BE6300 Serial Port And Communication Protocol

1.0 Outline

The new BE6300 series products have a built-in, isolated, RS485 interface which supports many communication protocols, including MODBUS protocol, M-BUS protocol, FUJI extending protocol. MODBUS protocol is regular factory control protocol, our meters support the two formats of MODBUS: RTU AND ASCII.

M-BUS is commonly used as a heat meter measuring protocol internationally, users using this protocol choose “MODBUS ASCII”in M63.

BE6300 FUJI extending protocol is developed based on Japan FUJI ultrasonic flow meter protocol, compatible with FUJI ultrasonic flow meter protocol, and the 7 version ultrasonic flow meter protocol.

The BE6300 can support 12 kinds of compatible communication protocols. If using compatible communication protocol, users need to choose “MODBUS ASCII”in M63, and then choose any protocol listed.

BE6300 series products can function as simple RTU equipment, using current loop and OCT output to control marching type or analog electromagnetic valve opening, OCT output can control power on/off of other devices. Its 1 channel analog input is used to input signals of pressure, temperature, etc.

When the setup item in M63 is “MODBUS-RTU ONLY”, it is used to support MODBUS-RTU protocol. When the item is “MODBUS ASCII＋previous protocol”,it is used to support MODBUS ASCII、Meter-BUS,BE6300 FUJI extending protocol and Huizhong flow meter, water meter compatible protocol. Also using M63 to choose different Huizhong flow meter, water meter compatible, to choose after choosing “MODBUS-RTU”, “MODBUS-ASCII”.

Setup serial port parameters in M62, 8 kinds of supportable baud rate: 19200,14400, 9600, 4800, 2400, 1200, 600, 300. Stop bit: 1 or 2. Check bit is optional.

Using self-equipped standard MODBUS drivers of different Supervisory Control and Data Acquisition can connect BE6300 to data acquisition by using MODBUS-PROFIBUS converter, it can conveniently connect BE6300 to PROFIBUS using RS485 to connect RS485 bus. It is also available to use GSM message module board made by us,transferring flow rate/heat quantity measuring datas through message. the module board can multi-machine network, and use mobile phone to check the work status and measuring datas of flow meter.

When using in network environment,except that programming address identification number(IDN) on parallel port or serial port keyboard, other operations can be done on upper monitor.

Data output adopts command-respond method, that means upper monitor send an command, the flow meter respond correspondingly.

Flow data collecting can use commonly used flow rate/heat quantity data monitor system developed by our company,the system sufficiently used software and hardware design of flow meter features, based on features of BE6300 flow meters, has advantages of cost-effective, simple and quick, reliable operation,etc.

1.2 MODBUS protocol

It can support the two formats of MODBUS; MODBUS-RTU format or MODBUS-ASCII format in M63. Default format is MODBUS-ASCII.

BE6300 series ultrasonic flow meter/heat meter can only support three function codes of MODBUS: 03, 06, 16. Respective function is reading register, writing single register and data block.

For example: in the method of RTU, read the flow velocity of No.1 equipment, read register of 5, 6, that is two registers. Command as follows:

01 03 00 04 00 02 85 CA （**hexadecimal digits**）

(Equipment number) (function) (start register) (register number) (checksum)

85 CA is **hexadecimal digits, obtained by algorithm of CRC-16(**BISYNCH, polynomial is $x^{16} + x^{15} + x^2 + 1$, mask word is 0A001H). For detailed algorithm, please refer to information about MODBUS.

Returned datas should be (set status is simulated operating,flow velocity ＝1.2345678m/s）
01 03 04 06 51 3F 9E 3B 32（**hexadecimal digits**）

Equipment number function data byte data＝1.234567 checksum

Four bytes of 3F 9E 06 51 is IEEE754 format float floating point of 1.2345678

Another example,read net totaliser flow,two registers of REG25,REG26,command as follows:
01 03 00 18 00 02 44 0C（**hexadecimal digits**）

returned datas should be(set net totaliser＝802609,its 4 byte **hexadecimal digits is** 00 0C 3F 31)
01 03 04 3F 31 00 0C A7 ED（**hexadecimal digits**，A7 ED is checksum）

When net totaliser＝0，returned data is 01 03 04 00 00 00 00 FA 33
FA 33 is checksum.

Pls note the above datas storage sequence. When explaining datas by C language, use pointer to put the needed datas to corresponding variable address. Normal storage sequence is that low byte is in front. For above example : 1.23456m/s, storage sequence of 3F 9E 06 51 data is 51 06 9E 3F。

In ASCII mode,read No. 1 equipment,10 register commands start from register 1 are as follows:
：01030000000AF2（ENTER）

Returned data :0103280000000000000000000000000000000000000000D4

“：” is leader in ASCII mode, “F2”and“D4” are two byte checksum.the method is the addition of all the single byte in command except of “ ： ”and “ENTER”, without carry,obtaied by calculating complement.for example:above command: 01h＋03h＋00h＋00h＋00h＋0Ah＝0Eh,the complement＝0－0Eh＝F2。The returned data checksum is 1＋3＋28h＝2Ch，the complement＝0－2Ch=D4h。

In MODBUS-RTU mode, read 125 registers mostly each time. but in MODBUS－ASCII mode, read only 61 registers, if more than the figures, the flow meter will return error message. For more details, pls refer to information about the MODBUS protocol.

When adjusting MODBUS protocol, recommend to use a free adjustment software-MODSCAN, this

software can be found on internet. When there is problem, but can receive check and correct data packet,so that the communication has no problem.

In default state,communication setup :velocity is 9600,no check,8 data bit,1 stop bit.

1.3 MODBUS register address table

（note the difference with water meter protocol）

Register	Number of registers	Variable Name	Data Type	Description
0001-0002	2	Instant flow rate	REAL4	unit：m^3/hour
0003-0004	2	Instant heat flow rate	REAL4	unit：GJ/hour
0005-0006	2	Fluid velocity	REAL4	unit：m/s
0007-0008	2	Measuring sound velocity of fluid	REAL4	unit：m/s
0009-0010	2	Positive totalizer flow	LONG	All the flow totalizers that use long integers, its measure is controlled by M32 (REG1438)
0011-0012	2	positive totalizer flow decimal part	REAL4	REAL4 is standard IEEE-754 format float floating point.the format data is also called FLOAT format.
0013-0014	2	Negative totalizer flow	LONG	Long integers is lower digit in front and with character
0015-0016	2	Negative totalizer flow decimal part	REAL4	
0017-0018	2	Positive totalizer heat quantity	LONG	all the heat quantity totalisers that use long integers,its measure is controlled by M84(REG1441)
0019-0020	2	Positive totalizer heat quantity decimal part	REAL4	
0021-0022	2	Negative totalizer heat quantity	LONG	
0023-0024	2	negative totalizer heat quantity decimal part	REAL4	
0025-0026	2	Net totalizer flow	LONG	
0027-0028	2	Net totalizer decimal part	REAL4	
0029-0030	2	Net totalizer heat quantity	LONG	
0031-0032	2	Net totalizer heat quantity decimal part	REAL4	
0033-0034	2	Temperature 1 / supplying water temperature	REAL4	Unit: ℃
0035-0036	2	Temperature 2 / return water temperature	REAL4	Unit: ℃
0037-0038	2	Analog input AI3 value	REAL4	Converted dimensionless data
0039-0040	2	Analog input AI4 value	REAL4	Converted dimensionless data
0041-0042	2	Analog input AI5 value	REAL4	Converted dimensionless data
0043-0044	2	Analog input AI3 current value	REAL4	Unit: mA
0045-0046	2	Analog input AI4 current value	REAL4	Unit: mA
0047-0048	2	Analog input AI5 current value	REAL4	Unit: mA
0049-0050	2	System setup password	BCD	Writable 00H represents to cancel password setup
0051	1	Hardware setup password	BCD	Writable “A55Ah” represents opening
0053-0055	3	Date and time of the instrument	BCD	Writable 6 byte BCD respectively represents second, minute, hour, date,

				month, year. Lower bit is in front.
0056	1	Automatically store data day,hour	BCD	Writable 2 byte represent scheduled storage data starting time and day,for example:0312H represent the storage data of the third day and the twelve O'clock each month.0012H represents storage data of the twelve O'clock each day.
0059	1	input key value(analogue keyboard)	INTEGER	Writable. Refer to manual key value list.
0060	1	make screen display x number Menu	INTEGER	Writable
0061	1	input backlit light time	INTEGER	Writable unit:second
0062	1	Buzzer' beeping times left	INTEGER	Writable The mostly 255 times
0062	1	OCT pulse number left	INTEGER	Writable The mostly 65536
0072	1	instrument work error code	BIT	16 bit respectively represents following meanings in remark 4
0077-0078	2	supply water resistor number	REAL4	Unit: ohm
0079-0080	2	return water resistance number	REAL4	Unit: ohm
0081-0082	2	total transfer time of ultrasonic	REAL4	Unit: ms
0183-0184	2	replenished flow by this power on	REAL4	Unit: m^3
0185-0186	2	frequency coefficient	REAL4	Lower than 0.1
0187-0188	2	total automatically store time	LONG	storage time is determined by register 0056
0189-0190	2	automatically store positive totalizer flow	REAL4	storage time is determined by register 0056
0191-0192	2	automatically store instant flow	REAL4	storage time is determined by register 0056
0221-0222	2	inside pipe diameter	REAL4	Unit: mm
0229-0230	2	upstream transfer delayed	REAL4	Unit: μs
0231-0232	2	downstream transfer delayed	REAL4	Unit: μs
0233-0234	2	estimated total transfer time	REAL4	Unit: μs
0257-0288	32	monitor buffer area	BCD	Readable
0289	1	monitor buffer area storage pointer	INTEGER	
0311	2	worked time of today	LONG	no character, unit: s
0313	2	worked time of this month	LONG	no character, unit: s
0315	2	today Max instant flow	INTEGER	Unit: m3/h
0317	2	this month Max instant flow	INTEGER	Unit: m3/h
1437	1	present instant flow measuring unit	INTEGER	Data range:0-31(remark 5)
1438	1	present totaliser flow measuring unit	INTEGER	Data range:0-7(remark 1)
1439	1	present totaliser flow multiplier factor	INTEGER	n: range 0-7， (remark 1)

1440	1	present totaliser heat quantity multiplier factor	INTEGER	n:range 0-10，(remark 1)
1441	1	present heat energy measuring unit	INTEGER	Range :0～3。0=GJ， 1=Kcal 2=KWh， 3=BTU
1442	1	instrument communication address number	INTEGER	
1491	1	instrument types	INTEGER	BIT0=0 represent flow meter BIT0=1 represent heat meter BIT3=1 represent heat meter installed on supply water pipe BIT3=0 represent heat meter installed on return water pipe
1451	2	user scaling factor	REAL4	
1521	2	factory scaling factor	REAL4	unmodifiable
1529	2	equipment electronic serial number	BCD	This equipment electronic serial number high bit is in front.

Remark:
(1) Inside total flow uses combined method by long integers and decimal. when using read long integers is ok without decimal part. Total flow size and total unit and multiplier factor have relations, assumed that long integers part of total flow is N (for positive total flow, it is the digit of register 0009,0010,32 bit with character long integers), decimal part of totalizer flow is Nf (for positive total flow, it is the digit of register 0011,0012,4 byte floating point), multiplier factor of total flow is n (register 1439), then positive total flow=(N+Nf) ×10n-3 (unit is confirmed in register 1438 of total flow unit)

In register 1438,the meaning of data 0-7 is as follows:

0 cubic meter (m3)
1 liter (L)
2 US gallon (GAL)
3 imperial gallon (IGL)
4 US Mega gallon (MGL)
5 cubic feet (CF)
6 US oil barrel [42](OB)
7 imperial oil barrel (IB)

Totalizer flow=(N+Nf)×10n-4

include： for net heat quantity, N is in the register of 0029，0030
for neat heat quantity, Nf is in the register of 0031，0032
n is confirmed in the register of 1440.
totalizer heat quantity unit is confirmed in the register of 1441.

(2) Not supply other variables,if you need, please consult our factory.

(3) Please note that some of data in above table are not valid for non heat meter, using flow meter solely, you can ignore the irrelevant term, these irrelevant terms are to unify our products' communication protocol, convenient for users to use.

(4) error code is 16 bit,the meaning is as follows:

Bit0 error of no receipt of signal
Bit1 error of lower signal
Bit2 error of poor signal
Bit3 error of empty pipe
Bit4 error of circuit hardware
Bit5 adjusting current gain
Bit6 over range error of frequency output
Bit7 error of the current that current loop output is over range(normally need to setup max range)
Bit8 verification error of inside data register

Bit9 master frequency or clock frequency exists error
Bit10 parameter block exists checksum error
Bit11 program memory data checksum error
Bit12 temperature measuring circuit possibly exists error
Bit13 reserved
Bit14 error of inside timer overflow
Bit15 analogue input circuit exists error

Attention:if used in flow meter, pls shield the bit related with heat quantity measurement before using these codes,because the status of the bit are not assured.

(5) instant flow unit code as follows:

0	m^3/s	**1**	$m^3/minute$	**2**	m^3/h	**3**	m^3/day
4	L /s	**5**	L /minute	**6**	L /h	**7**	L /day
8	GAL /s	**9**	GAL /minute	**10**	GAL /h	**11**	GAL /day
12	IGL /s	**13**	IGL /minute	**14**	IGL /h	**15**	IGL /day
16	MGL /s	**17**	MGL /minute	**18**	MGL /h	**19**	MGL /day
20	CF /s	**21**	CF /minute	**22**	CF /h	**23**	CF /day
24	OB /s	**25**	OB /minute	**26**	OB /h	**27**	OB /day
28	IB /s	**29**	IB /minute	**30**	IB /h	**31**	IB /day

1.3.2 year, month, day total data MODBUS address table

（1） day total data (the addresses are not the same as that of other version flow meter)

Each day total data adopts data block of 32 byte to store circulation, totally 512 data blocks, the pointer address of present data block is in register 0162, the data range : 0~511. Present pointer point to the data of “yesterday”, present pointer minus 1, it point to “the day before yesterday”.when the data pointer equal to 0, and minus 1, it point to data block 511.set the digit in register 0162 is 1, then, total data of yesterday is in register of 10257-10272, the data of the day before yesterday is in register of 10241-10256,the data of three days ago is in register of 18417-18432.

Attention: in Supervisory Control and Data Acquisition, need to add “4” before the variable reading of floating point etc. So as to fill register address in this kind of software, the register of 10241 should be “410241” Address table is as follows:

Data block number	Register address	Pieces of register	Name of variable	Data type	Description
n/a	162	1	day total data pointer	Integer	data range:0-127
0	10241	1	status byte and day	BCD	lower byte is status, higher byte is day
	10242	1	month and year	BCD	lower byte is month, higher byte is year
	10243-10244	2	total work time	LONG	used to check all day work time
	10245-10246	2	all day net total flow	REAL4	today total flow
	10247-10248	2	net total heat flow value	REAL4	23:59:59 totalizer value at the last second time
	10249-10250	2	positive totalizer value	LONG	23:59:59 totalizer value at the last second time
	10251-10252	2	negative totalizer value	LONG	totalizer value at the last second time

	10253-10254	2	heat quantity positive totalizer value	LONG	23:59:59 totalizer value at the last second time
	10255-10256	2	heat quantity negative totalizer value	LONG	23:59:59 totalizer value at the last second time
1	10257	1	status byte and day	BCD	lower byte is status,higher byte is day
	10258	1	month and year	BCD	lower byte is month,higher byte is year
	10259-10260	2	total work time	LONG	used to check all day work time
	10261-10262	2	all day net total flow	REAL4	today total flow
	10263-10264	2	net total heat flow value	REAL4	23:59:59 second time totalizer value
	10265-10266	2	positive totalizer value	LONG	23:59:59 second time totalizer value
	10267-10268	2	negative totalizer value	LONG	23:59:59 second time totalizer value
	10269-10270	2	heat quantity positive totalizer value	LONG	23:59:59 second time totalizer value
	10271-10272	2	heat quantity negative totalizer value	LONG	23:59:59 second time totalizer value
511	18417-18432	16			the data block of the number 511

Remark： 1. Status byte meaning refer to the introduction
2. If all the read data is OFFH,that means the register is empty.

(2) Month total data (the address are not the same with that of other version flow meter)
Structure of month total data is the same with day total data,pls refer to introduction of day total data.
Especially the data of date byte is always 0, has 128 data blocks.

Address table is as follows:

Data block number	Register address	Pieces of register	Name of variable	Data type	Description
n/a	163	1	month total data pointer	Integer	data range:0-127
0	8193	1	status byte	BCD	lower byte is status,higher byte is 0
	8194	1	month and year	BCD	lower byte is month, higher byte is year
	8195-8196	2	total work time	LONG	used to check all month work time
	8197-8198	2	all month net total flow	REAL4	this month total flow
	8199-8200	2	net total heat flow value	REAL4	Totalizer value at the last second time of this month
	8201-8202	2	positive totalizer value	LONG	Totalizer value at the last second time of this month
	8203-8204	2	negative totalizer value	LONG	Totalizer value at the last second time of this month

	8205-8206	2	heat quantity positive totalizer value	LONG	Totalizer value at the last second time of this month
	8207-8208	2	heat quantity negative totalizer value	LONG	Totalizer value at the last second time of this month
1	8209	1	status byte	BCD	lower byte is status
	8210	1	month and year	BCD	lower byte is month,higher byte is year
	8211-8212	2	total work time	LONG	used to check all month work time
	8213-8214	2	all month net total flow	REAL4	this month total flow
	8215-8216	2	net total heat flow value	REAL4	Totalizer value at the last second time of this month
	8217-8218	2	positive totalizer value	LONG	Totalizer value at the last second time of this month
	8219-8220	2	negative totalizer value	LONG	Totalizer value at the last second time of this month
	8221-8222	2	heat quantity positive totalizer value	LONG	Totalizer value at the last second time of this month
	8223-8224	2	heat quantity negative totalizer value	LONG	Totalizer value at the last second time of this month
127	10225-10240	16			the data block of the number 127

Remark： 1. Status byte meaning refer to the introduction
2. If all the read data is OFFH,that means the register is empty.
3. Year total data are exported from month total data.

1.3.3 power on/off data MODBUS address table

When power off, flow meter can record the time of power off and work status of flow meter at that time and all totalizators value, each data block is comprised of 128 byte, totally has 32 pieces data block, circling record last 32 times power off. System utilizes these data to restore the flow meter to the work status before power off, users can check by using these data.

Store the data of power on/off by using queue ring structure, note that the present position of data are related with pointer, and the difference compared to day, month, year total data is that the pointer minus 1 can point to the data of power on/off,refer to day totalizer introduction part, the address table of MODBUS of power on/off data is as follows: (the address is not the same with that of other vision flow meter)

Data block number	Register address	Pieces of register	Name of variable	Data type	Description
n/a	164	1	power on/off data pointer	Integer	data range 0-31
0	6145	1	second and minute of power on	BCD	lower byte is second,higher byte is minute
	6146	1	hour and day of	BCD	lower byte is hour,higher byte

			power on		is day
	6147	1	month and year of power on	BCD	lower byte is month,higher byte is year
	6148	1	status word of power on	BIT	B13 symbol has been replenished,other bits refer to introduction of status word
	6149	1	second and minute of power off	BCD	lower byte is second,higher byte is minute
	6150	1	hour and day of power off	BCD	lower byte is hour,higher byte is day
	6151	1	month and year of power off	BCD	lower byte is month,higher byte is year
	6152	1	status word of power off	BIT	refer to introduction of status word
	6153	1	present Menu window code	Integer	lower byte is main Menu windows when power off,higher byte is LCD Menu list code
	6154	1	times of power on	Integer	
	6155-6156	2	flow meter total work times	LONG	
	6157-6158	2	positive total flow	LONG	
	6159-6160	2	positive total flow decimal	REAL4	
	6161-6162	2	negative total flow value	LONG	
	6163-6164	2	negative total flow decimal	REAL4	
	6165-6166	2	heat quantity positive total	LONG	
	6167-6168	2	heat quantity positive total decimal	REAL4	
	6169-6170	2	heat quantity negative total value	LONG	
	6171-6172	2	heat quantity negative total decimal	REAL4	
	6173-6174	2	net total flow	LONG	
	6175-6176	2	net total flow decimal	REAL4	
	6177-6178	2	heat quantity net total	LONG	
	6179-6180	2	heat quantity net	REAL4	

			total decimal		
	6181-6182	2	day total flow	LONG	
	6183-6184	2	day total flow decimal	REAL4	
	6185-6186	2	month total flow	LONG	
	6187-6188	2	month total flow decimal	REAL4	
	6189-6190	2	year total flow	LONG	
	6191-6192	2	year total flow decimal	REAL4	
	6193-6194	2	instant flow when power off	REAL4	
	6195-6196	2	operating time with troubles	LONG	
	6197-6198	2	day total work time	LONG	
	6199-6200	2	month total work time	LONG	
	6201-6202	2	M47 password	BCD	
	6203-6204	2	the time length of power off period	LONG	
	6205-6206	2	instant flow at the time of last power on	REAL4	
	6207-6208	2	to be replenished total flow because of last power off	REAL4	

Questions and answers about communication

（1） Question: Why can't I connect to the flow meter? no response after connecting?

Answer:

1. Check whether the serial port parameters are matching,whether choose the right protocol in M63.
2. Check physical wiring.
3. Power on again, there should be a character “AT”,otherwise, there is problem in 1 and 2 procedure above.
4. Check the command is correct. When using extending protocol, <ENT> character should be after the command.
5. Check whether the setup of address in M46 is right or not.

（2） Question: The reading datas of MODBUS is like a mess that is not in accordance with displaying datas.

Answer：

Normally if MODBUS protocol can read datas, that means there is no problem for the protocol, the datas in a mess is because of follow existing errors.

1. Data format is wrong；B. Register address is wrong, that results in data shifting to create errors.
   For example: REAL4 －this real (float floating point numbers of IEEE754 format), there are 4 different alignments according to word and byte, the kind used in the BE6300 is the most common, ie low word and high byte format. You can modify data store format of your software to solve this problem. If use common used Supervisory Control and Data Acquisition, it has a method of choosing format.

（3） Question: My system require sending one command per hour receive many variables at same time,which protocol should be used?

Answer：

One MODBUS command can read lots of variables one time. If MODBUS-RTU can not solve this problem, use BE6300 extending protocol connected by joint mark of “&”, or use simple compatible protocol or Meter-Bus protocol.

（4） Question: Reading measurement value by protocol is not in accordance with the displaying value on flow meter?

Answer：

1. Confirm the variable address is the variable that you want or not? There are too many variables inside flow meter, whether confused or not? When reading datas, REG 0001 represent 0000 in order character string, not 0001.0001 represent the content of reading REG 0002 in command character string.
2. For totalizer value, it only display 7 binary decimal digits, by MODBUS protocol, it can read 8 binary decimal digits. So the last 7 binary are the same.

（5） Question: My system can not support long integers and real format, what should I do?

Answer:

Need to adopt data conversion mode, or look for new drivers to solve.

（6） Question: If the flow meter has simulated operating status to test conveniently,how to setup?

Answer:

has!input “0” in M11 to start simulated operating status. Under this status,setup flow velocity to be 1.2345678m/s,instant flow rate is 0,and display “R” status. If there is requirement for the flow rate to be set value,then input a minus set value in M44.for example:input -3600m³/s,the instant flow rate will display 3600 m³/s.at this time,all the totalizers will accumulate correspondingly. Thus obtain variable totalizer output.

Using this function,without connecting the transducers,conveniently to adjust with networking software and test the function of the flow meter.

（7） question: when using C, how about the floating point storage sequence?

Answer:
For example: 3F 9E 06 51 four byte is IEEE754 format float floating point of 1.2345678.the sequence of MODBUS data flow is 06 51 3F 9E， No. 1 address data flow should be 01 03 04 06 51 3F 9E 3B 32 (**hexadecimal digits) ,using C language in X86 computer,storage sequence from low to high according to internal storage is** 51 06 9E 3F.

For example: read two register command of REG25,REG26 of net totaliser as follows:

01 03 00 18 00 02 44 0C (**hexadecimal digits). return data should be (set net totaliser=802609,its 4 byte hexadecimal digits is 00 0C 3F 31)** 01 03 04 3F 31 00 0C A7 ED(**hexadecimal digits,A7 ED is checksum)**