

Yudian AIBUS & MODBUS COMMUNICATION PROTOCOL

INSTRUCTION (V8.0)

Developed by Xiamen Yudian Automation Technology Co., Ltd., AIBUS is the communication protocol designed for AI-series displaying and controlling instruments. It functions by easy instructions and is characterized by the function of setting and reading parameters at the same time. Thus, Circle Time is not damaged while setting parameters. With its shorter instruction length, AIBUS has quicker rate than MODBUS(especially when setting instruction in MODBUS, it cannot be read meanwhile since circle time will be influenced and prolonged). AIBUS has system control ability to construct large scale process. It exploits 16 bit SUM correcting code, operates with higher speed and more reliable communication since it supports 9600, 19200 and other wave frequencies. With 19200, the average time for an upper computer to visit a high performance controller like AI-7/8 series is only 20 mS, and AI-5 series is 40mS. One RS485 is allowed to connected with up to 80 pc of controllers (to promise the reliability of communication, one RS485 repeater is added when over 60 pc). AI series controllers can be connected with touch screen and PLC with full resource and higher speed. PC is widely used when under WINDOWS operation environment for its convenience and powerful function. The application of the latest Industrial PC touch screen further brings a new environment to industrial automation. This results in the much lower cost and much higher performance of controllers+PC much than that of the traditional DCS. Yudian's AI-5 series controllers have as long life as 1 million times while AI-7/8 is allowed to continue setting parameter, like PV,SV, the highest is 1 billion times, and can be used in complicate regulating system.

一、 interface specification

AI series instruments adopt Asynchronous Serial Port, interface level is in accordance with RS232C and standard RS485. Data format is 1 start bit, 8 bit data, no check-bit, 1-2 stop-bit. Wave frequency ranges from 4800~19200 bit/S, usually 9600 bit/S. 19200 bit/S is suggested when over 40 pc instruments or require higher refresh rate. 4800 bit/S is suggested when with longer communication length and interruption. AI controllers adopt RS 485 and can connect 1~80 pc to one communication interface.

二、

It only needs 2 wires to communicate AI controllers and PC when the length is over 1 KM(some are 3-4KM), which is advantageous compared with RS 232. To make sure PC can be connected, RS232/RS485 or USB/RS485 converters can be used, changing RS232 or USB interfaces into RS 484 interface. Yudian has developed new RS232/RS485 and USB/RS485 converters with litter volume and certain thunder-proof ability. No initialization is needed nor outer power supply. All software can be adjusted to use.

As RS 485 interface required, it can connect up to 32 controllers and computers with one communication line. Repeaters is needed when over 32 pc. Or use 1/2 and 1/4 off-chip interface. At present, AI interface can connect 60 pc without repeater and is thunder-proof and electrostatic-proof to some degree.

AI's RS 232 and RS485 interfaces adopt advanced optical isolated technology, when there is damage or fault in one pc, operation of others is not influenced. When parts of communication interface or model is failed, controllers keep working with high reliability. 16 bit correct code has a high accuracy as

high as 30000 times than parity check, can promise the reliable data. Under most conditions AI controllers are not influenced by other brand's product communication. No disordered data collecting. But AI controller protocol doesn't promise other brand's product can work normally so Yudian doesn't suggest to use Yudian's controllers with other brand's controllers on one RS485 communication line. Separated connection is better.

二、Communication Instruction

AI controllers adopt 16 bit data format to symbol all instruction codes and datas. After optimization of software communication instruction, there are only two: reading instruction and writing instruction. These two instructions make it easier to compile software with 100 % fullness. The standard reading and writing instructions formation are as follows:

Reading: address code+52H(82)+ parameter code+0+0+check code

Writing: address code+43H(67)+ parameter code+low byte+high byte+check code

Address code: in order to connect more AI controllers to one communication interface, each controller has its own communication address. Some valid addresses are 0~80 (some are 0~100), so up to 80 pc are connectable. Address code depends on Addr Parameter. Two repeated 128~208 (80H~D0H) is used to symbol address code. Since code over 128 is seldom used, thus it can reduce the data and address clashes. AI protocol requires, address code is formed by two same bytes, value is : address+80H as follows:

E.g.: If the parameter Addr=10(16 bit is 0AH,0A=80H= 8AH), then its address code is 8AH 8AH.

Parameter code: controllers' parameter is formed by 1 8-bit binary number (1 byte, write as 16 number). It indicates the reading and writing parameter.

Check code: it is formed by 16bit SUM correct coding. Its computational method is:

Parameter code to be read*256+82+ADDR

Writing instruction's correct code's computational method is the remainder of the below formula:

Parameter code to be read*256+67+parameter to be written+ADDR

ADDR above is the address parameter of controller, range is 0~80. Correct code is the remainder of the above formula: 2 bytes, former is low byte, latter is high byte. Values to be written is indicated by 16 bit binary number.

Return data: writing or reading whichever, below 10 bit data is returned:

PV+SV+MV and alarm status+writing/reading parameter value+ correct code

Thereinto, PV ,SV, and reading values each takes up 2 bytes, symbolizing one 16-bit binary number has twos complement, with low byte in front and high byte behine. Decimal point is not represented, so users should do on PC; MV takes up 1 byte in 8 signed binary number format, value range is -100~+100, status take up 1 byte, correct code take up 2 bytes, totalling 10 bytes. The meaning of all returned datas are as follows:

Codes	Regulator Controller	AI-708M Indicator	AI-708H/808H Flow channel	AI-808H Temp./ Pressure channel	AI-301M Frequency regulator/IO module
PV	Testing value	Testing value	Flow testing value	Temperature testing value,0.1 ℃	Testing value
SV	Setting value	Channel number	Accumulated flow low level or batch control testing	Pressure testing value,0.001MPa	Current setting value

		(1-6)	value		
MV	Output value ,MV	Status bytes B	Accumulated flow high level or batch control setting value	Flow or frequency value before compensation,0.1Hz	Regulating output value
Status bytes	Status bytes A	Status bytes A			Status bytes A
Parameter value	Meaning values to be read and written.				

Returned correct code equals the remainder of the formulat: PV+SV+ alarm status*256+MV)+parameter +ADDR

When calculating, every two 8-bit byte forms one 16-bit binary number. The remainder is correct

Status byte A symbols some controllers' status, its meaning is as follows (NO.7 is fixed with" 0"):

	Regulator/ indicator(V7.0)	AI-702M/704M/706M	Regulator, indicator (V7.5)
NO.0	High limit alm (HIAL)	High limit alm (HIAL)	HIAL
NO.1	Low limit alm (LoAL)	Low limit alm (LoAL)	LoAL
NO.2	positive deviation alarm (dHAL)	0	HdAL
NO.3	negative deviation alarm (dLAL)	0	LdAL
NO.4	Input over range alarm (orAL)	Over range alarm (orAL)	Oral
NO.5	AL1status, 0 movement	0	Stand-by (0)
NO.6	AL2status, 0 movement	0	0,output value MV,1 status byte B

Indicators has status byte B. With B, NO.0-6 stand for the interface respectively for OP1,OP2, AL1, AL2, AU1, AU2 and MIO, 0 stands for no connection or no output, 1 stand for outer on/off connected and output, OUTP or AUX correspond to 0. Their corresponding interfaces can be input and output for on/off switch, the alarm interfaces not used by ALP can be used as I/O interface for on/off switch by modifying NONC(normally opened/ closed): "opened" is set for input, when read input signal is 1, it means outer on/off is closed or there is signal input.

Parameter list (V8.0 518/518P/708/708P/719/719P)

Parameter code	AI-518/518P	Specification	06H(MODBUS address)
00H	(SV)	Unit same as MV	40001
01H	HIAL (high limit alarm)	Unit same as MV	40002
02H	LoAL(low limit alarm)	Unit same as MV	40003
03H	dHAL(Deviation high alarm)	Unit same as MV	40004
04H	dLAL (Deviation low alarm)	Unit same as MV	40005
05H	AHYS(Alarm Hysteresis)	Unit same as MV	40006
06H	Ctrl (Control mode)	0, ONOFF; 1, APID; 2, nPID; 3, PoP; 4, SoP	40007
07H	P(Proportional band)	Unit same as MV	40008
08H	I (Time of Integral)	s	40009
09H	d (Time of Deviative)	0.1s	40010
0AH	Ctl(Control period)	0.1s	40011
0BH	InP(Input type)	Refer to manual	40012
0CH	dPt(Radix point position)	0, 0; 1, 0.0; 2, 0.00, 3, 0.000; If above read-in data +128, it means all MV and their parameters with same unit(for either temperature signal or linear signal), should be display after divided by 10 and then " 4 pieces into 5" process。 For example, dPt value as	40013

		128+1=129, read-in MV or relevant parameter value 16 integer is 1000, And it is to be displayed as 10.0 actually; If dPt value is 1, and actual display is 100.0; this parameter could be written in, but shouldn't add 128, the range for self written in is 0~3.	
0DH	ScL(Signal scale low limit)	Unit same as MV	40014
0EH	ScH (Signal scale high limit)	Unit same as MV	40015
0FH	ALP(Alarm output selection)	Refer to manual	40016
10H	Sc(Translation correct)	Unit same as MV	40017
11H	oP1(Main output type)	0, SSR; 1, rELy; 2, 0-20; 3, 4-20	40018
12H	OPL(Output low limit)	%	40019
13H	OPH(Output high limit)	%	40020
14H	CF (Communication function)	Refer to manual	40021
15H	Model Tagged word	5180(AI-518) or 5187 (AI-518P)	40022
16H	Addr (Address)		40023
17H	FILt (Digital Filtering)		40024
18H**	AMAn(Manual/auto selection)	0, MAN; 1, Auto; 2, FMAn; 3, FAut	40025
19H	Loc(Parameter Lock)		40026
1AH**	MV(Manual output value)		40027
1BH	Srun (Stop/ Run selection)	0, run; 1, StoP; 2, HoLd	40028
1CH	CHYS (Control Hysteresis)	Unit same as MV	40029
1DH	At (Auto tuning)	0, OFF; 1, on; 2, FoFF	40030
1EH	SPL (Low limit of SV)	Unit same as MV	40031
1FH	SPH (Upper limit of SV)	Unit same as MV	40032
20H	Fru(Unit and power frequency)	0, 50C; 1, 50F; 2, 60C; 3, 60F	40033
21H	OHEF OPH((Work range of OPH))	Unit same as MV	40034
22H	Act (Acting method)	0, rE; 1, dr; 2, rEbA; 3, drbA	40035
23H	AdIS (Alarm display)	0, OFF; 1, on	40036
24H	Aut (Auxiliary output type)	0, SSR; 1, rELy; 2, 0-20; 3, 4-20	40037
25H	P2 (Refrigerating output proportional band)	Unit same as MV	40038
26H	I2 (Refrigerating output Time of Integral)	seconds	40039
27H	d2 (Refrigerating output Time of Derivative)	0.1s	40040
28H	Ctl2 (Refrigerating output period)	0.1s	40041
29H	Et (Event input type)	0, nonE; 1, ruSt; 2, SP1.2; 3, Pld2	40042
2AH***	SPr (Heating rate limit)	Measuring unit/ (seconds)	40043
2BH*	Pno (Program number)	Integer	40044
2CH*	PonP (Power on)	0, Cont; 1, StoP; 2, run1; 3, dASt; 4, HoLd	40045
2DH*	PAF (Parameter Function)	Functions refer to the manual	40046
2EH*	STEP (Program step)	Integer	40047

	number)		
2FH*	Run time	0.1m or0.1h, decided by PAF parameter	40048
30H*	Event input status	0, none; 1, Event 1 (AL1) action; 2, AL2 action; 3, AL1and AL2 action	40049
31H**	OPrt(soft start time)		40050
32H**	Strt(Valve start time)	Defines the time needed for valve start.	40051
33H**	SPSL (External setpoint low limit)	When external set point input port is used for measuring valve feedback signal, set the valve position value as 1.	40052
34H**	SPSH(External setpoint upper limit)	When external set point input port is used for measuring valve feedback signal, set the valve position value as 2.	40053
35H**	Ero(Error output value)	Defines regulation output value, when sensor input default or super range.	40054
36H**	AF2	Function parameter 2	40055
37H~3 FH	Standby		40056~40064
40H~47 H	EP1~EP8		40065~40072
48H**	Valve position (for read only)	0~25600 is equal to 0~100% (0~100% is the measuring value divided by 256)	40073
49H~4 FH	Standby		40074~40080
50H~51 H	SP 1, t 1	SP1-- SV 1, t1-- first segment program value	40081~
52H~	SP2 ~ program segment value , defined by Pno parameter		

NOTE:

1、Parameters with * mark is just for AI-518P/708P/719P, and they' re invalid parameter code for AI-518/708/719 , Parameters with **mark are for AI-719, and parameters with***mark is only for AI-518P/708P/719/719.

2、If read parameters outside above list(invalid parameter code or standby parameter code), then the instrument returns the value as 127 for high-value (if read integer, which is 32512~32767, because maximum set range is 32000, parameter beyond 32512 means the mark for mis-reading parameter code.), and is to be processed in the computer program; if parameter code read is larger than last value of valid program segment(0B4H), then it's regarded as wrong as well, and no response.

***When using MODBUS protocol communication, if reading SV to be 40001, it requires reading 4 records at a time. Suppose instrument address number to be 1, then dispatching data should be 01 03 00 00 00 04 CRC (40001、40002、40003、40004)

Return the data as :01 03 08 PV 40001) SV 40002) MV and CRC which is the parameter 40004: PS here mean the record of SV) read from Alarm Status (40003)

Upper Alarm: 01H (40002)

Then dispatching the record 01 03 00 02 00 04 CRC (read 40002、40003、40004、40005 to get 4 records)

Return the record as 01 03 08 PV (40002) SV (40003) MV and CRC which is the parameter (40005: PS here mean the record of HIAL) read from Alarm Status (40004) .

3、Instruments with manual operation function can support regulating output value manually by writing 1AH parameter.

4、15H is model tagged word for instruments, different tagged word for different model instruments.

	Tagged word
AI-518(V8.0)	5180

AI-518P(V8.0)	5187
AI-708(V8.0)	7080
AI-708P(V8.0)	7087
AI-719(V8.0)	7190
AI-719P(V8.0)	7197
AI-702M/704M/706M	768
AI-708H/808H	256 (for accumulate only) ; 257 (for batch control mode)
AI-808H	258
AI-301M	512
AI-7048	7048

3 Programme

System uses the master-slave multi-machine communication structure, each directive to the instrument, then instrument returns a data. When writing computer software, please be noted that the instrument must make response to each valid directive within 0~150ms, and you should not send new directive until the instrument responses to last directive, or it may cause default. If the response time longer than 150ms, it mean the directive may be invalid, or communication line default etc. At that time, computer should resend the directive or just change the address of instrument. For example, set the SV (parameter code is 0)of the instrument (address 1) to be 100.0℃ (Integer is 1000), then program with VB:

1、Initialize communication port, including baud rate which same as instrument, data bit 8, stop bit 2, without verifying。

2、VB program command (set SP1as 1000): COMM1.OUTPUT=

CHR\$(129)+CHR\$(129)+CHR\$(67)+CHR\$(0)+CHR\$(232)+CHR\$(3)+CHR\$(44)+CHR\$(4)

3、Radix point process (just for V8.0): To enhance efficiency, all values instrument transfers are 16bit two's complement integer. So computer should convert integer into actual data with decimal point. The method is when PC starts, priority should be put to read parameter dPt (0CH) to obtain the decimal point position of measuring signal. Note: if dPt value larger than or equal to 128, MV and parameter with same unit as MV should be displayed after divided by 10, when writing this parameter, the value showed should be converted to integer, multiplied by 10, and be downloaded with 16-bit two's complement.

Technical specification for communication :

Model	AI-301、 AI-7/8 series	AI-5 series
Latest response time (under 4800bit/S condition)	100mS	150mS
Fastest response time (under 19200 bit/S condition)	5mS	5mS
Average read-write period (under 19200bit/S condition)	20mS	50mS
Allowed parameter modification frequency	1 billion	1 million

NOTE: For AI-5XX series instruments, writing time for parameter is better to longer than 2 seconds, or it may cause default of storage unit during 5 year warranty period.

4 MODBUS Communication protocol

From V8.2, Modbus communication protocol could be available for AI series controllers. , AI controllers can support 2 subcommands under Modbus protocol, to intercommunicate widely with other Modbus equipment. For keeping the rate, AI controllers adopt RTU(Binary system) mode, baud rate should be set as 9600bit/S, no parity, support two directives of 03H (for reading parameter and record) 及 06H (write single record.) .

As per 03 directive for 518/708/708P/719/719P controller, it requires reading 4 records at a time, directives as follows :

ADDR+03H+0+parameter code to be read+0+4+CRC check code

Return the record to be : ADDR+03H+08H+ PV high order position+ PV low order + SV high order position +SV low order + Alarm status+ MV+ parameter value high order position + parameter value low order +CRC check code low order +CRC check code high order position

Write single parameter directive to be :

ADDR+06H+0+parameter code to be written+ record high order position to be written + record low order position to be written +CRC check code