Serial port and communication protocol

§1.1 outline

The new CAM-3000 series products have built-in isolated RS485 interface,support many communication protocol at same time,including MODBUS protocol,M-BUS protocol,FUJI extending protocol,compatible with HUIZHONG company products communication protocol.

MODBUS protocol is regular factory control protocol,our meters support the two formats of MODBUS:RTU AND ASCII.

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

Hipeak 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.

Compatible protocol is compatible with hipeak water meter protocol and HUIZHONG company products communication protocol,in order to make users conveniently connect CAM-3000 series products to developed data collecting system by users according to other national manufacturers communication protocol,our products can support 12 kinds of compatible communication protocol.if using compatible communication protocol,users need to choose “MODBUS ASCII”in M63,and then choose any protocol listed.

CAM-3000 series products can act as the fuction of simple RTU equipment,using current loop and OCT output to control marching type or analogue electromagnetic valve opening,OCT output can control power on/off of other devices,its 1 channel analogue 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,hipeak 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 baud or 2 baud.check bit is optional.

Using self-equiped standard MODBUS drivers of differents Supervisory Control and Data Acquisition can conveniently connect CAM-3000 to data acquisition.by using MODBUS-PROFIBUS converter,it can conveniently connect CAM-3000 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 multimachine 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 CAM-3000 flow meters,has advantages of cost-effective,simple and quick,reliable operation,etc.

There are many third party manufacturers who have data collecting software that support specially CAM-3000 series flow meters for users to use,some small softwares are free for users to network.to conveniently adjust communication,the new version of CAM-3000 designed a simulated operating status,so to simulated work to adjust without connecting flow meter with pipe.

§1.2 questions and answers about communication

（1） question:why it is unavailable to connect flow meter?no any respondence after connecting?

answer：A. check whether the serial port parameters are matching,whether choose the right protocol in M63.

B. whether phisical wiring is good or not.

C. power on again,there should be a character “AT”,otherwise,there is problem in A and B procedure.

D. check the command is correct or not.when using extending protocol,<ENT> character should be after the command.

E: 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.

A. data format is wrong；

B. Register address is wrong ,that results in datas 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 TDS100 is the most regular,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 hipeak 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：A.。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.

B．。For totaliser 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:does MODBUS have testing program?

Answer:has!recommand to use MODSCAN software,search it on the internet.the program is convenient,helpful to check reading datas,understand the meaning of all kinds of datas.

（7） 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 totalisers will accumulate correspondingly.thus obtain variable totaliser output.using this function,without connecting the transducers,conveniently to adjust with networking software and test the function of the flow meter.

（8） 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)**

§1.3 MODBUS protocol

It can support the two formats of MODBUS.to choose MODBUS-RTU format or MODBUS-ASCII format in M63.default format is MODBUS-ASCII.

CAM-3000 series ultrasonic flow meter/heat meter can only support three fuction codes of MODBUS:03,06,16.respective fuction 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,pls 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.

§1.3.1 MODBUS register address table

（note the difference with water meter protocol）

register	Numbers of register	Variable name	Data type	discription
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 totaliser flow	LONG	all the flow totalisers that use long integers,its measure is controlled by M32(REG1438)
0011-0012	2	positive totaliser 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 totaliser flow	LONG	Long integers is lower digit in front and with character
0015-0016	2	Negative totaliser flow decimal part	REAL4	

0017-0018	2	positive totaliser heat quantity	LONG	all the heat quantity totalisers that use long integers,its measure is controlled by M84(REG1441)
0019-0020	2	positive totaliser heat quantity decimal part	REAL4	
0021-0022	2	negative totaliser heat quantity	LONG	
0023-0024	2	negative totaliser heat quantity decimal part	REAL4	
0025-0026	2	net totaliser flow	LONG	
0027-0028	2	net totaliser decimal part	REAL4	
0029-0030	2	net totaliser heat quantity	LONG	
0031-0032	2	net totaliser 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	analogue input AI3 value	REAL4	converted dimensionless data
0039-0040	2	Analogue input AI4 value	REAL4	converted dimensionless data
0041-0042	2	Analogue input AI5 value	REAL4	converted dimensionless data
0043-0044	2	Analogue input AI3 current value	REAL4	unit：mA
0045-0046	2	Analogue input AI4 current value	REAL4	unit：mA
0047-0048	2	Analogue 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 openning
0053-0055	3	date and time of the instrument	BCD	writable。6 byte BCD respectively represent second ,minute,hour,date,month,year,lower bit is in front.
0056	1	automaticaly store data day,hour	BCD	writable 。2 byte represent scheduled storage data starting time and day,for example:0312H represent the storage datas of the third day and the twelve O’clock each month.0012H represents storage datas of the twelve O’clock each day.
0059	1	input key value(analogue	INTEGER	writable.refer to manual key value

		keyboard)		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 resistor number	REAL4	unit:ohm
0081-0082	2	total transfer time of ultrasonic	REAL4	Unit:ms
0083-0084	2	ultrasonic transfer time difference	REAL4	Unit:ns
0085-0086	2	ultrasonic upstream trasfer time	REAL4	Unit:ms
0087-0088	2	ultrasonic downstream transfer time	REAL4	Unit:ms
0089-0090	2	present current loop output current value	REAL4	unit:mA
0092	1	Work procedure and signal quality	INTEGER	high byte represents signal adjustment step,low byte represents signal quality,data range:0-9,high data represent good signal
0093	1	upstream signal strenghth	INTEGER	Data range:0-4095
0094	1	downstream signal strenghth	INTEGER	Data range:0-4095
0096	1	operating interface language type	INTEGER	0 represent Chinese，1 represent English
0097-0098	2	ultrasonic signal transit ratio	REAL4	Normal range:100+-3%
0099-0100	2	present reynolds number	REAL4	
0101-0102	2	present reynolds correction coefficient	REAL4	
0103-0104	2	work timer time	LONG	no character,unit:s
0105-0106	2	total work time	LONG	no character,unit:s
0105-0106	2	total power on times	LONG	no character
0113-0114	2	net totaliser flow(floating point format)	REAL4	unit:m^3,7 significance digit
0115-0116	2	Positive totaliser flow(floating point format)	REAL4	unit:m^3,7 significance digit

0117-0118	2	negative totaliser flow(floating point format)	REAL4	unit:m³,7 significance digit
0119-0120	2	net totaliser heat quantity(floating point format)	REAL4	Unit:GJ，7 significance digit
0121-0122	2	positive totaliser heat quantity(floating point format)	REAL4	Unit:GJ，7 significance digit
0123-0124	2	negative totaliser heat quantity(floating point format)	REAL4	Unit:GJ，7 significance digit
0125-0126	2	today total flow(floating point format)	REAL4	unit:m³，7 significance digit
0127-0128	2	this month total flow(floating point format)	REAL4	unit:m³，7 significance digit
0129-0130	2	manual total flow	LONG	
0131-0132	2	manual totaliser decimal part	REAL4	
0133-0134	2	batch controller total flow	LONG	
0135-0136	2	batch controller decimal part	REAL4	
0137-0138	2	today total flow	LONG	
0139-0140	2	today total flow decimal part	REAL4	
0141-0142	2	this month total flow	LONG	
0143-0144	2	this month total flow decimal part	REAL4	
0145-0146	2	this year total flow	LONG	
0147-0148	2	this year total flow decimal part	REAL4	
0158	1	display present Menu	INTEGER	
0165-0166	2	running time with trouble	LONG	Unit:s
0173-0174	2	present frequency output value	REAL4	unit：Hz
0175-0176	2	present current loop output value	REAL4	unit：mA
0181-0182	2	Present temperature difference	REAL4	unit：℃
0183-0184	2	replenished flow by this power on	REAL4	unit:m³
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 totaliser 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 used 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 totaliser 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) $\times 10^{n-3}$(unit is comfirmed in register 1438 of total flow unit)

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

0 cubic meter (m3)
1 litre (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)

Totaliser flow=(N+Nf)$\times 10^{n-4}$

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.
totaliser heat quantity unit is confirmed in the register of 1441.

（2）not supply other variables,if you need,pls consult our factory.

（3）Pls note that lots of datas 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(normaly 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 datas(the address are not the same with that of other vision flow meter)（注意与其它版本流量计的地址是不同的）

Each day tatal 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 datas 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	introduction
n/a	0162	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 totaliser value at the last second time
	10249-10250	2	positive totaliser value	LONG	23:59:59 totaliser value at the last second time
	10251-10252	2	negative totaliser value	LONG	totaliser value at the last second time
	10253-10254	2	heat quantity	LONG	23:59:59 totaliser value at the

			positive totaliser value		last second time
	10255-10256	2	heat quantity negative totaliser value	LONG	23:59:59 totaliser 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	23:59:59second time totaliser value
	10265-10266	2	positive totaliser value	LONG	23:59:59second time totaliser value
	10267-10268	2	negative totaliser value	LONG	23:59:59second time totaliser value
	10269-10270	2	heat quantity positive totaliser value	LONG	23:59:59second time totaliser value
	10271-10272	2	heat quantity negative totaliser value	LONG	23:59:59second time totaliser 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 vision 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	introduction
n/a	0163	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	totaliser value at the last second time of this month
	8201-8202	2	positive totaliser value	LONG	totaliser value at the last second time of this month
	8203-8204	2	negative totaliser value	LONG	totaliser value at the last second time of this month
	8205-8206	2	heat quantity positive totaliser value	LONG	totaliser value at the last second time of this month
	8207-8208	2	heat quantity negative totaliser value	LONG	totaliser 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	totaliser value at the last second time of this month
	8217-8218	2	positive totaliser value	LONG	totaliser value at the last second time of this month
	8219-8220	2	negative totaliser value	LONG	totaliser value at the last second time of this month
	8221-8222	2	heat quantity positive totaliser value	LONG	totaliser value at the last second time of this month
	8223-8224	2	heat quantity negative totaliser value	LONG	totaliser 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 datas are exported from month total datas.

§1.3.3 power on/off data MODBUS address table

When power off,TDS16 flow meter can record the time of power off and work status of flow meter at that time and all totalisers value,each data block is comprised of 128 byte,totally has 32 pieces data block,circling record last 32 times power off.system utilize these datas to restore the flow meter to the work status before power off,users can check by using these datas.

Store the datas of power on/off by using queue ring structure,note that the present position of datas are related with pointer,and the difference compared to day,month,year total datas is that the pointer minus 1 can point to the datas of power on/off,refer to day totaliser instroduction part,the address table of MODBUS of power on/off datas 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	introduction
n/a	0164	1	power on/off data pointer	Integer	data range0-31
0	6145	1	second and minute of power on	BCD	lower byte is second,higher byte is minute
	6146	1	hour and day of power on	BCD	lower byte is hour,higher byte 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	Unit: second
	6157-6158	2	positive total flow	LONG	Unit is determined in M32,M33
	6159-6160	2	positive total flow decimal	REAL4	Unit is determined in M32,M33
	6161-6162	2	negative total flow value	LONG	Unit is determined in M32,M33

	6163-6164	2	negative total flow decimal	REAL4	Unit is determined in M32,M33
	6165-6166	2	heat quantity positive total	LONG	Unit is determined in M32,M33
	6167-6168	2	heat quantity positive total decimal	REAL4	Unit is determined in M32,M33
	6169-6170	2	heat quantity negative total value	LONG	Unit is determined in M32,M33
	6171-6172	2	heat quantity negative total decimal	REAL4	Unit is determined in M32,M33
	6173-6174	2	net total flow	LONG	Unit is determined in M32,M33
	6175-6176	2	net total flow decimal	REAL4	Unit is determined in M32,M33
	6177-6178	2	heat quantity net total	LONG	Unit is determined in M32,M33
	6179-6180	2	heat quantity net total decimal	REAL4	Unit is determined in M32,M33
	6181-6182	2	day total flow	LONG	Unit is determined in M32,M33
	6183-6184	2	day total flow decimal	REAL4	Unit is determined in M32,M33
	6185-6186	2	month total flow	LONG	Unit is determined in M32,M33
	6187-6188	2	month total flow decimal	REAL4	Unit is determined in M32,M33
	6189-6190	2	year total flow	LONG	Unit is determined in M32,M33
	6191-6192	2	year total flow decimal	REAL4	Unit is determined in M32,M33
	6193-6194	2	instant flow when power off	REAL4	unit: m^3/s
	6195-6196	2	operating time with troubles	LONG	Unit:s
	6197-6198	2	day total work time	LONG	Unit:s
	6199-6200	2	month total work time	LONG	Unit:s
	6201-6202	2	M47 password	BCD	
	6203-6204	2	the time length of power off period	LONG	Unit:s
	6205-6206	2	instant flow at the time of last power on	REAL4	unit: m^3/s
	6207-6208	2	to be replenished total flow because of last power off	REAL4	unit: m^3
1	6209-6272	64			the second data block

2	6273-7336	64			the third data block
○○○○	○○○○○○○○○○	○○○○○○		○○○○○○	○○○○○○○○○○○○○○○○○○
31	8129-8192	64			the thirty-second data block

§1.4 hipeak FUJI extending communication protocol

CAM-3000 new version ultrasonic flow meter can also use hipeak series the seventh version TDS7—FUJI extending protocol.in following table,the red command is new added protocol.in this protocol,the transferred datas are ASCII codes to check and debug.

Applied in the system that sending one command but need many datas,use the character of '&' to connect many basic command together to form one compound command to send one time.refer to the introduction of the character of '&' in the following part.

command	Meaning of the command	Data format
DQD(cr) remark 0	return instant flow per day	±d.dddddE±dd(cr) remark 1
DQH(cr)	return instant flow per hour	±d.dddddE±dd(cr)
DQM(cr)	return instant flow per minute	±d.dddddE±dd(cr)
DQS(cr)	return instant flow per second	±d.dddddE±dd(cr)
DV(cr)	return instant fluid velocity	±d.dddddE±dd(cr)
DI+(cr)	return positive total flow	±ddddddE±d(cr)remark 2
DI-(cr)	return negative total flow	±ddddddE±d(cr)
DIN(cr)	return net total flow	±ddddddE±d(cr)
DIE(cr)	return heat quantity total flow	±ddddddE±d(cr)
DIE+(cr)	return positive heat quantity total flow	±ddddddE±d(cr)
DIE-(cr)	return negative heat quantity total flow	±ddddddE±d(cr)
DIT(cr)	return today net total flow	±ddddddE±d(cr)
DIM(cr)	return this month net total flow	±ddddddE±d(cr)
DIY(cr)	return this year net total flow	±ddddddE±d(cr)
DID(cr)	〉return instrument ID code(address code)	ddddd(cr) 5 bits
E(cr)	return instant heat flow per second	±d.dddddE±dd(cr)
DL(cr)	return signal strength	UP:dd.d,DN:dd.d,Q=dd(cr)
DS(cr)	return percentage data of analogue output AO	±d.dddddE±dd(cr)
DC(cr)	return present error code	Remark 3
DA(cr)	OCT or RELAY alarm	TR:s,RL:s(cr)remark 4
DT(cr)	present date and time	yy-mm-dd,hh:mm:ss(cr)
Time@TDS1=(cr)	Set date and time yy-mm-dd,hh:mm:ss	
M@(cr)	Send to CAM-3000 analogue key assignments	M@(cr)remark 5
LCD(cr)	return present displaying content of LCD monitor	
LOCK0(cr)	unlock(new added command)	unrelated with original password
LOCK1(cr)	〉lock(new added command)	

MENUXX(cr)	display directly skip to Menu XX	
LANGUAGEX(cr)	choose interface language	X=0 English, 1 simple chinese 2 italy, if available 3 korea, if available 4 franch，if available 5 german，if available 6 spanish，if available
BAUDRATEX(cr)	Change baud rate（data bit＝8，no verification，stop bit＝1）	X=0~7, corresponding to 19200, 14400, 9600,4800,2400,1200,600,300
C1(cr)	OCT actuation	
C0(cr)	OCT disconnect	
R1(cr)	RELAY actuation	
R0(cr)	RELAY disconnect	
FOdddd(cr)	make frequency output to output by n value	Fdddd(cr)(lf)
Aoa(cr)	make current loop output the current value a	AOa(cr)(lf)remark 6
BA1(cr)	return the resistor value of temperature T1	±d.dddddE±dd(cr)(lf)
BA2(cr)	return the resistor value of temperature T2	±d.dddddE±dd(cr)(lf)
BA3(cr)	return current value of AI3 （0~20mA）	±d.dddddE±dd(cr)(lf)
BA4(cr)	return current value of AI4（0~20mA）	±d.dddddE±dd(cr)(lf)
BA5(cr)	return current value of AI5（0~20mA）	±d.dddddE±dd(cr)(lf)
AI1(cr)	return T1 value of temperature input(temperature)	±d.dddddE±dd(cr)(lf)
AI2(cr)	return T2 value of temperature input(temperature)	±d.dddddE±dd(cr)(lf)
AI3(cr)	return AI3 value of analogue input(temperature,pressure,etc)	±d.dddddE±dd(cr)(lf)
AI4(cr)	return AI4 value of analogue input(temperature,pressure,etc)	±d.dddddE±dd(cr)(lf)
AI5(cr)	return AI5 value of analogue input(temperature,pressure,etc)	±d.dddddE±dd(cr)(lf)
ESN(cr)	return ESN	ddddddt(cr)(lf)remark 7
UINFO=user data(cr)	input the command of displaying user display information in [M][0][.],behind with 40 byte user data	The user display Menu content will keep unchanged until power off.
N	single byte address networking command prefix	Remark 8
W	numeric string address networking command prefix	Remark 8

P	with verification feedback command prefix	
&	use the character of '&' to connect many basic commands together to form one compound command to send one time	added length of characters are not over 253 bytes.
RING(cr)(lf)	modem ask handshake command	ATA(CR)(lf)
OK(cr)	modem answer signal	No output，
	flow meter ask handshake signal	AT(CR)(LF)
GA(cr)	GSM short message communication special command A	Remark 9
GB(cr)	GSM short message communication special command B	Remark 9
GC(cr)	GSM short message communication special command C	Remark 9

remark：

0.（cr）represents carriage return，the ASCII code is 0DH。(lf) represent newline，the ASCII code is 0AH。

1．d represent digits of 0~9，0 means +0.000000E+00

2．d represent digits of 0~9, ddddddd is integer ，the integer without decimal point before "E"。

3．Characters of 1~6 means instrument status，meaning of the characters refer to error codes,for example "R"，"IH"

4．s means one of ON/OFF/UD

For example:"TR:ON,RL:ON"represent OCT and RELAY are in actuation status

For example:"TR:UD,RL:UD" represent OCT and RELAY are not used.

5．@ represents key assignments,for example :30H represent "0"key，the command : "M4" correspond to "4" key.

6．a represent current value, range :0~20，for example:AO2.34567, AO0.2

7． dddddddd (eight byte)represent instrument ESN，t represent instrument type

8． If there are many new version CAM-3000 flow meters in data network,the basic commands can not be used alone,you must add N or W prefix firstly,otherwise result in answering by many flow meters at same time,confuse the system.

9. Use GSM module to connect flowmeter,so can have the fuction of using mobile phone short message to check the flow parameters of the flow meter

§1.4.1 function prefix and function character

（1） P prefix

Add character P in front of every basic command,that represents returned datas have CRC verification.checksum is obtained by binary system addition.

for example：command DI+（CR）（corresponding binary system data is 44H,49H,2BH,0DH）returned data is +1234567E+0m3 （CR）(corresponding binary system data is 2BH,31H,32H,33H,34H,35H, 36H,37H,45H,2BH,30H,6DH,33H,20H,0DH,0AH),then command PDI+(CR) returned data is +1234567E+0m3 !F7(CR), "!"represent it is summation character before it,and two byte checksum behind it ,(2BH+31H+32H+33H+34H+35H+ 36H+37H+45H+2BH+30H+6DH+33H+20H=(2)F7H)

There could be no datas before "!",possibly exist blank space character also.

（2） N prefix

The method of N command is N + single byte address code + basic command。

For example:to visit the instant fluid velocity of flow meter No.88, send command 'NXDV'(CR), decimal system code value of X is 88。Recommend users to use W command。

（3） W prefix

The method of W prefix is W+numeric string address code +basic command，numeric string data range: 0~65535 exclude 13（0DH carriage return），10（0AH newline），42（2AH *），38（26H&）。:to visit the instant fluid velocity of flow meter No.12345，send command W12345DV(CR), corresponding binary system code is 57H,31H,32H,33H,34H,35H,44H,56H,0DH。

（4） '&' function character

The function of '&' can achieve to add together many basic commands,only ensure that the formed total character after all basic commands added is not over 250 characters.the formed super command can be sent to flow meter one time,the flow meter answers at same time.

(5) P prefix, P could be added in front of basic commands。

For example:require to return at the same time the No 4321 flow meter's 1. instant flow 2. instant fluid velocity 3. positive total flow 4. heat quantity total flow 5. AI1 analogue input current value 6. AI2 analogue input current value,with verification,send the commands as follows:

W4321PDQD&PDV&PDI+&PDIE&PBA1&PAI2(CR)

returned data at the same one time is possibly as follows:

+0.000000E+00m3/d!AC(CR)

+0.000000E+00m/s!88(CR)

+1234567E+0m3 !F7(CR)

+0.000000E+0GJ!DA(CR)

+7.838879E+00mA!59

+3.911033E+01!8E(CR)

for example，require to modify the outside pipe diameter to be 123.456mm through serial port,then return monitor content,send commands as follows:

MENU11&M1&M2&M3&M:&M4&M5&M6&M=&LCD（CR）

§1.5 compatible communication protocol

Compatible communication protocol is easy to use for users to connect CAM-3000 with developed data acquisition system according to HUIZHONG communication protocol.new developed project do not need to use these protocols,because we will invent new meters that could not support these protocols.

New CAM-3000 can support 8 kinds of Huizhong communication protocol now.

In order to use Huizhong communication protocol,users need to choose "MODBUS ASCII" in M63,then choose one of followings.

0. CRL-G ；LL＝113 byte
1. SCL-61D (D<50mm) ；LL=13 byte， cumulant decreased 1000 times
2. SCL-61D (D≧50mm) ；LL=13 byte， cumulant decreased 10 times，（default options）
3. SCL-6
4. SCL-7x(D<50mm) ；LL=13 byte, cumulant decreased 10 times
5. SCL-7x (D≧50mm) ；LL=13 byte, cumulant decreased 10 times

6. CRL-G-DL (D<50mm) ； LL=13 byte, cumulant decreased 1000 times
7. CRL-G-DL(D≧50mm) ； LL=13 byte, cumulant decreased 10 times
8. CRL-H ； LL=33 byte, cumulant decreased 1000 times
9. CRL-HL ； LL=33 byte, with negative total heat quantity， cumulant decreased 1000 times
10. CRL-G-D (D<50mm) ； LL=33 byte, cumulant decreased 1000 times
11. CRL-G-D (D≧50mm) ； LL=33 byte, cumulant decreased 10 times
12. SCL-61DT (D<50mm) ； with temperature LL=17 byte， cumulant decreased 1000 times
13. SCL-61DT (D≧50mm) ； with temperature LL=17 byte, cumulant decreased 10 times
14. SCL-71x(D<50mm) ； LL=13 byte, cumulant decreased 10 times
15. SCL-73x (D≧50mm) ； LL=13 byte,cumulant do not decrease or increase

D represents pipe diameter in above protocol

Recommend to use MODBUS for new developed project.

Other detailed information refer to Huizhong information.the following is the introduction of SCL-61D(D≧50mm),the battery powered water meter manufactured by us is only compatible with this protocol,so new version flow meter take this protocol as default options.

§1.5.1 SCL-61D(D≧50mm) compatible protocol

interface：RS485

baud rate： default :9600， to choose 8 kinds of velocity in M62

check bit：（NONE）,（EVEN）,（ODD）

data bit：8

stop bit：1，2

Introduction in the followings:XXh represents present meter communication address(network address),data range: 00h-FFh。YYh represents new meter's communication address,data range: 00h-FFh.ZZh is checksum,is byte cumulative sum of all the data bytes(attention:it is binary system cumulative sum,not include control and command byte),not count carry bit part that is over FFh.h represents the data is **Hexadecimal**

command format

（1）read water meter data（4A command）

mainframe command： 2Ah XXh 4Ah meter answer: 26h XXh 4Ah LL（BCD code） ZZh

contents of LL（BCD code）are as follows:

position	content	byte number	introduction
1~4	instant flow	4	decrease 1000 times to actual data，unit:m3/h
5~8	positive total flow	4	decrease 10 times to actual data ，unit:m3
9~12	total operating time	4	Unit:hour
13	diagnose information code	1	refer to diagnosis information table

（2）read scheduled time storage data（49 command）

mainframe command： 2Ah XXh 49h meter answer: 26h XXh 49h LL（BCD 码） ZZh

This command can read datas of water meter like (1)4A,the only difference is that the read datas of this

command is the datas of last scheduled time storage,but the read datas of (1)4A is present datas of water meter.

（3）change communication address（4B command）

mainframe command： 2Ah XXh 4Bh YYh meter answer: 26h XXh 4Bh YYh

if choose that XXh=YYh，this command can cycling check whether the communication line is normal or not,scan the meter numbers in network,realize network autolayout.

Attention:normally,need to confirm wether the mainframe setup the right communication address.if no checking,in high bit error rate network,be cautious to use this 4B command,because if the mainframe send YYh that occurs error,then will “loose”lower computer,or make two meters have the same communication number that occurs confliction.

（4）change(setup) scheduled time data memory time(4C command)

mainframe command： 2Ah XXh 4Ch DDh HHh

meter answer： 26h XXh 4Ch DDh HHh MMh ZZh

DDh represents some day，HHh represents some hour， MM represents some minute，BCD code format

Get the data of DD as a day of some month,for example: 2Ah 86h 4Ch 12h 15h means the number of 86 meter memorize(store)present instant flow,total flow,work time and status code at 15 O’clock,12/each month,the stored datas can be read out by using 49 command.

If DD=0,that means to memorize(store) at HHh O’clock everyday.

（5）broadcasting timing（4D command）

mainframe command： 2Ah AAh 4Dh ssmmhhDDMMYY meter do not answer

ssmmhhDDMMYY represent time,date datas in BCD code format,respectively is second,minute,hour,day,month,year.

Diagnosis information code : 00h represents work normally

02h represents pipe empty error or work abnormally.

05h represents data storage error,hardware trouble,need to repair.

（6）extensional read water meter command（50 command）

mainframe command： 2Ah XXh 50h （*xxP） meter answer: 26h XXh 50h LL（BCD code） ZZh

contents of LL（BCD code） as follows:

position	content	byte numbers	introduction
1~4	instant fluid velocity	4	compact BCD code，decrease 1000 times to be actual data ,unit: m/h
5~8	instant flow	4	compact BCD code，decrease 1000 times to be actual data ， unit:m3/h
9~12	positive total flow	4	data part that compact BCD code represents，unit:m3
13~16	negative total flow	4	data part that compact BCD code represents ， unit:m3
17	total flow product coefficient value	1	Data range:N=0~6 0，1，2，3，4，5，6 respectively correspond to the unit: 1, 0.1, 0.01, 0.001, 0.0001, 0.00001, 0.000001 m3
18~21	total operating time	4	compact BCD code，unit:hour
22	diagnosis information code	1	refer to diagnosis information table

for example: 9~12 byte data is 12h，34h，56h，78h，but the 17 byte digit =2，actual positive total flow value is 12345678 X 0.01 =123456.78 m^3

for example:received character string is 26H，01H，50H，00H，00H，00H，90H，00H，00H，00H，65H，78H，56H，34H，12H，12H，34H，56H，80H，03H，00H，00H，12H，34H，00H，zz
then represented water meter value is as follows:

instant flow velocity=00000.090 m/s

instant flow rate=00000.065 m3/h

positive total flow=78563412x10-^{3}=78563.412 m3

negative total flow=12345680x10-^{3}=12345.680 m3

total work time=00001234 hour

water meter work status=00 represents it is normal。

attention:the users who need to replace,upgrade,pls notice following points:

（1）New version CAM-3000 series products emphasize that uesers can program and change,so in the protocol,there is no stable baud rate and check bit defination,users need to check by yourself,adopt suitable baud rate.

（2）。When New version CAM-3000 series ultrasonic flow meter communicating,little requirement for time,collect datas at any time.no special requirement for the interval time of collecting data.

（3） the default baud rate of new version CAM-3000 series ultrasonic flow meter before leaving factory is 9600,no check bit.if need to replace similar meters,require to change serial port parameter.users can require the factory to setup before leaving the factory when placing an order.users can change them by yourself.

（4）**You can check and visit the Communication address (communication number) of New version CAM-3000 series ultrasonic flow meter in M46,modify them by keys also.the address code is set to be 01 before leaving factory,users can modify to suitable address.**

1.6 M-BUS protocol

（1）outline

Version CAM-3000 2.00

Communication protocol of New version CAM-3000 battery powered lower consumption series ultrasonic flow meter/heat meter uses M-BUS communication protocol format,a new European Standard,suitable to all meters networking,refer detailed information to www.m-bus.com. M-BUS module adopt twisted pair that can transfer datas and supply power to meters that are all connected with bus and can be different types meters.

Each new version CAM-3000 battery powered lower consumption series ultrasonic flow meter/heat meter is equiped with software part of M-BUS protocol before leaving factory.but users have to order the hardware module part of M-BUS solely.

In most application conditions,the software part of M-BUS is completely used in RS232 bus and RS485 bus.

（2）M-BUS features

about hardware part

about software part

（3）interface

new version CAM-3000 battery powered lower consumption series ultrasonic flow meter/heat meter has following different hardware configuration according to different types,or users'requirements.

（A）RS-232 interface(configured).

（B）RS-485 interface(configured)。

（C）Optic electric interface adapter board:equiped with meter reader with optic electric interface to read inside parameters conveniently.

（D）M-BUS adapter board： using single twisted pair line to realize bi-directional data communication and supply power to meters.

message format:adopt Eropean standard IEC 870-5-1

baud rate：300/1200/2400/4800/9600/19200/14400 baud

check bit： odd pariry,no parity,even parity

data format： changeable length ,multibyte data,lower byte is in front.(mode 1)

（4）detaied information

（A）the seeking of dharma of check and CS：from C domain to the first byte before checksum,8 bits cumulative sum of all bytes,not include carry bit

（B）Address FDh(following h suffix represents hex. System)is used for address extended to the second address, FEh and FFh address is broadcasting address, FEh address need answer from slave machine,but FFh address need not answer.

（C）If there are many slave machine with the same first address on the bus,it will has confliction,ans the current and voltage of M-BUS bus will change abnormally,the mainframe can use this abnormal change,assist "cancel selection" "choose the second address"etc. messages to solve the confliction problem automatically .normaly,M-BUS can realize to redistribute the address automaticaly

（D）Do not use those manufacturers'special mainframe command that is used by users rarely.because these commands can make meters work abnormally.

（E）Notice that the M-BUS protocol of CAM-3000 meters is not the same with that of imported products protocol from other countries.

（5）software protocol

Detailed introductions of M-BUS protocol refer to DIN EN1434-3，further detailed informations refer to "The M-BUS：A Documentation" that can be obtained from the websit www.m-bus.com

Message format of new version CAM-3000 lower consumption industry water meter/ ultrasonic flow meter is variable format.and heat meter and water meter adopt the same protocol,when users do not need the heat datas,just throw away unwanted datas,or adopt following common used reserved data message,choose the wanted datas.

new version CAM-3000 lower consumption industry water meter/ ultrasonic flow meter support following functions:

* support the second M-BUS addressing visit
* can modify the first M-BUS address
* can change date and time
* support modify meter work parameters online

detaied protocol is as following table

（attention:some uncommon used variable of M-BUS message are incomplete）

Table 1 from mainframe=> to slave machine protocol message format

mainframe request command	format							introduction	slave machine answers
			C domain	A	CS			C domain=control domain A domain is address domain CS is checksum，CI domain	
initialise （SEND_NKE）	10h		40h	A	CS	16h		release common address,setup as normal status,default baud rate.	E5h
request data (SEND_UD2)	10h		5Bh/7Bh	A	CS	16h		request slave machine to transfer the answered datas of slave machine users	RSP_UD
delete use of common address	10h		40h	FDh	CS	16h		all the slave machines release common address FDh,for other slave machines to use later.	E5h
alarm protocol (SEND_UD1)	10h		5Ah/7Ah	A	CS	16h		with the fastest speed to respond to the alarm and checking of mainframe.	E5h
		L	L		C domain	A	CI domain		CS			
choose the second address	68h	0Bh	0Bh	68h	53h/73h	FDh	52h	ID1-4 M1-2 G Med	CS	16h	ID1-4 is 4 byte ID, M1-2=C9h,20h G=1 Med=4 return water heat meter bit is in front*	E5h
choose the second address	68h	0Bh	0Bh	68h	53h/73h	FDh	56h	ID4-1 M2-1 G Med	CS	16h	high bit is in front,others is the same with above message （Med=0Ch is supply water heat meter） *	E5h
Strengthen to choose the second address	68h	11h	11h	68h	53h/73h	FDh	52h	ID1-4 M1-2 G Med 0CH 78H SN1-4	CS	16h	increase 0Ch 78h +4 byte serial number than above two message *	E5h
modify the first address	68h	06h	06h	68h	53h/73h	A	51h	01h 7Ah NN	CS	16h	NN is new single byte address, range: 1-250	E5h
modify the second address	68h	09h	06h	68h	53h/73h	A	51h	0Ch 79h SA1-4	CS	16h	SA1-4 is 4 byte the new second address	E5h

		L	L		C domain	A	CI domain	CS			remark:slave machine modify baud rate command that is based on after previous baud rate answered	
change baud rate	68h	03h	03h	68h	53h/73h	A	B8h	CS	16h		change baud rate to be 300 after power on again,it become default，normaly is 4800	E5h
change baud rate	68h	03h	03h	68h	53h/73h	A	B9h	CS	16h		change baud rate to be 600 after power on again,it become default，normaly is 4800	E5h
change baud rate	68h	03h	03h	68h	53h/73h	A	BAh	CS	16h		change baud rate to be 1200 after power on again,it become default，normaly is 48000	E5h
change baud rate	68h	03h	03h	68h	53h/73h	A	BBh	CS	16h		change baud rate to be 2400 after power on again,it become default，normaly is 4800	E5h
change baud rate	68h	03h	03h	68h	53h/73h	A	BCh	CS	16h		change baud rate to be 4800 after power on again,it become default，normaly is 4800	E5h
change baud rate	68h	03h	03h	68h	53h/73h	A	BDh	CS	16h		change baud rate to be 9600 after power on again,it become default，normaly is 4800	E5h
change baud rate	68h	03h	03h	68h	53h/73h	A	BEh	CS	16h		change baud rate to be 19200 after power on again,it become default，normaly is 4800	E5h
change baud rate	68h	03h	03h	68h	53h/73h	A	BFh	CS	16h		restore baud rate to be baud rate setup in P4 menu.	E5h

reserved message type		L	L		C domain	A	CI domain	prefabricate data content code	CS				
reserve convention format	68h	03h	03h	68h	53h/73h	A	50h		CS	16h		request all datas,answered message format is listed in table 2（All）	E5h
reserve convention format	68h	04h	04h	68h	53h/73h	A	50h	00	CS	16h		request all datas,answered message format is listed in table 2（All）	E5h
reserve quick format	68h	04h	04h	68h	53h/73h	A	50h	51h	CS	16h		request quick readout datas （QUICK READOUT）	E5h

reserve user data format	68h	04h	04h	68h	53h/73h	A	50h	10h		CS	16h		request total heat quantity W,total flow V （User Data）	E5h
reserve simple account bill mode	68h	04h	04h	68h	53h/73h	A	50h	20h		CS	16h		request W,V,W,V of last year and operating time BT,trouble time FT（Simple Billing）	E5h
reserve complete account bill mode	68h	04h	04h	68h	53h/73h	A	50h	30h		CS	16h		Request W,V. W,V of last year,Max flow rate/heat flow，BT、FT（Enhanced Billing）	E5h
reserve present data	68h	04h	04h	68h	53h/73h	A	50h	50h		CS	16h		Request W，V .instant flow /heat flow，temperature of supply water and return water （Instantaneous Values）	E5h
reserve RAM history data	68h	04h	04h	68h	53h/73h	A	50h	60h		CS	16h		read event pointer point to 40H byte data,setup of event pointer refer to related command	E5h
reserve present data	68h	04h	04h	68h	53h/73h	A	50h	80h		CS	16h		request meter serial number,supply heat closing date	E5h
switchover to quick mode	68h	05h	05h	68h	53h/73h	A	51h	0Fh	A1h	CS	16h		quick readout format,message format is listed in table 3	E5h
switchover to convention mode	68h	05h	05h	68h	53h/73h	A	51h	0Fh	A0h	CS	16h		reserve all output data also	E5h
switchover to quick mode	68h	03h	03h	68h	53h/73h	A	A1h			CS	16h		Do not recommend to use this message that is setup for compatibility	E5h
switchover to convention mode	68h	03h	03h	68h	53h/73h	A	A0h			CS	16h		Do not recommend to use this message that is setup for compatibility	E5h
reserve all datas 1	68h	04h	04h	68h	53h/73h	A	51h	7Fh		CS	16h		message format is listed in table 2	E5h
Reserve all datas 2	68h	06h	06h	68h	53h/73h	A	51h	C8h	3Fh 7Eh	CS	16h		message format is listed in table 2	E5h
reserve null message	68h	06h	06h	68h	53h/73h	A	51h	7Fh	FEh 0Dh	CS	16h			E5h
common used chosen data message	68h	L	L	68h	53h/73h	A	51h	选取代码 selective code（composing）		CS	16h		limit :L<240， setup all to chosen status after power on again to initialise	E5h

selective code（composing）can choose following any reserve data code and its any composing(for example:assumed to reserve readout total heat quantity and total flow,message format is 68 L L 68 53/73 A 51 08 14 08 2D CS 16）

update cycle 08h 74h	all update cycle C8h 3Fh 74h	total heat quantity of last year 48h 00h…0Fh
average cycle 08h 70h	all average cycle C8h 3Fh 70h	total flow rate of last year 48h 10h…17h
total heat quantity 08h 00h…0Fh	all total heat quantity C8h 3Fh 00h…0Fh	year closing date 48h 6Ch
total flow rate 08h 10h…17h	all total flow rate C8h 3Fh 10h…17h	trouble time 38h 20h…23h
instant heat quantity 08h 28h…37h	all instant heat quantity C8h 3Fh 28h…37h	trouble time of last year 78h 20h…23h
instant flow rate 08h 38h…4Fh	all instant flow rate C8h 3Fh 38h…4Fh	Max value average cycle 88h 10h 70h…73h
supply water temperature 08h 58h…5Bh	all supply water temperature C8h 3Fh 58h…5Bh	Max instant heat flow of last year D8h 10h 28h…37h
return water temperature 08h 5Ch…5Fh	all return water temperature C8h 3Fh 5Ch…5Fh	present Max instant heat flow 98h 10h 28h…37h
temperature difference 08h 60h…63h	all temperature difference C8h 3Fh 60h…63h	present Max instant flow 98h 10h 38h…4Fh
serial number 08h 78h	all serial number C8h 3Fh 78h	present Max supply water temperature 98h 10h 5Bh
operating time 08h 20h…23h	all operating time C8h 3Fh 20h…23h	present Max return water temperature 98h 10h 5Fh
date and time 08h 6Ch	all time symbol C8h 3Fh 6Ch	

Remark: "…" in code means "between".for example:between 00h…0Fh,any digit is available.so that 08h 00h code has the same function with 08h 0Dh code

		L	L		C domain	A	CI domain	DIF	DIF	function		parameter	CS		introduction	answer
analogue key input	68h	0Ah	0Ah	68h	53h/73h	A	51h	2Fh	0Fh	00h	08h	00h 00h 00h	CS	16h	equal to LOW.ACC display key(include menu jump,digit key input)	E5h
analogue key input	68h	0Ah	0Ah	68h	53h/73h	A	51h	2Fh	0Fh	00h	10h	00h 00h 00h	CS	16h	equal to long press display key	E5h
analogue key input	68h	0Ah	0Ah	68h	53h/73h	A	51h	2Fh	0Fh	00h	28h	00h 00h 00h	CS	16h	equal to LOW.ACC modify key	E5h
analogue key input	68h	0Ah	0Ah	68h	53h/73h	A	51h	2Fh	0Fh	00h	30h	00h 00h 00h	CS	16h	equal to long press modify key	E5h
debug equipment use function	68h	L	L	68h	53h/73h	A	51h	2Fh	0Fh	04h	18 h	password+ parameter	CS	16h	factory special bebugging equipment fuction, PP1..PP7 is password	E5h
start code update	68h	L	L	68h	53h/73h	A	51h	2Fh	0Fh	09h	28 h	password+parameter	CS	16h	used for factory to update code,this operation can erase all codes	other protocol
initialise parameter block	68h	L	L	68h	53h/73h	A	51h	2Fh	0Fh	18h	38h	password+ nn1..nn64	CS	16h	write 64 bytes data to parameter block 1	E5h
readout contents of	68h	0Ah	0Ah	68h	53h/73h	A	51h	2Fh	0Fh	04h	68h	00h 00h 00h	CS	16h	readout monitor's 96 segments display,total 12 bytes content	non-standard

LCD																protocol
startup flow rate calibrating	68h	L	L	68h	53h/73h	A	51h	2Fh	0Fh	00h	13h	password+parameter	CS	16h	used for manufacturer to debug equipment use function	E5h
startup heat quantity calibrating	68h	L	L	68h	53h/73h	A	51h	2Fh	0Fh	00h	15h	password+parameter	CS	16h	used for manufacturer to debug equipment use function	E5h
static clear zero	68h	12h	12h	68h	53h/73h	A	51h	2Fh	0Fh	01h	01h	password+parameter	CS	16h	used for manufacturer to debug equipment use function	E5h
stop static clear zero	68h	12h	12h	68h	53h/73h	A	51h	2Fh	0Fh	01h	00h	password+parameter	CS	16h	used for manufacturer to debug equipment use function	E5h
erase Max value of this month	68h	0Ah	0Ah	68h	53h/73h	A	51h	2Fh	0Fh	02h	02h	00h 00h 00h	CS	16h	erase Max value of memorizer of this month	E5h
erase events memorizer	68h	0Ah	0Ah	68h	53h/73h	A	51h	2Fh	0Fh	03h	00h	00h 00h 00h	CS	16h	erase events memorizer	E5h
setup event pointer	68h	0Ah	0Ah	68h	53h/73h	A	51h	2Fh	0Fh	03h	01h	PTL PTH 00h	CS	16h	setup event memorizer pointer as PTH PTL	E5h
setup time method 1	68h	0Dh	0Dh	68h	53h/73h	A	51h	2Fh	0Fh	04h	58h	SSMMHHDDMMYY	CS	16h	setup date and time,recommendation parameter is respectively second,minute,hour,day,month,year.	E5h
		L	L		C domain	A	CI domain	DIF					CS			
setup time method 2	68h	0Ah	0Ah	68h	53h/73h	A	51h	04h	EDh 00h DATE/TIME				CS	16h	** setup date and time, DATE/TIME is standard TYPE F format	E5h
setup time method 3	68h	09h	09h	68h	53h/73h	A	51h	04h	6Dh DATE/TIME				CS	16h	** setup date and time, DATE/TIME is standard TYPE F format	E5h

remarks： * choose the second address,can use asterisk wildcard that can make the mainframe find the all slave machines on the bus quickly。

** setup the mode for compatible standard,because TYPE F does not have second，so these two messages setup second=0。TYPE F format is the date/time format M-BUS specified。

table 2 from slave machine to mainframe message format（RSP_UD）

byte	content	message byte	introduction	remark
4	Masthead of message	68h L L 68h	masthead，L Max=F8h	
3		08h A 72h	changeable length message,lower data bit is in front, A is M-BUS main address	
4		78h 65h 34h 21h	M-BUS the second address	
2		88h 11h	“DLH” characteristic coding	
1		02h	heat meter version	
1		04h	represent heat meter	
1		Z	transfer times	
1		S	Status byte Bit0..4 setup according to M-BUS standard，Bit5..7 respectively is heat flow/flow rate/temperature difference character	
2		00h 00h	signature	
3	current update cycle	01h	DIF: single byte integer，no DIFE，（Current Value）	
		74h	VIF: update cycle， unit:second	
		01h/02h/../1Fh （/ means “or”）	1s-31s，determined by user’setup。Default :3s。	
3	current measuring cycle	01h	DIF: single byte integer，no DIFE，（Current Value）	
		70h	VIF: measuring cycle（average time），unit:second	
		01h/02h/../1Fh	1s-31s，determined by user’setup。Default :3s。	
6/7	current total heat quantity	05h	DIF: four byte float，no DIFE，（Current Value）	
		0Dh/FBh 09h	VIF: total heat quantity unit（1KWh/1GJ)	remark 1
		00h 00h 00h 40h	Total heat quantity=2.0 KWh/GJ	
6	current total flow	05h	DIF: four byte float，no DIFE，（Current Value）	
		15h	VIF： total flow unit （m^3）	
		00h 00h 00h 40h	Total flow=2.0 m^3	
6	current instant heat quantity	05h	DIF: four byte float，no DIFE，（Current Value）	
		2Eh	VIF： instant heat quantity (energy)unit: kW	
		00h 00h A0h 3Fh	Instant heat quantity=1.25 kW	
6	current instant flow	05h	DIF: four byte float，no DIFE，（Current Value）	
		3Eh	VIF：current flow unit: （m^3/h）	
		38h A1h 80h 3Eh	Instant flow=0.25123 m^3/h	
6	current supply water temperature	05h	DIF: four byte float，no DIFE，（Current Value）	
		5Bh	VIF：supply water temperature(℃)	
		00h 40h B1h 42h	88.625 ℃	
6	current return water temperature	05h	DIF: four byte float，no DIFE，（Current Value）	
		5Fh	VIF：return water temperature (℃)	
		4Dh 55h 85h 42h	66.66666 ℃	
6	current temperature difference	05h	DIF: four byte float，no DIFE，（Current Value）	
		63h	VIF: temperature difference（℃）	
		CEh AAh AFh 41h	22.9584℃	
6	total flow of last year	45h	DIF:octet BCD number，no DIFE，memory number 1=year value	
		15h	VIF：total flow （m^3）	
		00h 00h 00h 40h	2.0 m^3	
6/7	total heat quantity of last year	45h	DIF:octet BCD number，no DIFE，memory number 1=last year value	
		0Dh/FBh 09h	VIF：total heat quantity （1KWh/1GJ)	
		00h 00h 00h 40h	2.0 KWh/GJ	
6	meter serial number	0Ch	DIF:octet BCD number，no DIFE，（Current Value）	
		78h	VIF：serial number	
		78h 56h 34h 12h	12345678	
4	Max value average cycle	89h	DIF: single byte BCD number，behind is DIFE，（Current Value）	
		10h	DIFE：rate=1	
		70h	VIF： average cycle time（s）	
		1	1s	
7	current Max instant heat quantity	95h	DIF: 4 byte float，behind is DIFE，Max instant heat quantity（heat power）	
		10h	DIFE：rate=1	
		2Eh	VIF：instant heat quantity，stable unit :KW	
		00h 00h A0h 3Fh	1.25 kW	
7	Max instant heat quantity of last year	D5h	DIF: 4 byte float，behand is DIFE， Max value storage data block 1=last year value	
		10h	DIFE：rate=1	
		2Eh	VIF：instant heat quantity unit:kW	
		00h 00h A0h 3Fh	1.25 kW	
7	current Max instant flow	95h	DIF: 4 byte float，behind is DIFE，Max value	
		10h	DIFE：rate=1	
		3Eh	VIF：instant flow m^3/h	
		38h A1h 80h 3Eh	Instant flow=0.25123 m^3/h	
7	current Max supply water temperature	95h	DIF: 4 byte float，behind is DIFE，Max value,	
		10h	DIFE：rate=1	
		5Bh	VIF：supply water temperature	
		38h A1h 80h 3Eh	0.25123 ℃	
7	current Max return water temperature	95h	DIF: 4 byte float，behind is DIFE，Max return water temperature,	
		10h	DIFE：rate=1	
		5Fh	VIF: return water temperature（℃）	

		38h A1h 80h 3Eh	0.25123 ℃	
7	total operating time	04h	DIF: 4 byte binary system integer，no DIFE，（Current Value）	
		20h	VIF：total operating time（work time）unit:second	
		4Eh 61h BCh 00h	Current total operating time=12345678s	
6	current trouble time	34h	DIF: 4 byte binary system integer，no DIFE，numerical value with trouble	
		20h	VIF： total trouble time（lost/trouble time）unit:second	
		10h 01h 00h 00h	total trouble time =266 秒	
6	trouble time of last year	74h	DIF: 4 byte binary system integer，no DIFE，numerical value with trouble，storage data block 1=last year value	
		20h	VIF：total trouble time（lost/trouble time）unit:second	
		10h 01h 00h 00h	total trouble time of last year=266s	
4	closing date of last year	42h	DIF: sixteen bit integer，behind is DIFE，storage data block 1=last year value	
		6Ch	VIF： time= closing date； data format type G	
		01h 04h	closing date is Apr. 1； unconcerned with year is 0	
7/8	Rate 2 total heat quantity	85h	DIF: 4 byte float，behind is DIFE，（Current Value）	
		20h	DIFE：rate=2；rate 2 accumulator register	
		0Dh/FBh 09h	VIF：total heat quantity （1KWh/1GJ)	
		00h 00h 00h 40h	2.0 unit 1KWh/1GJ	
7/8	Rate 3 total heat quantity	85h	DIF: 4 byte float，behind is DIFE，（Current Value）	
		30h	DIFE：rate=3；rate 3 accumulator register	
		0Dh/FBh 09h	VIF：total heat quantity （1KWh/1GJ)	
		00h 00h 00h 40h	2.0 unit 1KWh/1GJ	
7/8	Last year rate 2 total heat quantity	C5h	DIF: 4 byte float，behind is DIFE storage data block 1=last year value	
		20h	DIFE：rate=2；rate 2 accumulator register	
		0Dh/FBh 09h	VIF：total heat quantity （1KWh/1GJ)	
		00h 00h 00h 40h	2.0 unit 1KWh/1GJ	
7/8	Last year rate 3 total heat quantity	C5h	DIF: 4 byte float，behind is DIFE，storage data block 1=last year value	
		30h	DIFE：rate=3；rate 3 accumulator register	
		0Dh/FBh 09h	VIF：total heat quantity （1KWh/1GJ)	
		00h 00h 00h 40h	2.0 unit 1KWh/1GJ	
4	Max supply water temperature of last month	91h	DIF: single byte no sign number，behind is DIFE，Max temperature	
		11h	DIFE：rate=1， data block number 2，last month value	
		5Bh	VIF：supply water temperature (℃)	
		7Fh	127℃	
4	Max return water temperature of last month	91h	DIF: single byte no sign number，behind is DIFE，Max return water temperature	
		11h	DIFE：rate=1，data block number 2，last month value	
		5Fh	VIF：return water temperature (℃)	
		23h	35℃	
7	Max instant flow of last month	95h	DIF: 4 byte float，behind is DIFE，Max value	
		11h	DIFE：rate=1，data block number 2，last month value	
		3Eh	VIF： instant flow（m^3/h）	
		79h E9h F6h 42h	123.456 m^3 /h	
7	Max instant heat quantity of last month	95h	DIF: 4 byte float，behind is DIFE，Max instant heat quantity	
		11h	DIFE：rate=1，data block number 2，last month value	
		2Eh	VIF： instant heat quantity（kW）	
		66h E6h 40h 46h	12345.6 kW	
7	trouble time of last month	B4h	DIF: 4 byte binary system integer，behind is DIFE， numerical value with trouble	
		01h	DIFE：data block number 2，last month value	
		20h	VIF：total operating time（s）=lost/trouble time（s）	
		78h 56h 34h 12h	12345678s	
7/8	total heat flow of last month	85h	DIF: 4 byte binary system integer，behind is DIFE	
		01h	DIFE：data block number 2，last month value	
		0Dh/FBh 09h	VIF：total heat flow （1KWh/1GJ)	
		00h 00h 004h 40h	2.0 unit KWh/1GJ	
7/8	last month rate 2 total heat quantity	85h	DIF: 4 byte binary system integer，behind is DIFE	
		21h	DIFE：rate=2；data block number 2，last month value	
		0Dh/FBh 09h	VIF：total heat flow （1KWh/1GJ)	
		00h 00h 00h 40h	2.0 unit KWh/GJ	
7/8	Last month rate 3 total heat quantity	85h	DIF: four byte floating point，behind is DIFE，current value	
		31h	DIFE：rate=3；data block number 2，last month value	
		0Dh/FBh 09h	VIF：total heat flow（1KWh/1GJ)	
		00h 00h 00h 40h	2.0 unit KWh/GJ	
7	total flow of last month	85h	DIF: four byte floating point，behind is DIFE	
		01h	DIFE：data block number 2，last month value	
		16H	VIF：total flow （m^3）	
		00h 00h 00h 00h	0 m^3	
6	current date and time	04h	DIF：32 bit integer，no DIFE，current value	
		6Dh	VIF：date+time； data format Type F	
		1Fh 0Ch D0h 03h	current date and time 06-03-16 12:31:XX ，not include seconds	
6	manufacturer special information	0Fh	setup related datas by manufacturer	
		01h 02h	software version 9.21	

		00h 00h 01h	Byte D0 D1 D2 replenished information D2.0=1 9.2 version D2.7：0=return water installation；1=supply water installation	
1	end	CS	checksum	
1		16h	tailed	

Table 3 from slave machine to mainframe quickly readout message format（RSP_UD）

Byte	content	Message byte	introduction	remark
4	Masthead of message	68h L L 68h	Masthead of message ， L Max value =3Fh or 40h data length	
3		08h A 72h	changeable length message,lower data bit is in front, A is M-BUS main address	
4		78h 65h 34h 21h	M-BUS the second address	
2		88h 11h	"DLH" characteristic coding	
1		02h	heat meter version	
1		04h	represent heat meter	
1		Z	transfer times	
1		S	Status byte Bit0..4 setup according to M-BUS standard，Bit5..7 respectively is heat flow/flow rate/temperature difference character	
2		00h 00h	signature	
3	current update cycle	01h	DIF: single byte integer，no DIFE，（Current Value）	
		74h	VIF: update cycle， unit:s	
		01h/02h/../1Fh	1s-31s，determined by user'setup。Default :3s。	
3	current measuring cycle	01h	DIF: single byte integer ，no DIFE，（Current Value）	
		70h	VIF: measuring cycle（average time）， unit:s	
		01h/02h/../1Fh	1s-31s，determined by user'setup。Default :3s。	
6/7	current total heat quantity	05h	DIF: 4 byte binary system integer ，no DIFE，（Current Value）	
		0Dh/FBh 09h	VIF: total heat quantity unit（1KWh/1GJ)	
		01h 01h 00h 00h	total heat quantity=257 KWh/GJ	
6	current total flow	05h	DIF: 4 byte binary system integer ，no DIFE，（Current Value）	
		16h	VIF： total flow unit （m^3）	
		01h 01h 00h 00h	total flow=257 m^3	
6	current instant heat quantity	05h	DIF: 4 byte binary system integer ，no DIFE，（Current Value）	
		2Eh	VIF： instant heat quantity（energy）unit: kW	
		00h 00h A0h 3Fh	instant heat quantity=1.25 kW	
6	current instant flow	05h	DIF: 4 byte binary system integer ，no DIFE，（Current Value）	
		3Eh	VIF： current flow rate unit: （m^3/h）	
		38h A1h 80h 3Eh	current flow rate=0.25123 m^3/h	
6	current supply water temperature	05h	DIF: 4 byte binary system integer ，no DIFE，（Current Value）	
		5Bh	VIF： supply water temperature(℃)	
		00h 40h B1h 42h	88.625 ℃	
6	current return water temperature	05h	DIF: 4 byte binary system integer ，no DIFE，（Current Value）	
		5Fh	VIF：return water temperature(℃)	
		4Dh 55h 85h 42h	66.66666 ℃	
1	end	CS	checksum	
1		16h	tailed	

§1.7 key assignments coding

Key assignments coding is used when networking,analogue keys function on upper machine.for example:input command “M1”through serial port,that equals to press key “1”of the keyboard of CAM-3000 ultrasonic flow meter,so achieve to operate all fuctions of keyboard on upper machine completely.all keys coding are as follows:

Key number	Key assignment code (hexadecimal)	Key assignment code (decimal system)	ASCII code	key	Key assignment cod (hexadecimal)	Key assignment cod (decimal system)	ASCII code
0	30H	48	0	8	38H	56	8
1	31H	49	1	9	39H	57	9
2	32H	50	2	.	3AH	58	:
3	33H	51	3	◄	3BH	59	;
4	34H	52	4	MENU	3CH	60	<
5	35H	53	5	ENT	3DH	61	=
6	36H	54	6	▲/+	3EH	62	>
7	37H	55	7	▼/-	3FH	63	?

§1.8 programming example

1. VB send sentence of inquiry instant flow per second
   MSCOMM1.INPUT=”dqs”+vbcrlf;
2. using VB to send command，require to return back to No.4321 flow meter at same time: 1. instant flow 2. instant flow velocity 3. positive total value 4. total heat quantity5. AI1 analogue input current value 6. AI2 analogue input digits with verification。send commands as follows：
   MSCOMM1.INPUT=“W4321PDQD&PDV&PDI+&PDIE&PBA1&PAI2”+VBCRLF;
3. using VB to send command to modify the setup of outside pipe diameter (in M11) to be 345mm.
   MSCOMM1.INPUT=”M<”+VBCRLF+”M1”+VBCRLF+”M1”+VBCRLF+”M3”+VBCRLF+”M4”+VBCRLF+”M5”+VBCRLF+”M=”+VBCRLF
   Remark:“M<”represent MENU key，“M=”represent ENT key，“M1”represent“1”