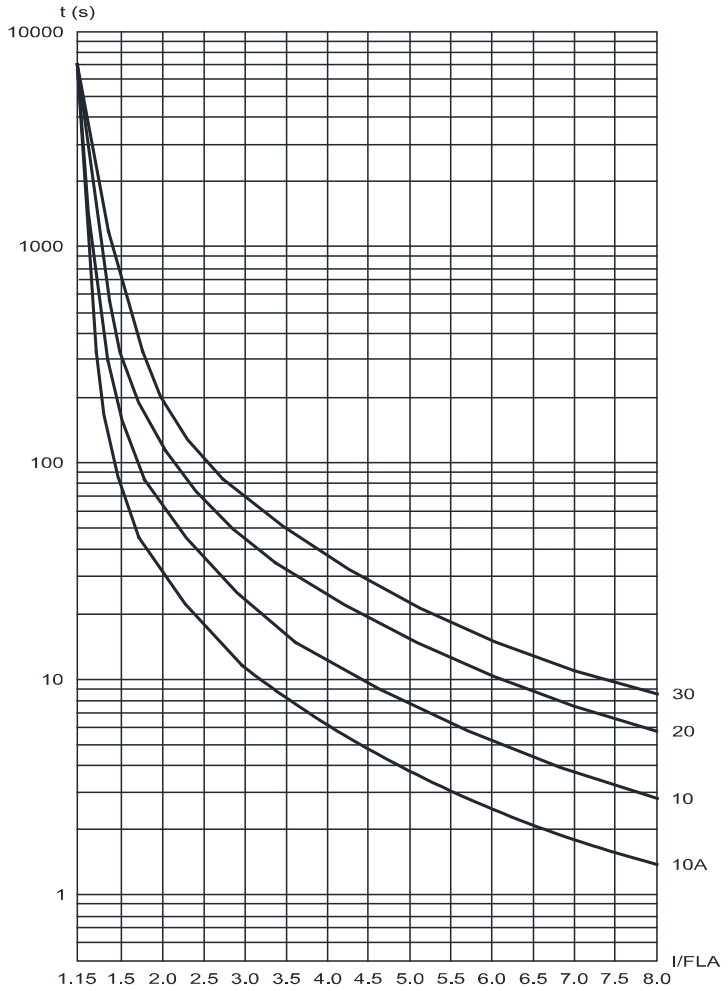
Parameter	MODBUS address	Setting range	Default
Over current protection value	40005	200-600(%FLA)	450% Factory setting

Parameter	MODBUS address	Setting range	Default
Over current trip delay time	40006	0~20(×0.1Sec.)	1Sec. Factory setting

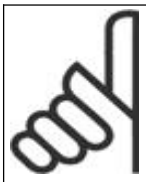
	Caution ESR has two different levels of over current breaking protection. 1. When the current is greater than 600% soft starter rated current (FLA), the soft starter will trip after 0.5 Sec. Fault relay (K2) tripped. 2. When the output current is greater than the over current protection set value (the motor rated current FLA 200%-600%) the soft starter is delayed for a period of time ("over current action delay time" specified time) then trip, the fault relay (K2) tripped.

Parameter	MODBUS address	Setting range	Default
Over load protection	40007	100~200(%FLA)	115% Factory setting

Parameter	MODBUS address	Setting range	Default
Overload protection grade	40008	0-CLASS10A 1-CLASS 10 2-CLASS 20 3-CLASS 30	0-CLASS10A Factory setting



Overload curve

	Caution Thermal protection of ESR. It is recommended that users set overload protection to (level 10A) , When the current exceeds "overload protection value", the soft starter detect overload protection.

Parameter	MODBUS address	Setting range	Default
Under current protection value	40009	0~100(%FLA)	0

Parameter	MODBUS address	Setting range	Default
Under current protection delay time	40010	0~600(×0.1Sec.)	60Sec.

Parameter	MODBUS address	Setting range	Default
Unbalanced current protection value	40011	10~50(%FLA)	30%

Parameter	MODBUS address	Setting range	Default
Unbalanced current protection delay time	40012	0~250(×0.1Sec.)	10Sec.

Parameter	MODBUS address	Setting range	Default
Phase sequence protection	40014	0- OFF 1- ON	1-ON

The parameter setting protection functions not introduced above.

	Caution More protections of ESR： 1） Overtemp protection. When the heatsink temperature is above 80 degrees, the soft start trip . 2） When the soft starter input terminal/output terminal missing phase, the soft start trip. 3） When The phase sequence of the soft starter line is abnormal, the soft starter is not allowed to start. 4） When the power module is short circuited, soft start tripped.

1.1.3 Start / stop parameters

Parameter	MODBUS address	Setting range	
Initial voltage	40017	30-70%	According to customer. Panel potentiometer setting.

	Caution The Initial voltage is set through the panel, and the setting value can only be read through communication mode, but it can't be changed.

Parameter	MODBUS address	Setting range	Default
Starting time	40018	1-30 Sec.	According to customer. Panel potentiometer setting.

	Caution The starting time is set through the panel, and the setting value can only be read through communication mode, but it can't be changed.

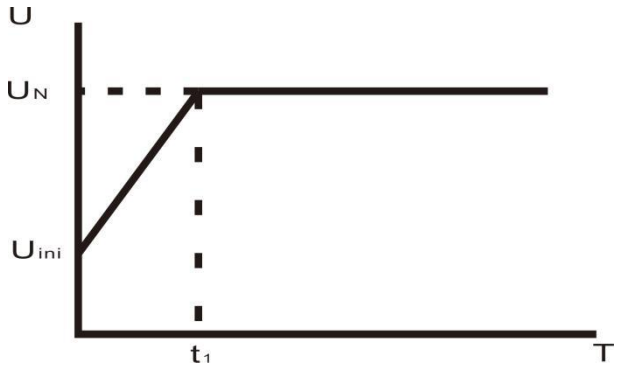
Parameter	MODBUS address	Setting range	Default
Stop time	40019	0-30 Sec.	According to customer. Panel potentiometer setting.

	Caution The stop time is set through the panel, and the setting value can only be read through communication mode, but it can't be changed.

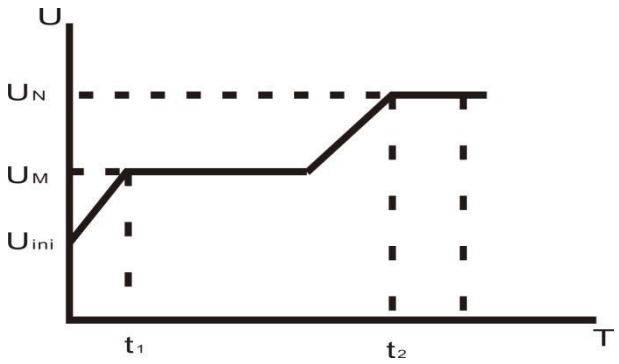
Parameter	MODBUS address	Setting range	Default
Current limit value	40020	200~500(%FLA)	350%

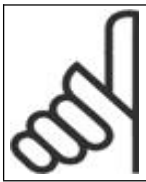
Parameter	MODBUS address	Setting range	Default
Max Start Time	40022	50~350(×0.1Sec.)	30Sec.

Voltage slope starting mode

	UN：Rated voltage Uini：Initial voltage T1：Acceleration time At a predetermined acceleration time (T1), the output voltage of the soft starter rises from the voltage to the full voltage (rated voltage Un).

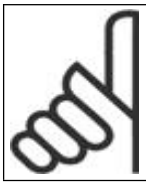
Current limit starting mode

	UN：Rated voltage Uini：Initial voltage Stop increasing voltage when current of motor exceeds current limit value. The voltage rises to the full voltage when current is lower than current limit value.

	Caution The motor can't start(Locked-Rotor) if the voltage is too low. It is suggested that set initial voltage from high to low or use the Recommended setting.

1.1.4 Relay parameters

Parameter	MODBUS address	Setting range	Default
K1 relay type	40033	0- Running signal relay 1- Bypass signal relay	0- Running signal relay Factory setting

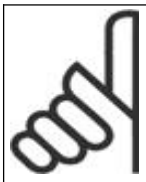
	Caution The type of K1 relay type can be changed according to application.

1.1.5 Communication parameters

Parameter	MODBUS address	Setting range	Default
Slave machines address	40037	1~127	1 Factory setting

Parameter	MODBUS address	Setting range	Default
Baud rate	40038	0-1200BPS 1-2400BPS 2-4800BPS 3-9600BPS 4-19200BPS 5-38400BPS 6-57600BPS	3-9600BPS Factory setting

Parameter	MODBUS address	Setting range	Default
Parity check	40039	0-EVEN 1-ODD 2-NONE	0-ECC

	Caution After setting up the communication parameters must restart the ESR soft starter. Incorrect settings cause communicate fault, it could cause cannot setting again. ESR can not restore the default parameter, so please be careful when setting communication parameters.

1.2 Parameters table

Parameter	MODBUS address	Setting range	Factory setting
Full Load Amps(FLA)	40002	1…1600(A)	According to product
Reserve	40003	0…1	0
Reserve	40004	65535…65535	
Over current protection value	40005	200...600(% FLA)	450% FLA
Over current trip delay time	40006	0 … 20(×0.1Sec.)	1 Sec.
Over load protection value	40007	100...200(% FLA)	115% FLA
Overload protection grade	40008	0-CLASS10A 1-CLASS 10 2-CLASS 20 3-CLASS 30	0-grade10A
Under current protection value	40009	0...100(% FLA)	0%
Under current protection delay time	40010	0 … 600(×0.1Sec.)	60 Sec.
Unbalanced current protection value	40011	10 … 50(% FLA)	30%
Unbalanced current protection delay time	40012	0 … 250(×0.1Sec.)	10 Sec.
Phase sequence protection	40014	0-OFF 1-ON	1-ON
Initial voltage	40017	0...15 (n*3+30)%	potentiometer setting.
Starting time	40018	0…15 T_{start}=n*2 (if n=0 T_{start}=1SEC)	potentiometer setting.
Stop time	40019	0…15 T_{stop}= n*2	potentiometer setting.
Current limit value	40020	200...500(% FLA)	350%
Parameter Setting	40021	0-potentiometer setting. 1-communcation setting.	potentiometer setting.
Max Start Time	40022	0...350(×0.1Sec.)	30 Sec.
K1 relay type	40033	0-Running signal relay 1-Bypass signal relay	0-Running signal relay
Bypass mode	40034	0-Send pulse after bypass 1-Stop pulse after bypass	0-Send pulse after bypass
Slave machines address	40037	0-127	1
Baud rate	40038	0-1200BPS 1-2400BPS 2-4800BPS 3-9600BPS 4-19200BPS 5-38400BPS 6-57600BPS	3-9600BPS
Parity check	40039	0-EVEN 1-ODD 2-NONE	0-ECC

2、Communication（option）

ESR use RS-485 line.

2.1 RS-485 technical characteristics：

Asynchronous serial communication
Half duplex
Communication protocol：Modbus RTU

2.1.1 Baud rate

ESR supports 1200/2400/4800/9600/19200 BPS.
More detail：1.1.5 Communication parameters.

2.1.2 Data bit

The data bit of ESR is 8.

2.1.3 Parity bit

Parity bit can be set：None/ECC/ODD.
More detail：1.1.5 Communication parameters.

2.1.4 Stop bit

When Parity bit is none，Stop bit is 2；
When Parity bit is ECC or ODD, Stop bit is1.

2.2 Response time

Normal response：4mSec. ≤ response time ≤ 40mSec.
Long response：response time ≤ 200mSec.

Notes：
Frequent query will cause longer response time of ESR;
When set the parameter by communication, the interval time of query should be 1000mSec.
ESR doesn’t support broadcast communication.
When ESR is communication bus terminal, 120Ω terminal resistance is recommended.
When ESR peer-to-peer communicate with PC, terminal resistance is no needed.
The maximum number of terminals connected with ESR is 32.
The transmission distance should <1.5KM (the relay is needed if distance>1.5KM).

2.3 MODBUS Message RTU Framing

Start	Slave Address 1Byte	Function Code 1Byte	Data 1	……	Data n	CRC-Hi 1Byte	CRC-Lo 1Byte	Stop

Start: Separated by a silent interval of at least 3.5 character times.
Slave Address：Slave Address from 1 to 127.
Function Code：Function Code（ESR support function Code 1，2，3，4，5，6，8，15，16）
Data 1…Data n：Data transmitted.
CRC-Hi：The CRC high－order byte from slave address to Data n.
CRC-Lo：The CRC low－order byte from slave address to Data n.
Stop: Separated by a silent interval of at least 3.5 character times.

2.3.1 Interval time

In RTU mode, message frames are separated by a silent interval of at least 3.5 character times. In the following sections, this time interval is called t 3,5.

Interval time= $\frac{3.5\times 11}{BaudRate}(Sec.)$

Example：
When Baud rate is 9600BPS, the interval time =3.5*11/9600=4mSec. So the interval time≥4mSec.

2.3.2 Slave Address

The number of slaves can be set from 1 to 127. (The default number is 1)

2.3.3 Function Code

Function Code	Modbus instruction	ESR function
01	read Coil Status	read instruction Status
02	read Input Status	read Input/output Status
03	read holding registers	read ESR parameter setting
04	read analog input registers	read ESR real-time data
05	force single coil	force instruction Status
06	preset single register	preset single ESR parameter
08	diagnostic	check communication loop
15（0x0F）	force multiple coils	force multiple instruction Status
16（0x10）	preset multiple registers	preset multiple ESR parameter

2.3.4 Register

ESR	Register address（4Digital）	Number of register	Permission
Instruction	00001…00008	8	R/W
Input/output Status	10001…10008	8	R
real-time data	30001…30016	16	R
parameter setting	40001…40032	32	R/W

2.4 Instruction（00001…00008 coil）

ESR have 8 coils

Address	ESR operation	illustration
00001	Start/Stop	=0 Stop， =1 Start ∗1
00002	Reserve	
00003	Reserve	
00004	Reserve	
00005	Reserve	
00006	Reserve	
00007	Reserve	
00008	Reset Fault	=0 NONE， =1 reset fault When this coil is set 1, ESR will reset the fault if it is in the status of fault. After reset fault, this coil will be set 0. ∗2

∗1：When start ESR by communication(00001 is set 1), the ESR can be stopped by communication(00001 is set 0) or cut off the control source power to force the ESR to stop.

∗2: Before reset the fault status(00008 is set 1), please cut off the Start/Stop signal to check the fault reason otherwise the ESR will start again as soon as the fault status is reset.

2.5 Input/output status（10001…10008）

Address	ESR operation	illustration
10001	outside start/stop signal	=0 OFF =1 ON
10002	inside start/stop signal	=0 OFF =1 ON
10003	DIP switch 1	=0 OFF =1 ON
10004	DIP switch 2	=0 OFF =1 ON
10005	Reserve	
10006	Reserve	
10007	Reserve	
10008	Reserve	

2.6 Real-time data（30001…30032 input registers）

Address	ESR operation	illustration
30001	A phase current	0…65535 unit：%FLA
30002	B phase current	0…65535 unit：%FLA
30003	C phase current	0…65535 unit：%FLA
30004	Initial voltage	0…512 Initial voltage% =30 +int((512-n)/32)*3
30005	Start time	0…512 Start time= (512-n)/16
30006	Stop time	0…512 Stop time=(512-n)/16
30007	Average current	0…65535 unit：%FLA
30008	Frequency	0…65535 unit：Hz
30009	System status	
30010	Input status	
30011	Fault status	
30012	Accumulated running time	0…65535 unit: hour
30013	Accumulated running time	0…65535 unit:X0.1sec
30014	Times of start	0…65535
30015	Times of fault	0…65535
30016	Max current during starting	0…65535 unit：%FLA
30017	Fault code-1	More detail please check the fault code table
30018	Fault code-2	More detail please check the fault code table
30019	Fault code-3	More detail please check the fault code table
30020	Fault code-4	More detail please check the fault code table
30021	Fault code-5	More detail please check the fault code table
30022	Fault code-6	More detail please check the fault code table
30023	Fault code-7	More detail please check the fault code table
30024	Fault code-8	More detail please check the fault code table
30025	Fault code-9	More detail please check the fault code table
30026	Fault code-10	More detail please check the fault code table
30027…32	Reserve	

Fault code table

Code	Description	Notes
0	No fault	
1	Overtemp trip	The temperature of the heatsink is higher than temperature setting value
2	Missing phase/No voltage trip	Miss one phase or two phase voltage or no voltage input
3	Over current trip	Current value exceeds over current set value
4	Over load trip	Current value exceeds overloading set value
5	Unbalance current trip	The unbalance three-phase current is larger than the unbalance current set value
6	Phase sequence trip	The sequence of three phase voltage is wrong
7	Max start time trip	Current value exceeds over current limit set value for the delay time
8	Under current trip	Current value lower than under current set value for the delay time
9	E^2PROM can not write trip	Can not write E^2PROM
10	Other trip	

2.7 Parameter setting（40001…40039 holding registers）

Parameter	MODBUS address	Setting range	Factory setting
Full Load Amps(FLA)	40002	1…1600(A)	According to product
Reserve	40003	0…1	0
Reserve	40004	65535…65535	
Over current protection value	40005	200...600(% FLA)	450% FLA
Over current trip delay time	40006	0 … 20(×0.1Sec.)	1 Sec.
Over load protection value	40007	100...200(% FLA)	115% FLA
Overload protection grade	40008	0-CLASS10A 1-CLASS 10 2-CLASS 20 3-CLASS 30	0-grade10A
Under current protection value	40009	0...100(% FLA)	0%
Under current protection delay time	40010	0 … 600(×0.1Sec.)	60 Sec.
Unbalanced current protection value	40011	10 … 50(% FLA)	30%
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Phase sequence protection	40014	0-OFF 1-ON	1-ON
Initial voltage	40017	0...15 (n*3+30)%	potentiometer setting.
Starting time	40018	0…15 T_{start}=n*2 (if n=0 T_{start}=1SEC)	potentiometer setting.
Stop time	40019	0…15 T_{stop}= n*2	potentiometer setting.
Current limit value	40020	300...500(% FLA)	350%
Parameter Setting	40021	0-potentiometer setting. 1-communcation setting.	potentiometer setting.
Max Start Time	40022	0...350(×0.1Sec.)	30 Sec.
K1 relay type	40033	0-Running signal relay 1-Bypass signal relay	0-Running signal relay
Bypass mode	40034	0-Send pulse after bypass 1-Stop pulse after bypass	0-Send pulse after bypass
Slave machines address	40037	0-127	1
Baud rate	40038	0-1200BPS 1-2400BPS 2-4800BPS 3-9600BPS 4-19200BPS 5-38400BPS 6-57600BPS	3-9600BPS
Parity check	40039	0-EVEN 1-ODD 2-NONE	0-ECC

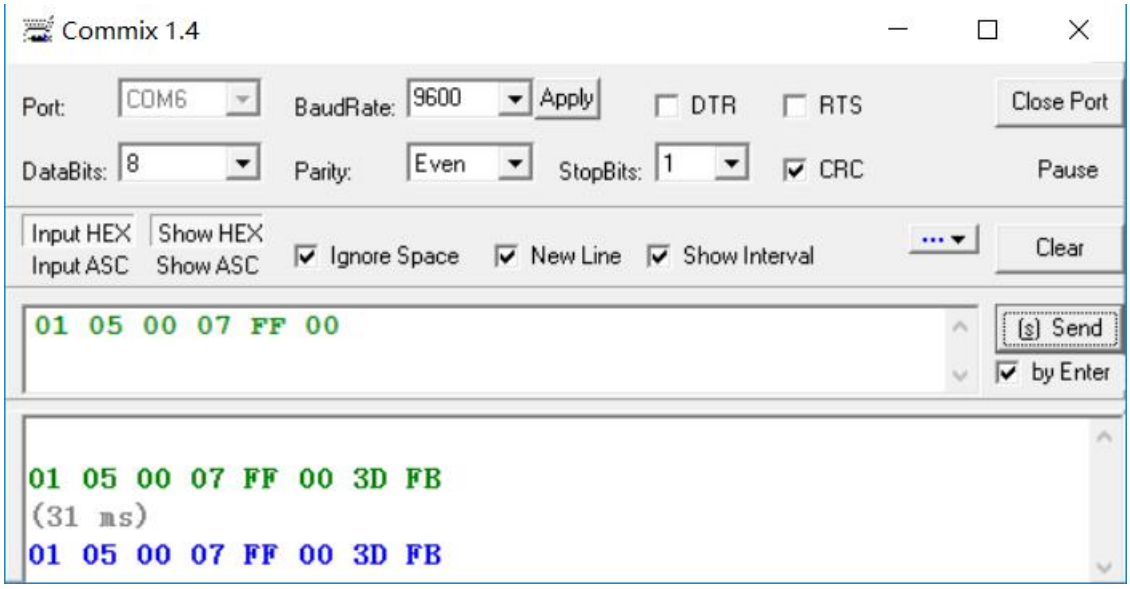
	WARNING The value set must in the parameter range acceptable. Wrong parameter setting will cause damage of softstarter.

2.8 Debugging

2.8.1 Instruction

Example 1 Reset fault

The coil address of reset fault is 00008 in 2.4 Instruction. Force single coil through function code ‘05’ of Modbus RTU. Suppose the slave number is 1.



Caution:

1. The start address is 0, so the address of 00008 coil is 0x0007
2. The coil set 0, data is 0x0000
3. The coil set 1, data is 0xFF00
4. Returned data

   01 slave number

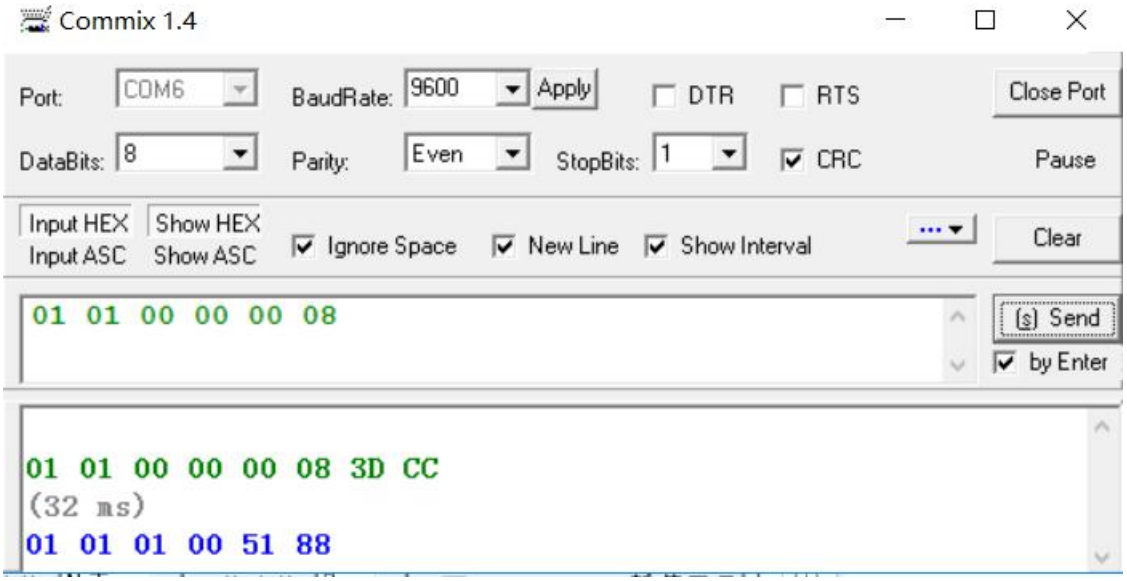
   05 function code

   0007 coil address

   FF00 coil set 1

   3DFB CRC

Example 2 Read 0001~00008 coil status.



Returned data：
01 slave number
01 function code
01 number of bytes
00 coil data
5188 CRC

Example 3 force multiple coils.
This example force 00001 and 00002 coil.

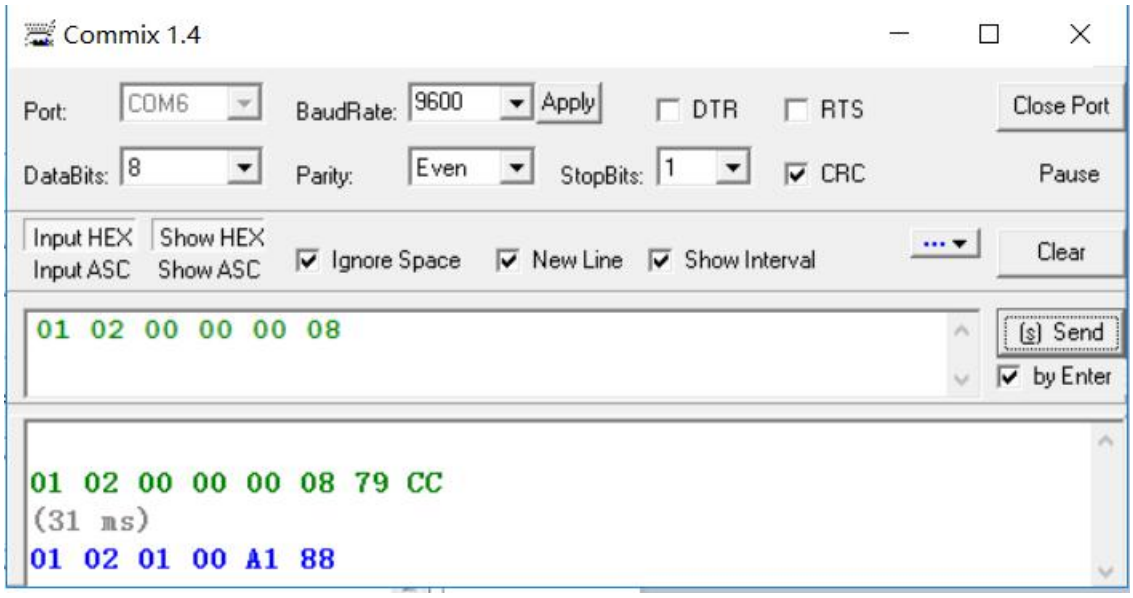
Transmitted data:
01 slave number

0F function code
0000 start address of coil
0002 number of forced coils
01 number of bytes
03 binary data 0000 0011 means two coils set 1

Returned data：
01 slave number
0F function code
0000 start address of coil
0002 number of forced coils

2.8.2 Read Input Status

Example 4 read input status of 10001~10008

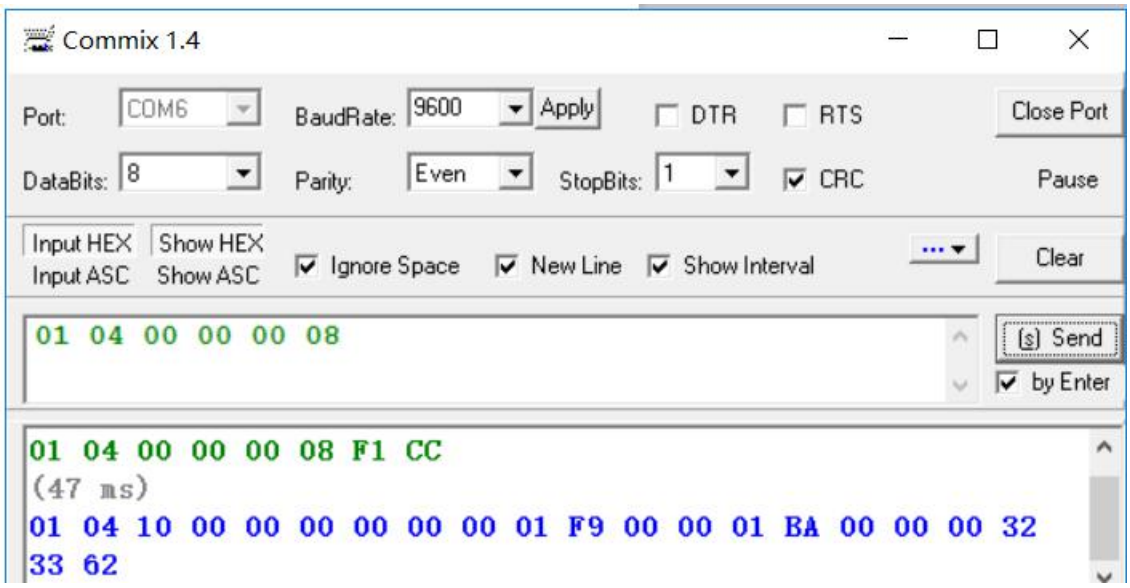


Transmitted data:
01 slave number
02 function code
0000 start address of input status
0008 number of input status read

Returned data：
01 slave number
02 function code
01 number of bytes returned
00 the data of input status returned
A188 CRC

2.8.3 Real-time data

Example 5 read A/B/C phase current, Initial voltage, Start time, Stop time, Average current and frequency.

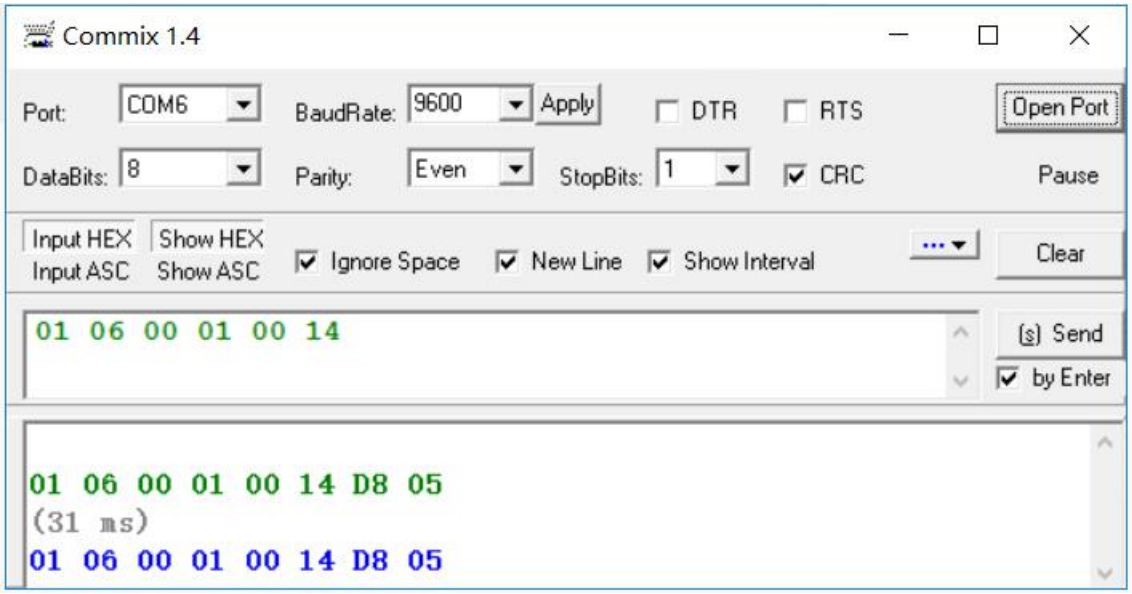


Transmitted data:
01 slave number
04 function code
0000 start address
0008 number of register read
F1CC CRC

Returned data：
01 slave number
04 function code
10 number of bytes returned (16bytes)
0000 A phase current
0000 B phase current
001C C phase current
01F9 initial voltage 01F9=505 in decimal system. According to the formula 30 +int((512-505)/32)*3=30%
0000 start time 0000=0 in decimal system. According to the formula int(512-0)/16= 32SEC
01BA stop time 01BA=442 in decimal system. According to the formula int(512-442)/16= 4SEC
0009 average current
0032 frequency
3362 CRC

2.8.4 Parameter setting

Example 6 set Full Load Amps(FLA)



Transmitted data:
01 slave number
06 function code
0001 address of register
0014 data to set
D805 CRC

Returned data:
01 slave number
06 function code
0001 address of register
0014 data to set
D805 CRC

2.8.5 Diagnostic

Example 7