

# serial port and communication protocol

## §1.1 outline

The new TDS-100 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.

TDS-100 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 TDS-100 water meter protocol and HUIZHONG company products communication protocol, in order to make users conveniently connect TDS-100 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.

TDS-100 series products can act as the function 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, TDS-100 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-equipped standard MODBUS drivers of different Supervisory Control and Data Acquisition can conveniently connect TDS-100 to data acquisition. by using MODBUS-PROFIBUS converter, it can conveniently connect TDS-100 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 TDS-100 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 TDS-100 series flow meters for users to use, some small softwares are free for users to network to conveniently adjust communication, the new version of TDS-100 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 response after connecting?

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

B. whether physical 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 TDS-100 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 -3600m<sup>3</sup>/s,the instant flow rate will display 3600 m<sup>3</sup>/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.

TDS-100 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 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)

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

FA 33 is checksum.

Pls note the above data storage sequence. when explaining data by C language, use pointer to put the needed data 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 : 0103280000000000000000000000000000000000D4

“: ” 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, obtained 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  | Numbe<br>rs of<br>register | Variable name                           | Data type | discription                                                                                                   |
|-----------|----------------------------|-----------------------------------------|-----------|---------------------------------------------------------------------------------------------------------------|
| 0001-0002 | 2                          | Instant flow rate                       | REAL4     | unit: m <sup>3</sup> /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<br>of fluid    | REAL4     | unit: m/s                                                                                                     |
| 0009-0010 | 2                          | positive totaliser flow                 | LONG      | all the flow totalisers that use long<br>integers, its measure is controlled<br>by M32(REG1438)               |
| 0011-0012 | 2                          | positive totaliser flow<br>decimal part | REAL4     | REAL4 is standard IEEE-754<br>format float floating point. the<br>format data is also called FLOAT<br>format. |
| 0013-0014 | 2                          | negative totaliser flow                 | LONG      | Long integers is lower digit in front<br>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: °C                                                                                                                                                                                                                       |
| 0035-0036 | 2 | Temperature 2/return water temperature        | REAL4 | unit: °C                                                                                                                                                                                                                       |
| 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 opening                                                                                                                                                                                          |
| 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 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 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 strength                  | INTEGER | Data range:0-4095                                                                                                             |
| 0094      | 1 | downstream signal strength                | 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               | REAL4   | unit:m <sup>3</sup> ,7 significance digit                                                                                     |

|           |   |                                                               |         |                                            |
|-----------|---|---------------------------------------------------------------|---------|--------------------------------------------|
|           |   | point format)                                                 |         |                                            |
| 0115-0116 | 2 | Positive totaliser<br>flow(floating point format)             | REAL4   | unit:m <sup>3</sup> ,7 significance digit  |
| 0117-0118 | 2 | negative totaliser<br>flow(floating point format)             | REAL4   | unit:m <sup>3</sup> ,7 significance digit  |
| 0119-0120 | 2 | net totaliser heat<br>quantity(floating point<br>format)      | REAL4   | Unit:GJ, 7 significance digit              |
| 0121-0122 | 2 | positive totaliser heat<br>quantity(floating point<br>format) | REAL4   | Unit:GJ, 7 significance digit              |
| 0123-0124 | 2 | negative totaliser heat<br>quantity(floating point<br>format) | REAL4   | Unit:GJ, 7 significance digit              |
| 0125-0126 | 2 | today total flow(floating<br>point format)                    | REAL4   | unit:m <sup>3</sup> , 7 significance digit |
| 0127-0128 | 2 | this month total<br>flow(floating point format)               | REAL4   | unit:m <sup>3</sup> , 7 significance digit |
| 0129-0130 | 2 | manual total flow                                             | LONG    |                                            |
| 0131-0132 | 2 | manual totaliser decimal<br>part                              | REAL4   |                                            |
| 0133-0134 | 2 | batch controller total flow                                   | LONG    |                                            |
| 0135-0136 | 2 | batch controller decimal<br>part                              | REAL4   |                                            |
| 0137-0138 | 2 | today total flow                                              | LONG    |                                            |
| 0139-0140 | 2 | today total flow decimal<br>part                              | REAL4   |                                            |
| 0141-0142 | 2 | this month total flow                                         | LONG    |                                            |
| 0143-0144 | 2 | this month total flow<br>decimal part                         | REAL4   |                                            |
| 0145-0146 | 2 | this year total flow                                          | LONG    |                                            |
| 0147-0148 | 2 | this year total flow decimal<br>part                          | REAL4   |                                            |
| 0158      | 1 | display present Menu                                          | INTEGER |                                            |
| 0165-0166 | 2 | running time with trouble                                     | LONG    | Unit:s                                     |
| 0173-0174 | 2 | present frequency output<br>value                             | REAL4   | unit: Hz                                   |
| 0175-0176 | 2 | present current loop output<br>value                          | REAL4   | unit: mA                                   |
| 0181-0182 | 2 | Present temperature<br>difference                             | REAL4   | unit: °C                                   |
| 0183-0184 | 2 | replenished flow by this<br>power on                          | REAL4   | unit:m <sup>3</sup>                        |

|           |    |                                                   |         |                                                                                                                                                                                        |
|-----------|----|---------------------------------------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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<br>2=KWh, 3=BTU                                                                                                                                              |
| 1442      | 1  | instrument communication address number           | INTEGER |                                                                                                                                                                                        |
| 1491      | 1  | instrument types                                  | INTEGER | BIT0=0 represent flow meter<br>BIT0=1 represent heat meter<br>BIT3=1 represent heat meter installed on supply water pipe<br>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                       | BCD     | this equipment electronic serial                                                                                                                                                       |



|  |  |        |  |                                 |
|--|--|--------|--|---------------------------------|
|  |  | number |  | number<br>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 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 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)

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

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 <sup>3</sup> /s | 1  | m <sup>3</sup> /minute | 2  | m <sup>3</sup> /h | 3  | m <sup>3</sup> /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 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 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        | LONG      | 23:59:59 totaliser value at the                  |

|       |             |       |                                        |       |                                                  |
|-------|-------------|-------|----------------------------------------|-------|--------------------------------------------------|
|       |             |       | value                                  |       | last second time                                 |
|       | 10251-10252 | 2     | negative totaliser value               | LONG  | totaliser value at the last second time          |
|       | 10253-10254 | 2     | heat quantity positive totaliser value | LONG  | 23:59:59 totaliser value at the 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                 |
|                   | 8193             | 1                  | status byte              | BCD       | lower byte is status,higher byte |

|      |             |        |                                        |        |                                                       |
|------|-------------|--------|----------------------------------------|--------|-------------------------------------------------------|
| 0    |             |        |                                        |        | 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 |
| 0000 | 0000000000  | 000000 | 0000000000000000                       | 000000 | 00000000000000000000                                  |
| 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 introduction 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<br>decimal             | REAL4 | Unit is determined in M32,M33 |
| 6161-6162 | 2 | negative total flow<br>value               | LONG  | Unit is determined in M32,M33 |
| 6163-6164 | 2 | negative total flow<br>decimal             | REAL4 | Unit is determined in M32,M33 |
| 6165-6166 | 2 | heat quantity<br>positive total            | LONG  | Unit is determined in M32,M33 |
| 6167-6168 | 2 | heat quantity<br>positive total<br>decimal | REAL4 | Unit is determined in M32,M33 |
| 6169-6170 | 2 | heat quantity<br>negative total value      | LONG  | Unit is determined in M32,M33 |
| 6171-6172 | 2 | heat quantity<br>negative total<br>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<br>decimal                  | REAL4 | Unit is determined in M32,M33 |
| 6177-6178 | 2 | heat quantity net<br>total                 | LONG  | Unit is determined in M32,M33 |
| 6179-6180 | 2 | heat quantity net<br>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<br>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<br>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<br>decimal                 | REAL4 | Unit is determined in M32,M33 |
| 6193-6194 | 2 | instant flow when<br>power off             | REAL4 | unit: m <sup>3</sup> /s       |
| 6195-6196 | 2 | operating time with<br>troubles            | LONG  | Unit:s                        |
| 6197-6198 | 2 | day total work time                        | LONG  | Unit:s                        |
| 6199-6200 | 2 | month total work<br>time                   | LONG  | Unit:s                        |
| 6201-6202 | 2 | M47 password                               | BCD   |                               |
| 6203-6204 | 2 | the time length of<br>power off period     | LONG  | Unit:s                        |
| 6205-6206 | 2 | instant flow at the time                   | REAL4 | unit: m <sup>3</sup> /s       |

|       |           |       |                                                           |       |                              |
|-------|-----------|-------|-----------------------------------------------------------|-------|------------------------------|
|       |           |       | of last power on                                          |       |                              |
|       | 6207-6208 | 2     | to be replenished total flow<br>because of last power off | REAL4 | unit: m <sup>3</sup>         |
| 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 TDS-100 FUJI extending communication protocol

TDS-100 new version ultrasonic flow meter can also use TDS-100 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) <sup>remark 0</sup> | return instant flow per day                     | ±d.dddddddE±dd(cr) <sup>remark 1</sup> |
| DQH(cr)                     | return instant flow per hour                    | ±d.dddddddE±dd(cr)                     |
| DQM(cr)                     | return instant flow per minute                  | ±d.dddddddE±dd(cr)                     |
| DQS(cr)                     | return instant flow per second                  | ±d.dddddddE±dd(cr)                     |
| DV(cr)                      | return instant fluid velocity                   | ±d.dddddddE±dd(cr)                     |
| DI+(cr)                     | return positive total flow                      | ±dddddddE±d(cr) <sup>remark 2</sup>    |
| DI-(cr)                     | return negative total flow                      | ±dddddddE±d(cr)                        |
| DIN(cr)                     | return net total flow                           | ±dddddddE±d(cr)                        |
| DIE(cr)                     | return heat quantity total flow                 | ±dddddddE±d(cr)                        |
| DIE+(cr)                    | return positive heat quantity total flow        | ±dddddddE±d(cr)                        |
| DIE-(cr)                    | return negative heat quantity total flow        | ±dddddddE±d(cr)                        |
| DIT(cr)                     | return today net total flow                     | ±dddddddE±d(cr)                        |
| DIM(cr)                     | return this month net total flow                | ±dddddddE±d(cr)                        |
| DIY(cr)                     | return this year net total flow                 | ±dddddddE±d(cr)                        |
| DID(cr)                     | ) return instrument ID code(address code)       | ddddd(cr) 5 bits                       |
| E(cr)                       | return instant heat flow per second             | ±d.dddddddE±dd(cr)                     |
| DL(cr)                      | return signal strength                          | UP:dd.d,DN:dd.d,Q=dd(cr)               |
| DS(cr)                      | return percentage data of analogue output<br>AO | ±d.dddddddE±dd(cr)                     |
| DC(cr)                      | return present error code                       | Remark 3                               |
| DA(cr)                      | OCT or RELAY alarm                              | TR:s,RL:s(cr) <sup>remark 4</sup>      |
| 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 TDS-100 analogue key<br>assignments     | M@(cr) <sup>remark 5</sup>             |

|                     |                                                                                                     |                                                                                                                                                                |
|---------------------|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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<br>2 italy, if available<br>3 korea, if available<br>4 franch, if available<br>5 german, if available<br>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                                                                                    |                                                                                                                                                                |
| F0dddd(cr)          | make frequency output to output by n value                                                          | Fddddd(cr)(lf)                                                                                                                                                 |
| Aoa(cr)             | make current loop output the current value a                                                        | AOa(cr)(lf) <sup>remark 6</sup>                                                                                                                                |
| BA1(cr)             | return the resistor value of temperature T1                                                         | ±d.dddddddE±dd(cr)(lf)                                                                                                                                         |
| BA2(cr)             | return the resistor value of temperature T2                                                         | ±d.dddddddE±dd(cr)(lf)                                                                                                                                         |
| BA3(cr)             | return current value of AI3 (0~20mA)                                                                | ±d.dddddddE±dd(cr)(lf)                                                                                                                                         |
| BA4(cr)             | return current value of AI4 (0~20mA)                                                                | ±d.dddddddE±dd(cr)(lf)                                                                                                                                         |
| BA5(cr)             | return current value of AI5 (0~20mA)                                                                | ±d.dddddddE±dd(cr)(lf)                                                                                                                                         |
| AI1(cr)             | return T1 value of temperature input(temperature)                                                   | ±d.dddddddE±dd(cr)(lf)                                                                                                                                         |
| AI2(cr)             | return T2 value of temperature input(temperature)                                                   | ±d.dddddddE±dd(cr)(lf)                                                                                                                                         |
| AI3(cr)             | return AI3 value of analogue input(temperature,pressure,etc)                                        | ±d.dddddddE±dd(cr)(lf)                                                                                                                                         |
| AI4(cr)             | return AI4 value of analogue input(temperature,pressure,etc)                                        | ±d.dddddddE±dd(cr)(lf)                                                                                                                                         |
| AI5(cr)             | return AI5 value of analogue input(temperature,pressure,etc)                                        | ±d.dddddddE±dd(cr)(lf)                                                                                                                                         |
| ESN(cr)             | return ESN                                                                                          | dddddddt(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, dddddd 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. ddddddd (eight byte)represent instrument ESN, t represent instrument type
8. If there are many new version TDS-100 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 TDS-100 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 TDS-100 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 ( $D \geq 50\text{mm}$ ) ; LL=13 byte, cumulant decreased 10 times, (default options)
3. SCL-6
4. SCL-7x( $D < 50\text{mm}$ ) ; LL=13 byte, cumulant decreased 10 times
5. SCL-7x ( $D \geq 50\text{mm}$ ) ; LL=13 byte, cumulant decreased 10 times
6. CRL-G-DL ( $D < 50\text{mm}$ ) ; LL=13 byte, cumulant decreased 1000 times
7. CRL-G-DL( $D \geq 50\text{mm}$ ) ; 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 ( $D < 50\text{mm}$ ) ; LL=33 byte, cumulant decreased 1000 times
11. CRL-G-D ( $D \geq 50\text{mm}$ ) ; LL=33 byte, cumulant decreased 10 times
12. SCL-61DT ( $D < 50\text{mm}$ ) ; with temperature LL=17 byte, cumulant decreased 1000 times
13. SCL-61DT ( $D \geq 50\text{mm}$ ) ; with temperature LL=17 byte, cumulant decreased 10 times
14. SCL-71x( $D < 50\text{mm}$ ) ; LL=13 byte, cumulant decreased 10 times
15. SCL-73x ( $D \geq 50\text{mm}$ ) ; 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( $D \geq 50\text{mm}$ ),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( $D \geq 50\text{mm}$ ) 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<br>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 m <sup>3</sup> |
| 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

$$12345678 \times 0.01 = 123456.78 \text{ m}^3$$

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 m<sup>3</sup>/h

positive total flow=78563412×10<sup>-3</sup>=78563.412 m<sup>3</sup>

negative total flow=12345680×10<sup>-3</sup>=12345.680 m<sup>3</sup>

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 TDS-100 series products emphasize that users can program and change,so in the protocol,there is no stable baud rate and check bit definition,users need to check by yourself,adopt suitable baud rate.
- (2) When New version TDS-100 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 TDS-100 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 TDS-100 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 TDS-100 2.00

Communication protocol of New version TDS-100 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](http://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 TDS-100 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 TDS-100 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 TDS-100 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](http://www.m-bus.com)

Message format of new version TDS-100 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 TDS-100 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        | A   | CI        | CS                             |    |     | remark:slave machine modify baud rate command that is based on after                              |                       |



|                              |     |     |     |     |             |   |              |                                   |     |    |     |                                                                                       |  |                                                                         |     |
|------------------------------|-----|-----|-----|-----|-------------|---|--------------|-----------------------------------|-----|----|-----|---------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------|-----|
|                              |     |     |     |     | domain      |   | domai<br>n   |                                   |     |    |     | 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, normally 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, normally 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, normally 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, normally 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, normally 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, normally 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, normally 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<br>domain | A | CI<br>domain | prefabricate data<br>content code |     | CS |     |                                                                                       |  |                                                                         |     |
| reserve convention<br>format | 68h | 03h | 03h | 68h | 53h/73h     | A | 50h          |                                   |     | CS | 16h |                                                                                       |  | request all datas,answered message format is listed in table 2<br>(All) | E5h |
| reserve convention<br>format | 68h | 04h | 04h | 68h | 53h/73h     | A | 50h          | 00                                |     | CS | 16h |                                                                                       |  | request all datas,answered message format is listed in table 2<br>(All) | E5h |
| reserve quick<br>format      | 68h | 04h | 04h | 68h | 53h/73h     | A | 50h          | 51h                               |     | CS | 16h |                                                                                       |  | request quick readout datas<br>(QUICK READOUT)                          | E5h |
| reserve user data<br>format  | 68h | 04h | 04h | 68h | 53h/73h     | A | 50h          | 10h                               |     | CS | 16h |                                                                                       |  | request total heat quantity W,total flow V<br>(User Data)               | E5h |



|                          |               |                              |                   |                                      |                   |                                                                                                                                                                     |
|--------------------------|---------------|------------------------------|-------------------|--------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| update cycle             | 08h 74h       | all update cycle             | C8h 3Fh 74h       | total heat quantity of last year     | 48h 00h...0Fh     | Remark: “...” in code means<br>“between”.for example:between<br>00h...0Fh,any digit is available.so<br>that 08h 00h code has the same<br>function with 08h 0Dh code |
| 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       |                                      |                   |                                                                                                                                                                     |

|                              |  |     |     |     |     |         |    |     |     |          |     |           |                     |    |    |              |                                                                    |                       |
|------------------------------|--|-----|-----|-----|-----|---------|----|-----|-----|----------|-----|-----------|---------------------|----|----|--------------|--------------------------------------------------------------------|-----------------------|
|                              |  | L   | L   |     | C   | A       | CI | 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 LCD      |  | 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 protocol |
| startup flow rate            |  | 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                   |

|                                      |     |     |     |     |             |   |              |     |                   |     |     |                    |    |     |                                                                                                    |     |
|--------------------------------------|-----|-----|-----|-----|-------------|---|--------------|-----|-------------------|-----|-----|--------------------|----|-----|----------------------------------------------------------------------------------------------------|-----|
| calibrating                          |     |     |     |     |             |   |              |     |                   |     |     |                    |    |     |                                                                                                    |     |
| startup heat<br>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<br>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<br>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<br>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<br>1               | 68h | 0Dh | 0Dh | 68h | 53h/73h     | A | 51h          | 2Fh | 0Fh               | 04h | 58h | SSMMHHDDMMYY       | CS | 16h | setup date and time,recommendation parameter is<br>respectively second,minute,hour,day,month,year. | E5h |
|                                      |     |     |     |     |             |   |              |     |                   |     |     |                    |    |     |                                                                                                    |     |
|                                      |     | L   | L   |     | C<br>domain | A | CI<br>domain | DIF |                   |     |     |                    | CS |     |                                                                                                    |     |
| setup time method<br>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<br>format                                     | E5h |
| setup time method<br>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<br>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 | 1s-31s, determined by user' setup. Default :3s.                                                                                    |          |
|      |                                        | (/ means "or" ) |                                                                                                                                    |          |
| 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/FBh09h      | 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 <sup>3</sup> )                                                                                             |          |
|      |                                        | 00h 00h 00h 40h | Total flow=2.0 m <sup>3</sup>                                                                                                      |          |
| 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 <sup>3</sup> /h)                                                                                        |          |
|      |                                        | 38h A1h 80h 3Eh | Instant flow=0.25123 m <sup>3</sup> /h                                                                                             |          |
| 6    | current supply water temperature       | 05h             | DIF: four byte float, no DIFE, (Current Value)                                                                                     |          |
|      |                                        | 5Bh             | VIF: supply water temperature(°C)                                                                                                  |          |
|      |                                        | 00h 40h B1h 42h | 88.625 °C                                                                                                                          |          |
| 6    | current return water temperature       | 05h             | DIF: four byte float, no DIFE, (Current Value)                                                                                     |          |
|      |                                        | 5Fh             | VIF: return water temperature (°C)                                                                                                 |          |
|      |                                        | 4Dh 55h 85h 42h | 66.66666 °C                                                                                                                        |          |
| 6    | current temperature difference         | 05h             | DIF: four byte float, no DIFE, (Current Value)                                                                                     |          |
|      |                                        | 63h             | VIF: temperature difference (°C)                                                                                                   |          |
|      |                                        | CEh AAh AFh 41h | 22.9584°C                                                                                                                          |          |
| 6    | total flow of last year                | 45h             | DIF:octet BCD number, no DIFE, memory number 1=year value                                                                          |          |
|      |                                        | 15h             | VIF: total flow (m <sup>3</sup> )                                                                                                  |          |
|      |                                        | 00h 00h 00h 40h | 2.0 m <sup>3</sup>                                                                                                                 |          |
| 6/7  | total heat quantity of last year       | 45h             | DIF:octet BCD number, no DIFE, memory number 1=last year value                                                                     |          |
|      |                                        | 0Dh/FBh09h      | 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, behind 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 <sup>3</sup> /h                                                                                                |          |
|      |                                        | 38h A1h 80h 3Eh | Instant flow=0.25123 m <sup>3</sup> /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 °C                                                                                                                         |          |
| 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 (°C)                                                                                                 |          |

|     |                                            |                 |                                                                                                                |  |
|-----|--------------------------------------------|-----------------|----------------------------------------------------------------------------------------------------------------|--|
|     |                                            | 38h A1h 80h 3Eh | 0.25123 °C                                                                                                     |  |
| 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                                                                      |  |
|     |                                            | 0DhFBh09h       | 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                                                                      |  |
|     |                                            | 0DhFBh09h       | 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                                                                      |  |
|     |                                            | 0DhFBh09h       | 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                                                                      |  |
|     |                                            | 0DhFBh09h       | 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 (°C)                                                                             |  |
|     |                                            | 7Fh             | 127°C                                                                                                          |  |
| 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 (°C)                                                                             |  |
|     |                                            | 23h             | 35°C                                                                                                           |  |
| 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 (m³/h)                                                                                       |  |
|     |                                            | 79h E9h F6h 42h | 123.456 m³ /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                                                                    |  |
|     |                                            | 0DhFBh09h       | VIF: total heat flow (1KWh/1GJ)                                                                                |  |
|     |                                            | 00h 00h 00h 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                                                            |  |
|     |                                            | 0DhFBh09h       | 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                                                            |  |
|     |                                            | 0DhFBh09h       | 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 (m³)                                                                                           |  |
|     |                                            | 00h 00h 00h 00h | 0 m³                                                                                                           |  |
| 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    |                                  | 01h             | DIF: single byte integer , no DIFE, (Current Value)                                                                                 |        |
|      | current update cycle             | 74h             | VIF: update cycle, unit:s                                                                                                           |        |
|      |                                  | 01h/02h/.../1Fh | 1s-31s, determined by user' setup. Default :3s.                                                                                     |        |
| 3    |                                  | 01h             | DIF: single byte integer , no DIFE, (Current Value)                                                                                 |        |
|      | current measuring cycle          | 70h             | VIF: measuring cycle (average time), unit:s                                                                                         |        |
|      |                                  | 01h/02h/.../1Fh | 1s-31s, determined by user' setup. Default :3s.                                                                                     |        |
| 6/7  |                                  | 05h             | DIF: 4 byte binary system integer , no DIFE, (Current Value)                                                                        |        |
|      | current total heat quantity      | 0Dh/FBh/09h     | VIF: total heat quantity unit (1KWh/1GJ)                                                                                            |        |
|      |                                  | 01h 01h 00h 00h | total heat quantity=257 KWh/GJ                                                                                                      |        |
| 6    |                                  | 05h             | DIF: 4 byte binary system integer , no DIFE, (Current Value)                                                                        |        |
|      | current total flow               | 16h             | VIF: total flow unit (m <sup>3</sup> )                                                                                              |        |
|      |                                  | 01h 01h 00h 00h | total flow=257 m <sup>3</sup>                                                                                                       |        |
| 6    |                                  | 05h             | DIF: 4 byte binary system integer , no DIFE, (Current Value)                                                                        |        |
|      | current instant heat quantity    | 2Eh             | VIF: instant heat quantity (energy) unit: kW                                                                                        |        |
|      |                                  | 00h 00h A0h 3Fh | instant heat quantity=1.25 kW                                                                                                       |        |
| 6    |                                  | 05h             | DIF: 4 byte binary system integer , no DIFE, (Current Value)                                                                        |        |
|      | current instant flow             | 3Eh             | VIF: current flow rate unit: (m <sup>3</sup> /h)                                                                                    |        |
|      |                                  | 38h A1h 80h 3Eh | current flow rate=0.25123 m <sup>3</sup> /h                                                                                         |        |
| 6    |                                  | 05h             | DIF: 4 byte binary system integer , no DIFE, (Current Value)                                                                        |        |
|      | current supply water temperature | 5Bh             | VIF: supply water temperature(°C)                                                                                                   |        |
|      |                                  | 00h 40h B1h 42h | 88.625 °C                                                                                                                           |        |
| 6    |                                  | 05h             | DIF: 4 byte binary system integer , no DIFE, (Current Value)                                                                        |        |
|      | current return water temperature | 5Fh             | VIF: return water temperature(°C)                                                                                                   |        |
|      |                                  | 4Dh 55h 85h 42h | 66.66666 °C                                                                                                                         |        |
| 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 TDS-100 ultrasonic flow meter, so achieve to operate all functions 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 code (hexadecimal) | Key assignment code (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

- VB send sentence of inquiry instant flow per second  
`MSCOMM1.INPUT="dqs"+vbCrLf;`
- 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 quantity 5. 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;`
- 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”