

## Part Four

### M-BUS Communication Protocol

#### 1. Interface

- (A ) RS-485
- (B ) IR
- (C ) logic level USART

#### 2. Default settings

Telegram format: IEC 870-5-1, DIN EN1434-3

Baud rate : IR 2400

RS-485, USART: 9600

Odd-even check : Even

Data bits : 8 bits

#### 3. References

“The M-BUS : A Documentation” which can be downloaded from [www.m-bus.com](http://www.m-bus.com)

“TKB3417 Description of the MBUS module for Ultraheat”

#### 4. Special function

- \* Available to set date and time
- \* Available to set Baud rate
- \* Available to set main address
- \* Include the secondary address
- \* Choice promotion
- \* Available to set data telegram according to personal demands

**Table 1 Master=>Slave telegrams**

Main unit request command	Format	C 域				A	CS	C 域				Note	Machine response
Initialization (SEND_NKE)	68h	0Bh	68h	0Bh	53h/73h	FDh	52h	ID1-4 M1-2 G Med	CS	16h		C domain=control domain A domain=address domain CS=checksum, CI domain	
Data request (SEND_UD2)	68h	0Bh	68h	0Bh	53h/73h	FDh	56h	ID4-1 M2-1 G Med	CS	16h		Release public address, set as normal status, default baud rate	E5h
Delete the use of public address	68h	11h	68h	0Bh	53h/73h	FDh	52h	ID1-4 M1-2 G Med 0CH 78H SN1-4	CS	16h		Request the slave user's data of slave send response	RSP UD
Warning protocol (SEND_UD1)	68h	06h	68h	06h	53h/73h	A	51h	01h 7Ah NN	CS	16h		All slave release public address FDh, convenient for later use.	E5h
Communication test	68h	09h	68h	0Dh	53h/73h	A	51h	0Ch 79h SA1-4	CS	16h		Respond the warning check at full throttle	E5h
Search the main address	68h	0Dh	68h	0Dh	53h/73h	A	51h	07h 79h SA1-4 xxh,xxh,xxh	CS	16h		To test whether communication line works	E5h
												To respond the main address	
Select secondary address	68h	0Bh	68h	0Bh	53h/73h	FDh	52h	ID1-4 M1-2 G Med	CS	16h			
Select secondary address	68h	0Bh	68h	0Bh	53h/73h	FDh	56h	ID4-1 M2-1 G Med	CS	16h		ID1-4 is ID of 4 bits4, M1.2=88h, 11h G=1 Med=4 return water heat meter is in front*	E5h
Enhance to select address	68h	11h	68h	0Bh	53h/73h	FDh	52h	ID1-4 M1-2 G Med 0CH 78H SN1-4	CS	16h		High-order is in front, others same as above-message. (Med=0Ch is inflow heat meter) *	E5h
Modify the main address	68h	06h	68h	06h	53h/73h	A	51h	01h 7Ah NN	CS	16h		Add 0Ch 78h +4 byte serial number than above two message *	E5h
Modify the secondary address	68h	09h	68h	0Dh	53h/73h	A	51h	0Ch 79h SA1-4	CS	16h		NN means the new address of single byte, range from 1-250	E5h
Modify the secondary address	68h	0Dh	68h	0Dh	53h/73h	A	51h	07h 79h SA1-4 xxh,xxh,xxh	CS	16h		SA1-4 means the new address of 4 byte, to avoid two same address in one system.	E5h
Set the secondary address as ESN	68h	09h	68h	0Dh	53h/73h	A	51h	0Ch 79h 00h 00h 00h 00h	CS	16h		M-BUS secondary address is set as ESB by default setting, and it is available to modify the secondary address.	E5h
Set the secondary address as ESN	68h	0Dh	68h	0Dh	53h/73h	A	51h	07h 79h 00h 00h 00h 00h xxh,xxh,xxh,xxh	CS	16h		To solve the problem of same secondary address	E5h
Note, change of baud rate should be behind the response of the previous baud rate.													
Change baud rate	68h	03h	68h	03h	53h/73h	A	B8h	CS	16h			Change baud rate to 300 become the system default after power on again	E5h
Change baud rate	68h	03h	68h	03h	53h/73h	A	B9h	CS	16h			Change baud rate to 600 become the system default after power on again	E5h
Change baud rate	68h	03h	68h	03h	53h/73h	A	BAh	CS	16h			Change baud rate to 1200 become the system default after power on again	E5h
Change baud rate	68h	03h	68h	03h	53h/73h	A	BBh	CS	16h			Change baud rate to 2400 become the system default after power on again	E5h
Change baud rate	68h	03h	68h	03h	53h/73h	A	BCh	CS	16h			Change baud rate to 4800 become the system default after power on again	E5h
Change baud rate	68h	03h	68h	03h	53h/73h	A	BDh	CS	16h			Change baud rate to 9600 become the system default after power on again	E5h
Change baud rate	68h	03h	68h	03h	53h/73h	A	B7h	CS	16h			Restore baud rate to default	E5h

Reserve message type		L	L	C region	A	CI region	Preset data code		CS			
Reserve regular format	68h	03h	68h	53h/73h	A	50h			CS	16h		Demand all data, format of response message shown in table2 (All)
Reserve regular format	68h	04h	68h	53h/73h	A	50h	00		CS	16h		Demand all data, format of response message shown in table2 (All)
Reserve quick format	68h	04h	68h	53h/73h	A	50h	51h		CS	16h		Demand quick read of data (QUICK READOUT)
Reserve user data format	68h	04h	68h	53h/73h	A	50h	10h		CS	16h		Demand accumulated heat W, accumulated flow (User Data)
Reserve model of simple bill	68h	04h	68h	53h/73h	A	50h	20h		CS	16h		Demand W,V W,V of last year as well as running time BT and fault time F (Simple Billing)
Reserve model of complete bill	68h	04h	68h	53h/73h	A	50h	30h		CS	16h		Demand W,V W,V of last year, max flow/max heat, BT,FT (Enhanced Billing)
Reserve current data	68h	04h	68h	53h/73h	A	50h	50h		CS	16h		Demand W,V instant flow/heat flow, inflow temperature (Instant Values)
Reserve current data	68h	04h	68h	53h/73h	A	50h	80h		CS	16h		Demand serial number, balance date of heat supply
Switch to fast way	68h	05h	68h	53h/73h	A	51h	0F h	A1h	CS	16h		Quickly read the format, message format shown in table 3.
Switch to regular way	68h	05h	68h	53h/73h	A	51h	0F h	A0h	CS	16h		Reserve all output data
Switch to fast way	68h	03h	68h	53h/73h	A	A1h			CS	16h		Not recommend this message, which set for compatibility.
Switch to regular way	68h	03h	68h	53h/73h	A	A0h			CS	16h		Not recommend this message, which set for compatibility.
Reserve all data 1	68h	04h	68h	53h/73h	A	51h	7Fh		CS	16h		Message format shown in Table 2
Reserve all data 2	68h	06h	68h	53h/73h	A	51h	C8h	3Fh 7Eh	CS	16h		Message format shown in Table 2
Reserve empty message	68h	06h	68h	53h/73h	A	51h	7Fh	FEh 0Dh	CS	16h		
Reserve heat data	68h	06h	68h	53h/73h	A	51h	08h	05h	CS	16h		the essence is that general data choose message
Reserve heat of last year	68h	06h	68h	53h/73h	A	51h	48h	05h	CS	16h		the essence is that general data choose message
General data message	68h	L	68h	53h/73h	A	51h	Select code (combination)		CS	16h		Limit L<240, select all after power-on initializing

  

Code selection(combination) could choose any reserved data below and any combination of them.(for example, scheduled to read accumulated heat and accumulated flow, message format: 68 L												
L 68 53/73 A 51 08 14 08 2D CS 16)												
Update period	08h 74h	All update period	C8h 3Fh 74h	All average period	C8h 3Fh 70h	Accumulated heat rate of last year	48h 00h...0Fh	Accumulated flow rate of last year	48h 10h...17h	Balance date of the year	48h 6Ch	Fault time
Average period	08h 70h	All accumulated heat rate	C8h 3Fh 00h...0Fh	All accumulated flow rate	C8h 3Fh 10h...17h	Average period of last year	88h 10h 70h...73h	Max instant heat rate of last year	D8h 10h 28h...37h	Current max instant heat rate	98h 10h 28h...37h	Current max instant flow rate
Accumulated heat rate	08h 00h...0Fh	All instant heat rate	C8h 3Fh 28h...37h	All instant flow rate	C8h 3Fh 38h...4Fh	Current max inflow temperature	98h 10h 38h...4Fh	Current max return water temperature	98h 10h 5Bh	Current max inflow temperature	98h 10h 5Bh	Current max return water temperature
Accumulated flow rate	08h 10h...17h	All inflow temperature	C8h 3Fh 58h...5Bh	All return water temperature	C8h 3Fh 5Ch...5Fh	Temperature difference	08h 60h...63h	Serial number	08h 78h	Running time	08h 20h...23h	Time and date
Instant heat rate	08h 28h...37h	All temperature difference	C8h 3Fh 60h...63h	All serial number	C8h 3Fh 78h							
Instant flow rate	08h 38h...4Fh	All running time	C8h 3Fh 20h...23h									
Inflow temperature	08h 58h...5Bh	All time stamps	C8h 3Fh 6Ch									
Return water temperature	08h 5Ch...5Fh											
Temperature difference	08h 60h...63h											
Serial number	08h 78h											
Running time	08h 20h...23h											
Time and date	08h 6Ch											

Note: '...' in code means between. For example, 00h...0Fh means any numbers between 00h and 0Fh. It also means code of 08h 00h and 08h 0Dh have the same function.



## Part Five Haifeng ASCII protocol

1. The Haifeng Protocol is designed to be compatible with the one used in our previous versions of ultrasonic flow meters. This protocol is a set of basic commands that are in ASCII format, ending with a carriage return (CR) and line feed (LF). For most of the commands, The line feed (LF) should be better omitted for fast responding.

The colored commands in the following table are new ones

Command	Meaning	Data format
DQD(cr) <a href="#">note 0</a>	Request flow rate per day	±d.dddE±dd(cr) <a href="#">note 1</a>
DQH(cr)	Request flow rate per hour	±d.dddE±dd(cr)
DQM(cr)	Request flow rate per minute	±d.dddE±dd(cr)
DQS(cr)	Request flow rate per second	±d.dddE±dd(cr)
DQE(cr)	Request Instant Caloric Value	±d.dddE±dd(cr)
DV(cr)	Request fluid velocity	±d.dddE±dd(cr)
DI+(cr)	Request positive totalizer	±dddddE±d(cr) <a href="#">note 2</a>
DI-(cr)	Request negative totalizer	±dddddE±d(cr)
DIN(cr)	Request net totalizer	±dddddE±d(cr)
DIE(cr)	Request net thermal energy totalizer	±dddddE±d(cr)
DIE+(cr)	Request positive energy totalizer	±dddddE±d(cr)
DIE-(cr)	Request negative energy totalizer	±dddddE±d(cr)
DIT(cr)	Request net total flow for today	±dddddE±d(cr)
DIM(cr)	Return net total flow for this month	±dddddE±d(cr)
DIY(cr)	Request net total flow for this year	±dddddE±d(cr)
DID(cr)	Return the ID number/address	ddddd(cr) 5 bytes long
DL(cr)	Request signal strength and signal quality	UP:dd.d,DN:dd.d,Q=dd(cr)
DS(cr)	Request the percentage of AO output	±d.dddE±dd(cr)
DC(cr)	Request display number and Error Code	<a href="#">note 3</a>
DT(cr)	Request the present date and time	yy-mm-dd,hh:mm:ss uu(cr)
Time@TDS1=(cr)	Set date and time yy-mm-dd,hh:mm:ss	
MKEY@(cr) <a href="#">note 4</a>	Send a key value as if a key is pressed. @ is the key value	@ is key value which can be found in the KEY VALUE table
LCD(cr)	Request current window content	
MENUXX(cr)	Go to window XX	
BUADRATEExp(cr)	Change baud rate to “x” with parity “p”	x=2~7,9600,4800,2400,1200,600,300 p=N(none), E(even), O(odd)
BUADRATE-A	Restore baud rate for RS485	
BUADRATE-B	Restore baud rate for IR	
AO<(O)>4-20mA<(O)>digits string(cr)	Set AO to ‘a’ mA current	<a href="#">Note 5</a>
RING(cr)(lf)	Handshaking request from a modem	ATA(CR)(lf)
CUSTOMERNUMBER=	Set customer number	
CUSTOMERNUMBER?	Request customer number	
FIRMWAREVERSION	Request firmware information	
ESN(cr)	Request the ESN (electronic serial number) of the flow meter	49ddddd(cr)(lf) <a href="#">note 6</a>
MBUSADD= (str)	Set address to STR	
MBUSADD?	Request address number	
MBUSADD2= (str)	Set MBUS secondary address to STR	
MBUSADD2?	Request MBUS secondary address	
System Boot Instantly by 13840932903	Reboot the system	
Isp-Prog &JXWANG12	Command for firmware updating	
OCT<OUTPUT>=10	Quit OCT1 serial controlling mode	
OCT<OUTPUT>=11	OCT1 output open	
OCT<OUTPUT>=12	OCT1 output close	
OCT<OUTPUT>=20	Quit OCT2 serial controlling mode	

OCT<OUTPUT>=21	OCT2 output opcy en	
OCT<OUTPUT>=22	OCT2 output close	
SLEEP(*)>METER(*)>ENABLE=0	Enable sleep of the meter	
SLEPP(*)>METER(*)>ENABLE=1	Quit sleep of the meter	
AnalogInput0	Always readout 1.23456 for testing	±d.dddE±dd(cr)(lf)
AnalogInput1	Return temperature at T1 input	±d.dddE±dd(cr)(lf)
AnalogInput2	Return temperature at T2 input	±d.dddE±dd(cr)(lf)
AnalogInput6	Request CPU temperature	
AnalogInput7	Request battery voltage	
AnalogInput8	Request main clock frequency coefficient	
BATCH_A	Request batch controller total	
BATCH_V?	Request batch setting	
BATCH_V=(str)	Set a new batch	
BATCH_E0	Disable batch controller	
BATCH_E1	Enable batch controller	
BATCH_R0	Run Batch controller	
BATCH_R1	Stop Batch controller	
BATCH_T1?	Request trig timer #1	
BATCH_T1=DD HH:MM	Set trig timer #1	
BATCH_T2?	Request trig timer #2	
BATCH_T2=DD HH:MM	Set trig timer #2	
BATCH_T3?	Request trig timer #3	
BATCH_T3=DD HH:MM	Set trig timer #3	
BATCH_T4?	Request trig timer #4	
BATCH_T4=DD HH:MM	Set trig timer #4	
BATCH_T5?	Request trig timer #5	
BATCH_T5=DD HH:MM	Set trig timer #5	
TARIFF_T1?	Request tariff timer #1	
TARIFF_T1=MM-DD HH-MM	Set tariff timer #1	
TARIFF_T2?	Request tariff timer #2	
TARIFF_T2=MM-DD HH-MM	Set tariff timer #2	
TARIFF_T3?	Request tariff timer #3	
TARIFF_T3=MM-DD HH-MM	Set tariff timer #3	
DI2	Request Tariff total2	
DI3	Request Tariff total3	
N	Prefix of an IDN-addressing-based networking, The IDN address is byte, range 0-253	Note 7
W	Prefix of an IDN-addressing-based networking, The IDN address is word, range 0-65535	Note 7
P	Prefix of any commands for returns with check-sum	
&	Commands connector to make a compounding command in one line.	Result commands limit 253 or less byte long.

NOTES:

- (cr) stand for carriage return, its ASCII value is 0DH. (lf) stand for line feed, its ASCII value is 0AH.
- d stand for a digit number of 0~9, 0 is expressed as +0.000000E+00
- d stand for digit 0~9, the number before 'E' is an integer.
- The first two bytes are menu numbers, and the rest is ErrCode whose meaning can found at the display part.
- @ stand for key value, for example, value 30H means key '0'. The command 'MKEYA(cr)' acts just like the a short key is pressed.
- ' a' stands for the output current value. The maximum value should not exceed 20.0 For example

AO<(O)<4-20mA<(O)<2.34567(cr)

6. ' dddddd' stands for the Electronic Serial Number

7. If there are more than one devices in a network, all the basic command must be prefixed with 'N' or 'W', otherwise multiple flow meter may reply to the same request, and thus a conflict may occurs.

## 2. Working with Command prefixes and the command connector

### 2.1 The 'P' prefix

The 'P' prefix can be added before every basic command to have the returned message with a two digits check-sum. The check-sum is obtained by a binary addition. For example, if the command DI+(CR) (44H,49H,2BH,0DH in binary numbers ) will bring a return like +1234567E+0m3 (CR) (2BH,31H,32H,33H,34H,35H,36H,37H,45H,2BH,30H,6DH,33H,20H,0DH,0AH in binary numbers), then the PDI+(CR) will brings a return like +1234567E+0m3 !F7(CR), after the character'!' are the check-sum in ASCII format(2BH+31H+32H+33H+34H+35H+ 36H+37H+45H+2BH+30H+6DH+33H+20H=(2)F7H)

Pay attention to that there may be no characters or only spaces before the character '!'.

### 2.2 The 'N' prefix

The usage of prefix 'N' goes like: N + single byte address + basic command.

For example if the address number 88 flow meter is going to be addressed, the command should like: NXDV(CR), the decimal value of X should be 88.

The prefix W is strongly recommended for new users.

### 2.3 The 'W' prefix

Usage: W + character string address + basic command

The value of the character string should have a value in the range of 0~65535, except for the value of 13 (0DH carriage return) , 10 (0AH line feed) , 42 (2AH \*) , 38 (26H&) .

For example, if the velocity of number 12345 flow meter is wanted, the command can be like: W12345DV(CR), (57H,31H,32H,33H,34H,35H,44H,56H,0DH in binary numbers)

### 2.4 The command connector '&'

The command connector '&' adds several basic commands into a one-line compound command. The compound command should not exceed a length of over 253 characters. The prefix 'P' should be added before every basic command, to make the returned results having a check-sum.

For example, if the 1)flow rate 2)velocity 3)positive totalizer 4) net energy totalizer 5) the **AnalogInput1** input 6) the **AnalogInput2** input of the address number 4321 flow meter are wanted to return with check-sum, the one-line command is like:

W4321PDQD&PDV&PDI+&PDIE&P**AnalogInput1**&P **AnalogInput2**(CR)

The returned data are:

+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)

Any command can be connected together. For example, MENU11&MMEYA&MMEYA&MKEYA(CR)

## Part Six Compatibility Protocol

## Part Seven CJ-188-2004 communication protocol

The CJ-188-2004 is a Chinese National Standard for heat or energy meters

The command to read a meter with a ESN which is 17312151, the ESN is displayed on M07, is as following

FE FE FE FE FE FE FE FE FE FE FE FE 68 20 51 21 31 17 00 11 11 01 03 1F 90 12 29 16

Where all the numbers are in HEX.

The first 11 FEs are preamble

68(0x68) is starter

20(0x20) is meter type

51(0x51) is address A0. if address A0-A6 are all 0xAA, this command is a broadcasting one. Any meter will response to a broadcast command with it's ESN number in the response telegram. If there is only one meter on the BUS, a broadcasting command can be used to obtain the ESN number of the meter.

21(0x21) address A1

31(0x31) address A2

17(0x17) address A3 (A0、A1、A2、A3 is ESN number, lower byte first)

00(0x00) address A4, always 0x00 or 0xAA with a broadcasting command

11(0x11) address A5, always 0x11 or 0xAA with a broadcasting command

11(0x11) address A6, always 0x11 or 0xAA with a broadcasting command

01(0x01) Control Code

03(0x03) length of the DATA

1F(0x1F) DATA Identifier 0

90(0x90) DATA Identifier 1

12(0x12) SER

29(0x29) Checksum CS which is the arithmetic sum of all the numbers, except preambles (68 20 51 21 31 17 00 11 11 01 03 1F 90 12, the sum is 0x29)

16(0x16) ending byte.

A0,A1,A2,A3,CS change with the different meter number, others are fixed.

### User Telegram:

FE FE FE FE FE FE FE FE FE FE FE FE 68 20 51 21 31 17 00 11 11 81 2E 1F 90 12 00 00 00 00 05  
00 00 00 00 05 00 00 00 00 14 00 00 00 00 35 19 00 00 00 2C 76 30 00 68 30 00 73 02 00 32  
41 11 12 09 07 20 04 00 E9 16

68 means starting-frame symbol 68H

20 means type of instrument T

51 means address A0

21 means address A1

31 means address A2

17 means address A3 (A0、A1、A2、A3 is the heat meter number as read, from low to high)

00 means address A4

11 means address A5

11 means address A6

81 means control code C

2E means data length region L (1F 90 12 00 00 00 00 05 00 00 00 00 05 00 00 00 14 00 00 00 00 35 19 00 00 00 2C 76 30 00 68 30 00 73 02 00 32 41 11 12 09 07 20 04 00 totaling 2E characters)

1F means data identification DI<sub>0</sub>

90 means data identification DI<sub>1</sub>

12 means serial number SER

00 00 00 00 means current cold, 05 means unit of current cold: kWh(Table 1)

00 00 00 00 means current heat, 05 means unit of current heat: kWh(Table 1)

00 00 00 00 means thermal heat, 14 means unit of thermal heat: W(Table 1)



00 00 00 00 means instant flow rate, 35 means unit of instant flow rate:m<sup>3</sup>/h(Table 1)  
 19 00 00 00 means accumulated flow rate, 2C means unit of accumulated flow rate:m<sup>3</sup> (Table)  
 76 30 00 means supply water temperature 0030.76℃  
 68 30 00 means return water temperature 0030.68℃  
 73 02 00 means accumulated working time 00273 hours  
 32 41 11 12 09 07 20 means real time is 11:41:32 12/09/2007  
 04 00 means status words(as described in Table2, Table3), low battery voltage, inflow and outflow temperature transducers are normal, integrator is normal.  
 E9 means check code CS (68 20 51 21 31 17 00 11 11 81 2E 1F 90 12 00 00 00 00 05 00 00 00 00 05 00 00 00 14 00 00 00 00 35 19 00 00 00 2C 76 30 00 68 30 00 73 02 00 32 41 11 12 09 07 20 04 00 proceed binary system accumulation, excluding the overflow value exceeded FFH.  
 16 means end mark 16H

The normal response frame of heat meter begin with 68H end with 16H. A4,A5,A6 are fixed at 00H 11H 11H, control code is fixed at 81H, data length region is fixed at 2EH, data identification and serial number are the same as they are transmitted, other bytes are changed with the specific heat meter.

Table1 Unit and Code

Unit	Code	Unit	Code
Wh	02H	GJ×100	13H
kWh	05H	W	14H
MWh	08H	kW	17H
MWh×100	0AH	MW	1AH
J	01H	L	29H
kJ	0BH	m <sup>3</sup>	2CH
MJ	0EH	L/h	32H
GJ	11H	m <sup>3</sup> /h	35H

Table2 Status ST definition table of the first byte

	D0	D1	D2	D3	D4	D5	D6	D7
Definition	—	—	Battery voltage	Reserve	Reserve	Reserve	Reserve	Reserve
Description	—	—	0: normal 1: under voltage	Reserve	Reserve	Reserve	Reserve	Reserve

Table3 Status ST definition table of the secondary byte

	D0	D1	D2	D3	D4	D5	D6	D7
Definition	Integrator breakdown	Supply water temperature transducer breakdown	Return water temperature transducer breakdown	Flow rate transducer breakdown	Reserve	Reserve	Reserve	Reserve
Description	0: normal 1: breakdown	0: normal 1: breakdown	0: normal 1: breakdown	0: normal 1: breakdown	Reserve	Reserve	Reserve	Reserve