TDS-100M Ultrasonic Flowmeter

User Manual（Ver.18.0）

ULTRASONIC FLOWMETER

Flow 0.0000 m3/h *I
NET   0x1 m3

MENU ▲ ▶ ENT

Due to the busy development new generation of flow meters, we translated only the important and new parts for the user manual of the TDS-100M ultrasonic flow meter/converter. Full translation will be available later. We apology for the inconveniency caused by there is no proper English user manual.

Technical Manual for new versions TDS-100

1. Introduction

The new versions of TDS-100 ultrasonic flow meter/ultrasonic transmitter/ultrasonic heat meter are developed based on our earlier version-7 and version-11 ultrasonic flow meter.

1. Must-knows about TDS-100M

Please the users must read the following paragraphs when you use TDS-100M for the first time

1. The setup of a TDS-100M ultrasonic flow converter needs one of the three tools. The first tool is a parallel LCD and keypad module which can be connected to the 20 Pins port. The second tool is a serial LCD and keypad module which can be connected to the RS232 port. The third one is a PC-based software (under development), by means of the software, the parameters that TDS-100M needs to work properly could be downloaded by use of the RS232 port on the PC. If your computer does not have a RS232 port, you need to buy a USB-RS232 converter.

2. All setup parameter data are stored in the RAM memory temporally. Users need to solidify the parameters, when setups are been finished, that is to store the parameter to the internal flash memory. Go to Menu26, Select the option that says "make default paras" then pressing the ENT key will start the progress of storing. If the current parameters are different with that in the flash memory, the system will store your current parameters into the flash memory and then boot again. By doing so, the parameters will always be get lost, even when both the power supply and the backup battery are removed.

3. The zero point, that is the indicated flow under the situation of motionless liquid, has a great influence over the linearity and accuracy of the flow meter. Users should try every possibility to perform the Zero Setup that is located at Menu 42. Zero setup should always been performed under the condition of motionless liquids. If Zero setup was been performed with motion of the liquid, you can use Menu 43 to restore to the original zero point. The zero point will be stored in the RAM memory temporally when you use Menu 42. If you want to solidify the zero point, you need to perform Menu 26 "make default paras" function again. If this step was omitted, the system will override the RAM zero point by restoring the zero point that is stored in the flash memory with next power-on.

4. The internal calendar is the base of date accumulators. Incorrect date and time will cause messy records with the date accumulators. Please the user check the calendar by input correct date and time. The calendar runs relying on the backup battery when there is no 24VDC supply. When the battery voltage is less than 2 volts, a new backup battery should be replaced with. Replacing the battery with a new one should be performed with the 24VDC applied so that the accumulator data and calendar data will not get lost.

5. Please pay great attention to the power supply. The applied voltage should be in the range of +15V to 24VDC, or 15V to 20VAC. Avoid applying a 110VAC or 220VAC power forever, or the module will be damaged.

6. Pay attention to the display located on Menu 48, which shows the points of lines for the linearity correction function. 0 stands for shutting off the function. The default value is 0. Try to make sure that value is 0 so as to avoid abnormal flow.

7. The latest calibrated data which are produced by performing the analog input or output calibration are store in the RAM memory temporally. Users need to perform the M26 function to make these data be solidified.

8. Use Menu 49 to check if there are inputs from the RS232 port with network application. If not, please check protocol selection software switch located at Menu 63 and the serial port parameters options located at Menu62. Select option 1 at Menu 63 for the MOSBUS RTU application. Select option 0 for MODBUS ASCII and FUJI extended and Simple Water Meter protocols.

9. By a flash of the LED indicator for every 2 seconds, TDS-100M means the meter work properly. A short flash for every second indicates no-signal or poor signal condition and a long flash for every second shows the meter is performing a receiving gain adjusting.

2. Introduction to TDS-100M

(1) Development introduction

The TDS-100M is a compact, high performance general purpose ultrasonic flow meter module. The design of the meter is intended to provide for users like system integrators and OEM users with a lowest cost but of high performance flow meter. The development of the meter is based on a widely used flow meter made by this company. The meter uses only one high performance MSP430 series microprocessor made by Taxes Instruments.

This module can work alone without a LCD and Keypad module. The parameters that the flow meter needed to work properly can be (1) setup by a parallel keypad module witch will be plugged onto the parallel interface inside of the module, or by a serial keypad module witch will be plugged onto the RS232C or RS485 port of the meter. (2) downloaded by use of a PC computer based software (the software is under development now).

The transducers can be one the all kinds of the types made by this company, include the clamp-on type, the insertion type, the PI- type and standard-pipe type. It can even use transducers by the users or the transducers made by other company.

The module will satisfy the measurement requirement for most kind of liquids, such as water, sea water, sew water and chemistry liquids. It can even measure pure paper pulp or fluids with higher density suspend particles.

The module can be used alone as a flow meter. Users can even integrate a number of the modules into a multi-channel flow meter that can measures up to several dozen of different pipes or a flow meter that has higher accuracy by measures the same pipe with all the channels.

The low flow performance of this module is better compared with our previous flow meters. It can measures a flow that is as low as 0.001m/S properly when the PI-transducers are used.

(2)Features

1. better than 1% accuracy, better than 0.2% repeatabilty.

2. 128 times of measurement and the revised software make the performance better and the indicated flow more stable.

3. RS232 and RS485 serial port

4. One or two analog inputs.

5. Optional 4-20mA analog output.

6. Two OCT output channels

7. Ability to measure sew water.

8. 4 kinds of different types of transducers can be used, addition with user-defined transducers.

9. The internal universal serial bus enables several output modules to be connected to it.

10. All the parameters can be solidify into the flash memory.

11. Several optional function module to be chosen to add to the main module.

12. 3 different kinds of communication protocol supported by the same time, include MODBUS.

13. Date totalizers that can record as much as 128 sets of data by day, 64 sets of data by month. All the data can be retrieved by use of the MODBUS registers

14. 32 times of records of power-on and power-off data. Data can be read through MOBUS.

15. built-in data logger/printer, full programmable with what to be print ,the start time, interval, and duration.

16. Programmable pulse width of OCT output.

17 Parallel interface for display and keypad.

18 plug-on-and-off display and keypad module can be connected to the serial port of the meter.

19 Almost the same menu arrangement make the users of previous version of flow meter very easy to operate.

20 A fluid velocity threshold enables the identification of the kinds of fluid.

21. Digital inputs can be inputted by used of the analog inputs.

22. A full programmable built-in batch controller which can be started by key-pressing, inputs to the analog inputs or through MODBUS protocol.

23. Power supply by 15VDC~24VDC/50mA or 15VAC~17VAC/50mA.

3. Menu Window Details

The flow meter user interface comprises about 100 independent windows. That are numbered by M00,M01,M02……. M99,M+0,M+1 etc.

You do not need to remember all the menu windows. Just remember the most command used windows and the proximate window numbers of some uncommonly used windows would be sufficient. You can always use the going up and going down key to find the right window.

Note: 1 it is recommended to practice those menu windows on your flow meter while reading this chapter for the sake of easier understanding.
    2.To quickly switch to a menu window, simply press the 'MENU' key followed by the window number (a two digit number). To move from one window to the next, use 'UP' or 'Down' keys.

Menu Window No.	Function
M00	Display flow rate and NET totalizer If the the net totalizer is turned off, the net totalizer value shown on the screen is the value prior to its turn off Select all totalizer unit in menu M31
M01	Display flow rate, velocity
M02	Display date time and POS(positive) totalizer If the the positive totalizer is turned off, the positive totalizer value shown on the screen is the value prior to its turn off
M03	Display flow rate and NEG(negative) totalizer If the the negative totalizer is turned off, the negative totalizer value shown on the screen is the value prior to its turn off
M04	Display date and time, flow rate. The date and time setting method is found in MENU60
M05	Display energy rate(instantaneous Caloric)and total energy (Caloric)
M06	Display temperatures, inlet T1, outlet T2
M07	Display analog inputs, AI3/AI4, current value and its corresponding temperature or pressure or liquid level value
M08	Display all the detailed error codes Display working condition and system error codes. 'R' stands for normal, others refer to Chapter for details.
M09	Display today's total NET flow
M10	Window for entering the outer perimeter of the pipe If pipe outer diameter is known, skip this menu and go to Menu 11to enter the outer diameter
M11	Window for entering the outer diameter of the pipe. Valid range:0 to 18000mm. Note: you just need to enter either the outer diameter in M11 or the peripheral in M10
M12	Window for entering pipe wall thickness You may skip the menu and enter inner diameter in M13 instead.
M13	Window for entering the inner diameter of the pipe If pipe outer diameter and wall thickness are enter correctly, the inner diameter will be calculated automatically, thus no need to change anything in the windown
M14	Window for selecting pipe material Standard pipe materials (no need to enter material sound speed) include: (0) carbon steel (1) stainless steel (2) cast iron (3) ductile iron (4) copper (5) PVC (6) aluminum (7) asbestos (8) fiberglass (9) other(need to enter material sound speed in M15)
M15	Window for entering the pipe material speed, only for non-standard pipe materials
M16	Window for selecting the liner material, select none for pipes without any liner. Standard liner materials(no need to enter the liner sound speed) include: (1) Tar Epoxy (2) Rubber (3) Mortar (4) Polypropylene (5) Polystryol (6)Polystyrene (7) Polyester (8) Polyethylene (9) Ebonite (10) Teflon (11) Other (need to enter liner sound speed in M17)
M17	Window for entering the non-standard liner material speed.
M18	Window for entering the liner thickness, if there is a liner
M19	Window for entering the ABS thickness of the inside wall of the pipe
M20	Window for selecting fluid type For standard liquids(no need to enter fluid sound speed) include: (0) Water (1) Sea Water (2) Kerosene (3) Gasoline (4) Fuel oil (5) Crude Oil (6) Propane at -45C (7) Butane at 0C (8)Other liquids(need to enter sound speed in M21 and viscosity in M22) (9) Diesel Oil (10)Caster Oil (11)Peanut Oil (12) #90 Gasoline (13) #93 Gasoline

	(14) Alcohol (15) Hot water at 125C
M21	Window for entering the the sound speed of non- standard liquid, used only when option item 8 'Other' is selected in M20
M22	Window for entering the viscosity of the non-standard liquids, used only when option item 8 'Other' is selected in M20
M23	Window for selecting transducer type, There are 22 types as following 　0.　Standard M　　　　(The middle size) 　1.　Insertion Type C 　2.　Standard S 　3.　User Type 　4.　Standard B 　5.　Insertion Type B(45) 　6.　Standrad L　　　　(The large size transducers) 　7.　JH-Polysonics 　8.　Standard-HS　　(small size transducer for Handheld flow meter) 　9.　Standard-HM　(middle size transducer for Handheld flow meter) 　10. Standard-M1　(middle size transducer #1) 　11. Standard-S1　(small size transducer #1) 　12. Standard-L1　(large size transducer #1) 　13. PI-Type 　14. FS410　　　　(middle size transducer for FUJI flow meter) 　15. FS510　　　　(large size transducer for FUJI flow meter) 　16. Clamp-on TM-1 (Middle size transducer for other company) 　17. Insertion TC-1　(for other company) 　18. Calmp-on TS-1　(small size for other company) 　19. Reserved 　20. Clamp-on TL-1　(For other company) 　21. Insertion TLC-1　(For other company) If the user-type-transducer is selected, you need enter additional 4 user-type-wedge parameters that describe the user transducers. If the PI-type transducer is selected, you need enter additional 4 PI-type transducer parameters that describe the PI-type transducers
M24	Window for selecting the transducer mounting methods Four methods can be selected: (0) V-method (1) Z-method (2) N-method (3) W-method
M25	Display the transducer mounting spacing or distance
M26	(1) A switch for the parameters in flash memory will be loaded when power is turned on. The default option is that the parameters will be loaded. If this switch is not turned on, the system will try to use the parameters in the system RAM, if these parameters are ok, otherwise the system will load the parameters in flash memory (2) Function to store the current parameters into the flash memory, so that these parameters will be solidified and will be loaded as the default parameters every time when power is turned on.
M27	Entry to store to or restore from the internal Flash memory, as many as 9 different pipe parameter configurations To save or load the current setup parameter, use the going up or going down keys to change the address number, press 'ENT' key, and use going down or going up keys to select to save to or load from the memory.
M28	Entry to determine whether or not to hold (or to keep) the last good value when poor signal condition occurs. YES is the default setup.
M29	Entry to setup empty signal threshold. When the signal is less than this threshold, the pipe is regarded as empty pipe, and the flow meter will not totalize flow. This is based on the fact that, for most occasions, when pipe is empty, the transducer would still receive signal, just smaller than normal, As a result, The flow meter would show normal operation, which is not correct. Make sure that the enter value must be less than the normal signal strength.

	To make sure that, when much noisy signals are received, the flow meter will not incorrectly totalize flow, there is also a 'Q' threshold should be entered in M.5
M30	Window for selecting unit system. The conversion English to Metric or vice versa will not affect the unit for totalizers.
M31	Window for selecting flow rate unit system. Flow rate can be in 0. Cubic meter short for (m3) 1. Liter (l) 2. USA gallon (gal) 3. Imperial Gallon (igl) 4. Million USA gallon (mgl) 5. Cubic feet (cf) 6. USA liquid barrel (bal) 7. Oil barrel (ob) The flow unit in terms of time can be per day, per hour, per minute or per second. So there are 32 different flow rate units in total for selection.
M32	Window for selecting the totaliziers unit. Available units are the same as those in M31
M33	Window for setting the totalizer multiplying factor The multiplying factor ranges from 0.001 to 10000. Factory default is 1
M34	Turn on or turn off the NET totalizer
M35	Turn on or turn off the POS (positive) totalizer
M36	Turn on or turn off the NEG(negative) totalizer
M37	(1) Totalizer reset (2) Restore the factory default settings parameters. Press the dot key followed by the backspace key. Attention, It is recommended to make note on the parameters before doing the restoration
M38	Manual totalizer used for easier calibration. Press a key to start and press a key to stop the manual totalizer.
M39	Interface Language selection. The selection could also be changed automatically by the system, if English LCD display is used as the display device.
M3.	Setup for local segmental LCD display. Enter 0 or 1 for the non-auto-scan mode; Enter 2~39 for the auto-scan mode. In the auto-scan mode the display will automatically scan displaying from 00 to the entered number of the local segmental LCD display.
M40	Flow rate damper for a stable value. The damping parameter ranges form 0 to 999 seconds. 0 means there is no damping. Factory default is 10 seconds
M41	Low flow rate (or zero flow rate) cut-off to avoid invalid accumulation.
M42	Zero calibration/Zero point setup. Make sure the liquid in the pipe is not running while doing the setup.
M43	Clear the zero point value, and restore the solidified zero point value.
M44	Set up a flow bias. Generally this value should be 0.
M45	Flow rate scale factor. The default value is '1'. Keep this value as '1', when no calibration has been made.
M46	Network address identification number. Any integer can be entered except 13(0DH, carriage return), 10 (0AH, line feeding), 42 (2AH), 38, 65535. Every set of the instrument in a network environment should have a unique IDN. Please refer to the chapter for communication.
M47	System locker to avoid modification of the system parameters. If password is forgotten, you could send a command 'LOCK0' to the serial input to unlock. Or you can write 0 to REGISTER49-50 under MODBUS protocol.
M48	Entry to linearity correcting data inputs. By using of this function, the non-linearity of flow meter will be corrected. Correcting data shall be obtained by careful calibration.
M49	Displays the input contents for the serial port. By checking the displays, you can know if the communication is ok.
M50	Switches for the built-in data logger. There are as many as 22 different items can be

	chosen. To turn the this function, select 'YES' the system will ask for selecting the items. There are 22 items available. Turn on all those items you want to output
M51	Window to setup the time of scheduled output function (data logger, or Thermo-printer). This includes start time, time interval and how many times of output. When a number great than 8000 entered for the times of output, It means the output will be keeping always. The minimum time interval is 1 second and the maximum is 24 hours.
M52	Data logging direction control. (1) If 'Send to RS485' is selected, all the data produced by the data logger will be transmitted out through the RS-232/RS485 interface (2) If 'To the internal serial BUS' is selected, the data will be transmitted to the internal serial bus which allows a thermal printer, or a 4-20mA analog output module, to be connected to it.
M53	Display analog inputs, AI5, current value and its corresponding temperature or pressure or liquid level value.
M54	Pulse width setup for the OCT (OCT1) output. Minimum is 6 mS, maximum is 1000 mS
M55	Select analog output (4-20mA current loop, or CL) mode. Available options: (0) 4-20mA output mode (setup the output range from 4-20mA) (1) 0-20mA output mode (setup the output range from 4-20mA, This mode can only be used with Version-15 flow meter) (2) Serial port controls 0-20mA (3) 4-20mA corresponding fluid sound speed (4) 20-4-20mA mode (5) 0-4-20mA mode (can only be used with Version-15 flow meter) (6)20-0-20mA mode(can only be used with Version-15 flow meter) (7) 4-20mA corresponding flow velocity (8)4-20mA corresponding heat flow rate
M56	4mA or 0mA output value, Set the value which corresponds to 4mA or 0mA output current (4mA or 0mA is determined by the setting in M55)
M57	20mA output value, Set the value which corresponds to 20mA output current
M58	Current loop verification Check if the current loop is calibrated correctly.
M59	Display the present output current of current loop circuit.
M60	Setup system date and time. Press ENT for modification. Use the dot key to skip the digits that need no modification.
M61	Display Version information and Electronic Serial Number (ESN) that is unique for each flow meter. The users may employ the ESN for instrumentation management
M62	RS-232/RS485 setup. All the devices connected with flow meter should have matched serial configuration. The following parameters can be configured: Baud rate (300 to 19200 bps), parity, data bits (always is 8), stop bits
M63	Select communication protocol. Factory default is 'MODBUS ASCII+TDS7'.this is a mode for MODBUS-ASCII, Meter-BUS, TDS7-Fuji Extended Protocol, Huizhong's various protocols. If you are going using MODBUS-RTU you have to select ' MODBUS_RTU'.
M64	AI3 value range. Used to enter temperature/pressure values that are corresponding to 4mA and 20mA input current. The display values have no unit, so that they can present any physical parameter.
M65	AI4 value range. Used to enter temperature/pressure values that are corresponding to 4mA and 20mA input current.

M66	AI5 value range. Used to enter temperature/pressure values that are corresponding to 4mA and 20mA input current.
M67	Windows to setup the frequency range (lower and upper limit) for the frequency output function. Valid range is 0Hz-9999Hz. Factory default value is 0-1000 Hz. For Version-12, Version-13, Version-14 flow meters, you need a hardware module, which shall be plugged to the Serial Expanding Bus, for the frequency output function. Please remember to order the module if you need frequency output function. For Version-15 flow meter, you need to indicate on your orders that you need the frequency function; Otherwise you will get a flow meter which has no frequency output circuits.
M68	Window to setup the minimum flow rate value which corresponds to the lower frequency limit of the frequency output.
M69	Windows to setup the maximum flow Rate value that corresponds to the upper frequency limit of the frequency output.
M70	LCD display backlight control. The entered value indicates how many seconds the backlight will be on with every key pressing. If the enter value is great than 50000 seconds, It means that the backlight will always keeping on.
M71	LCD contrast control. The LCD will become darker or brighter when a value is entered.
M72	Working timer. It can be cleared by pressing ENT key, and then select YES.
M73	Window to setup the lower limit of flow rate for Alarm#1. When the flow rate is below the set value, Alarm#1 equals 'on'
M74	Window to setup the upper limit of flow rate for Alarm#1. When the flow rate is above the set value, Alarm#1 equals 'on' There are two alarms in the flow meter, and every alarm can be pointed to alarm output devices such as the BUZZER or OCT output or RELAY output. For example, if you want the Alarm#1 be to output by the OCT circuit, you need to set M78 at selection item 6.
M75	Window to setup the lower limit of flow rate for Alarm#2.
M76	Window to setup the upper limit of flow rate for Alarm#2.
M77	Buzzer setup. If a proper input source is selected, the buzzer will beep when the trigger event occurs. The available trigger sources are: 0. No Signal 1. Poor Signal 2. Not Ready(No*R) 3. Reverse Flow 4. AO Over 100% 5. FO Over 120% 6. Alarm #1 7. Reverse Alarm #2 8. Batch Control 9. POS Int Pulse 10.NEG Int Pulse 11.NET Int Pulse 12.Energy POS Pulse 13.Energy NEG Pulse 14.Energy NET Pulse 15.MediaVel=>Thresh 16.MediaVelo<Thresh 17.ON/OFF viaRS232 18.Key Stroking ON 19.Disable BEEPER
M78	OCT (Open Collect Transistor Output)/OCT1 setup By selecting a proper input source, the OCT circuit will close when the trigger event occurs. The available trigger sources are: 0. No Signal 1. Poor Signal 2. Not Ready(No*R) 3. Reverse Flow 4. AO Over 100% 5. FO Over 120% 6. Alarm #1 7. Reverse Alarm #2 8. Batch Control 9. POS Int Pulse 10.NEG Int Pulse 11.NET Int Pulse 12.Energy POS Pulse 13.Energy NEG Pulse 14.Energy NET Pulse 15.MediaVel=>Thresh 16.MediaVelo<Thresh 17.ON/OFF viaRS232 18.Oct Not Using When the OCT circuit is close, it will draw current. The maximum current shall not be over 100mA. When the OCT circuits is open, there will be no current output or draw in. Attention: the maximum voltage applied to OCT can not be over 80 volts or the circuit will be damaged
M79	Relay or OCT2 setup By selecting a proper input source, the hardware will close when the trigger event

	occurs Note. In order to make the user interface compatible with the future tds10, the name RELAY was used other than OCT2, but in fact it is an OCT output. The available trigger sources are: 0. No Signal 1. Poor Signal 2. Not Ready(No*R) 3. Reverse Flow 4. AO Over 100% 5. FO Over 120% 6. Alarm #1 7. Reverse Alarm #2 8. Batch Control 9. POS Int Pulse 10.NEG Int Pulse 11.NET Int Pulse 12.Energy POS Pulse 13.Energy NEG Pulse 14.Energy NET Pulse 15.MediaVel=>Thresh 16.MediaVelo<Thresh 17.ON/OFF viaRS232 18.Disable Relay
M80	Window for selecting the trig signal for the built-in batch controller. Available trig sources: 0. Key input (press Ent key to start the batch controller) 1. Serial port 2. AI3 rising edge (when AI3 receives 2mA or more current) 3. AI3 falling edg (when AI3 stop receiving 2mA or more current) 4. AI4 rising edge (when AI3 receives 2mA or more current) 5. AI4 falling edge (when AI3 stop receiving 2mA or more current) 6. AI5 rising edge (when AI3 receives 2mA or more current) 7. AI5 falling edge (when AI3 stop receiving 2mA or more current) For the input analog current signal, 0 mA indicates "0", 4mA or more indicates '1'.
M81	The built-in batch controller Set the flow batch value(dose) The internal output of the batch controller can be directed either to the OCT or the RELAY output circuits. M81 and M80 should be used together to configure the batch controller. Note: Because the measuring period is 500mS, the flow for every dos should be keeping at 60 seconds long to get a 1% dose accuracy.
M82	View the dayly, monthly and yearly flow totalizer and thermal energy totalizer value. The totalizer values and errors for the last 64 days, 32 last 32 months and last 2 years are stored in the RAM memory, To view them, use the 'ENT' and 'UP' 'Down' keys.
M83	Automatic Amending Function for automatic offline compensation. Select 'YES' to enable this function, select 'NO' to disable it. When the function is enabled, The flow meter will estimate the average flow uncounted (or 'lost') during the offline session and add the result to the totalizer. The estimation of the uncounted flow is made by computing the product of the offline time period and the average flow rate, which is the average of the flow rate before going offline and the one after going on line.
M84	Set the thermal energy unit: GJ or KC.
M85	Select temperature sources 0. from T1,T2 (factory default) 1. from AI3,AI4
M86	Select the Specific Heat Value. Factory default is 'GB'. Under this setting, the flow meter will calculate the enthalpy of water based on the international standard. If the fluid is other than water, you should select option '1. Fixed Specific Heat', and enter the specific heat value of the fluid.
M87	Turn on or turn off the Energy totalizer.
M88	Select thermal energy totalizer multiplying factor. Factory default is '1'.
M89	1. Display the temperature difference 2. Window for entering the lowest temperature difference.
M90	Display signal strengths S (one for upstream and one for downstream), and signal quality Q value. Signal strength is presented by 00.0 to 99.9, the bigger the value, the bigger the signal

	strength will be, and more reliable readings will be made. Q value is presented by 00 to 99, the bigger the better. It should at least be great than 50 for normal operations.
M91	Displays the Time Ratio between the Measured Total Transit Time and the Calculated time. If the pipe parameters are entered correctly and the transducers are properly installed, the ratio value should be in the range of 100±3%. Otherwise the entered parameters and the transducer installation should be checked.
M92	Displays the estimated fluid sound velocity. If this value has an obvious difference with the actual fluid sound speed, pipe parameters entered and the transducer installation should be checked again.
M93	Displays total transit time and delta time(transit time difference)
M94	Displays the Reynolds number and the pipe factor used by the flow rate measurement program. Pipe factor is calculated based on the ratio of the line-average velocity and the cross-section average velocity.
M95	(1) Display the positive and negative energy totalizers (2) Upon entering this window, the circular display function will be started automatically. The following windows will be displayed one by one, each window will stay for 8 seconds: M95>>M00>>M01>>M02>>M02>>M03>>M04>>M05>>M06>>M07>>M08>>M90>>M91>>M92>> M93>>M94>>M95. This function allows the user to visit all the important information without any manual action. To stop this function, simply press a key. Or switch to a window other than M95.
M96	This is not a window but a command for the thermal printer to advance 5 lines of paper.
M97	This is not a window but a command to print the pipe parameters. By default, the produced data will be directed to the internal serial bus (thermal printer). You can also direct those data to the serial communication port.
M98	This is not a window but a command to print the diagnostic information. By default, the produced data will be directed to the internal serial bus (thermal printer). You can also direct those data to the serial communication port.
M99	This is not a window but a command to copy the current display window. By default, the produced data will be directed to the internal serial bus (thermal printer). You can also direct those data to the serial communication port. By use of the window copying function, you can hardcopy very window displaying manually by switching windows, or you can obtain the window displaying data by communication.
M+0	Browse the 32 recorded instrument power-on and power-off date and time with the flow rate at the time of power on and off
M+1	Displays the total working time of the flow meter. When the backup battery is removed, the total working time will be reset to zero.
M+2	Displays the last power-off date and time
M+3	Displays the last power-off flow rate
M+4	Displays how many times of has been powered on and powered off.
M+5	A scientific calculator for the convenience of field working. All the values are in single accuracy. The calculator can be used while the flow meter is conducting flow measurement. Water density and PT100 temperature can also be found in this function.
M+6	Set fluid sound speed threshold Whenever the estimated sound speed (displayed in M92) exceeds this threshold, an alarms signal will be generated and can transmitted to BUZZER or OCT or RELAY. This function can used to produce an alarm or output when fluid material changes.
M+7	Displays total flow for this month(only for the time past)
M+8	Displays total flow for this year(only for the time past)
M+9	Display the not-working total time in seconds. The total failure timer will also include the time when power off, if the back-up battery is applied.
M.2	Entry to solidify the zero point. Password protected.

M.5	Setup the Q value threshold. If the present Q is below this threshold, flow rate will be set to 0. This function is useful when flow meter is installed in noisy environment or on airy pipes.
M.8	The maximum flow rates for today and this month.
M.9	Serial port tester with CMM command output for very second.
M-0	Entry to hardware adjusting windows only for the manufacturer
M-1	4-20mA output adjustment
M-2	4mA calibration for AI3 input
M-3	20mA calibration for AI3 input
M-4	4mA calibration for AI4 input
M-5	20mA calibration for AI4 input
M-6	4mA calibration for AI5 input
M-7	20mA calibration for AI5 input
M-8	Lower Temperature Zero setup for the PT100
M-9	Higher Temperature Zero setup for the PT100
M-A	Temperature Calibration at 50℃
M-B	Temperature Calibration at 84.5℃

Note   1.windows in Red are new to our older version of flow meter

2. windows in Blue are energy related windows

3. the term totalizer is also called accumulator.

4. Protocols

§4.1

TDS-100M has an non-isolated serial ports, RS485

TDS-100M can support three different communication protocols at the same time, that is MODBUS, the Fuji Extended Protocol and the Easy-to-Use Water Meter Protocol

MODBUS is a very commonly used industrial protocol. Both the RTU and the ASCII format of MODBUS can be supported

the Fuji Extended Protocol is developed based on the protocol used in a Japanese ultrasonic flow meter. The extended protocol is compatible with that of Version 7 flow meter made by Hipeak.

The Easy-to-Use Water Meter Protocol is compatible with the water meters made by Hipeak and the water meters made by Huizhong Instruments.

TDS-100M can even be used as a sample RTU terminal. The 4-20mA output in the TDS-100M can be used to open an analog proportional valve; The OCT output can be used to control the turn-on and turn-off of other devices such as a pump. The analog input can be used to input pressure or temperatures signals.

That the hardware allows a MODEM to be connected directly to the RS232 port will make it very easy to setup a flow SCADA by means of PTN. While with the RS485 port, TDS-100M can be directly connected to a network based on RS485 bus. By use of a GSM module, flow data can be obtained by use of a mobile phone.

There is a programmable device address (or ID number) located at window M46 to make the flow meter be easily used in a SCADA system. If there are more than two flow meters be used in a network, the

prefix W should be used before every command.

The data link can be RS232C (0-15 meters) or RS485 (0-1000meters) when the distance is short. When the distance is over 1 km, the data link can be a kind of current loop, radio, MODEM, GSP or GPRS.

When TDS-100M is used in a network, all the parameters of the flow meter can be programmed through the network, except the device address that needs the keypad.

At most occasions, data should be obtained by polling the flow mete with a command, the flow meter will respond with what the master asks.

The TDS-100M has a special command sets to facilitate the use of the flow meter in a GSM network.

§4.2 The MODBUS protocol

Both the two formats of the MODBUS protocol can be supported.

A software switch located at the window number 63(shorted as M63 after) select MODBUS-ASCII or MODBUS-RTU will be in functioning.

The default option is MODBUS-ASCII format.

TDS-100M can only support MODBUS functions code 3 and code 6, i.e. reading registers and writing a register.

For example, reading the registers from REG0001 to REG0010 in the unit #1 (ultrasonic flow meter) under the MODBUS-RTU format, the command could be as following

01	03	00	00	00	0A	C5	CD	（hex）
Unit	Function	start	REG	Numbers of REGs		Check-sum		

While under the MODBUS-ASCII format, the command could be

:01030000000AF2(CR and LF)

Details about the standard MODBUS protocol will not be studied in this manual, please the users find them on other related materials.

By default, the RS232/RS485 will be setup with 9600,none,8,1(9600bd， none parity， 8 data bits， 1 stop bit)

§4.2.1 MODBUS REGISTERS TABLE

MODBUS REGISTERS TABLE for TDS-100M
（please take notice the difference with the water meter MODBUS table）

REGISTER	NUMBER	VARIABLE NAME	FORMAT	NOTE
0001-0002	2	Flow Rate	REAL4	REAL4 is a format of
0003-0004	2	Energy Flow Rate	REAL4	Singular IEEE-754
0005-0006	2	Velocity	REAL4	number, also called
0007-0008	2	Fluid sound speed	REAL4	FLOAT
0009-0010	2	Positive accumulator	LONG	Long integer, lower byte first
0011-0012	2	Positive decimal fraction	REAL4	
0013-0014	2	Negative accumulator	LONG	

0015-0016	2	Negative decimal fraction	REAL4	
0017-0018	2	Positive energy accumulator	LONG	
0019-0020	2	Positive energy decimal fraction	REAL4	
0021-0022	2	Negative energy accumulator	LONG	
0023-0024	2	Negative energy decimal fraction	REAL4	
0025-0026	2	Net accumulator	LONG	
0027-0028	2	Net decimal fraction	REAL4	
0029-0030	2	Net energy accumulator	LONG	
0031-0032	2	Net energy decimal fraction	REAL4	
0033-0034	2	Temperature #1/inlet	REAL4	
0035-0036	2	Temperature #2/outlet	REAL4	
0037-0038	2	Analog input AI3	REAL4	
0039-0040	2	Analog input AI4	REAL4	
0041-0042	2	Analog input AI5	REAL4	
0043-0044	2	Current input at AI3	REAL4	In unit mA
0045-0046	2	Current input at AI3	REAL4	In unit mA
0047-0048	2	Current input at AI3	REAL4	In unit mA
0049-0050	2	System password	BCD	Writable 。 00H for unlock
0051	1	Password for hardware	BCD	Writable。"A55Ah" for unlock
0053-0055	3	Calendar (date and time	BCD	Writable。6 Bytes of BCD stands SMHDMY , lower byte first
0056	1	Day+Hour for Auto-Save	BCD	Writable。For example 0512H stands Auto-save on 12:00 on 5th。0012H for 12:00 on everyday。
0059	1	Key to input	INTEGER	Writable
0060	1	Go to Window #	INTEGER	Writable。
0061	1	LCD Back-lit lights for	INTEGER	Writable 。 In unit second
0062	1	Times for the beeper	INTEGER	Writable。Max 255
0062	1	Pulses left for OCT	INTEGER	Writable。Max 65535
0072	1	Error Code	BIT	16bits, see note 4
0077-0078	2	PT100 resistance of inlet	REAL4	In unit Ohm
0079-0080	2	PT100 resistance of outlet	REAL4	In unit Ohm
0081-0082	2	Total travel time	REAL4	In unit Micro-second
0083-0084	2	Delta travel time	REAL4	In unit Nino-second
0085-0086	2	Upstream travel time	REAL4	In unit Micro-second
0087-0088	2	Downstream travel time	REAL4	In unit Micro-second
0089-0090	2	Output current	REAL4	In unit mA

0092	1	Working step and Signal Quality	INTEGER	The high byte is the step and low for signal quality, range 00-99, the larger the better.
0093	1	Upstream strength	INTEGER	Range 0-2047
0094	1	Downstream strength	INTEGER	Range 0-2047
0096	1	Language used in user interface	INTEGER	0 : English，1:Chinese
0097-0098	2	Rate of measured travel time by calculated.	REAL4	Normal 100+-3%
0099-0100	2	Reynolds number	REAL4	
0101-0102	2	Pipe Reynolds factor	REAL4	
0103-0104	2	Working Timer	LONG	unsigned，in second
0105-0106	2	Total working time	LONG	unsigned，in second
0105-0106	2	Total power on-off time	LONG	unsigned
0113-0114	2	Net accumulator	REAL4	In Cubic Meter，float
0115-0116	2	Positive accumulator	REAL4	In Cubic Meter，float
0117-0118	2	Negative accumulator	REAL4	In Cubic Meter，float
0119-0120	2	Net energy accumulator	REAL4	In Cubic Meter，float
0121-0122	2	Positive energy accumulator	REAL4	In Cubic Meter，float
0123-0124	2	Negative energy accumulator	REAL4	In Cubic Meter，float
0125-0126	2	Flow for today	REAL4	In Cubic Meter，float
0127-0128	2	Flow for this month	REAL4	In Cubic Meter，float
0129-0130	2	Manual accumulator	LONG	
0131-0132	2	Manual accumulator decimal fraction	REAL4	
0133-0134	2	Batch accumulator	LONG	
0135-0136	2	Batch accumulator decimal fraction	REAL4	
0137-0138	2	Flow for today	LONG	
0139-0140	2	Flow for today decimal fraction	REAL4	
0141-0142	2	Flow for this month	LONG	
0143-0144	2	Flow for this month decimal fraction	REAL4	
0145-0146	2	Flow for this year	LONG	
0147-0148	2	Flow for this year decimal fraction	REAL4	
0158	1	Current window	INTEGER	
0165-0166	2	Failure time	LONG	In unit second
0173-0174	2	Current output frequency	REAL4	
0175-0176	2	Current output with 4-20mA	REAL4	
0181-0182	2	Temperature difference	REAL4	
0183-0184	2	Lost flow	REAL4	
0185-0186	2	Clock coefficient	REAL4	Should less than 0.1
0187-0188	2	Total time for Auto-Save	REAL4	Time to save by 0056
0189-0190	2	POS flow for Auto-Save	REAL4	Time to save by 0056
0191-0192	2	Flow rate for Auto-Save	REAL4	Time to save by 0056
0221-0222	2	Inner pipe diameter	REAL4	In millimeter

0229-0230	2	Upstream delay	REAL4	In microsecond
0231-0232	2	Downstream delay	REAL4	In microsecond
0233-0234	2	Calculated travel time	REAL4	In microsecond
0257-0288	32	LCD buffer	BCD	
0289	1	LCD buffer pointer	INTEGER	
0311	2	Worked time for today	LONG	Unsigned, in seconds
0313	2	Worked time for this month	LONG	Unsigned, in seconds
1437	1	Unit for flow rate	INTEGER	See note 5
1438	1	Unit for energy totalizer	INTEGER	0=GJ 1=Kcal
1439	1	Multiplier for accumulator	INTEGER	Range 0~7,see note 1
1440	1	Multiplier for energy accumulator	INTEGER	Range 0~10,see note 1
1441	1	Unit for energy flow rate	INTEGER	0=GJ/h , 1=Kcal/h
1442	1	Device address	INTEGER	
1451	2	User scale factor	REAL4	
1521	2	Manufacturer scale factor	REAL4	Read only
1523	1	Multiplier for accumulator	INTEGER	Same address with
1524	1	Multiplier for energy accumulator	INTEGER	water meter, but has different meaning
1525	1	Unit for energy accumulator	INTEGER	
1529	2	Electronic serial number	BCD	High byte first

Note：（1） The internal accumulator is been presented by a LONG number for the integer part together with a REAL number for the decimal fraction. In general uses, only the integer part needs to be read. Reading the fraction can be omitted. The final accumulator result has a relation with unit and multiplier. Assume N stands for the integer part (for the positive accumulator, the integer part is the content of REG 0009, 0010, a 32-bits signed LONG integer,), Nf stands for the decimal fraction part (for the positive accumulator, the fraction part is the content of REG 0011, 0012, a 32-bits REAL float number,), n stands for the flow multiplier (REG 1439).

then

The final positive flow rate=$(N+Nf) \times 10^{n-3}$ (in unit decided by REG 1439)。

The meaning of REG 1439 which has a range of 0~7 is as following:

0	cubic meter	(m3)
1	liter	(L)
2	American gallon	(GAL)
3	imperial gallon	(IGL)
4	American million gallon	(MGL)
5	Cubic feet	(CF)
6	American oil barrel	(1 barrel =42gallon) (OB)
7	Imperial oil barrel	(IB)

While

The energy flow rate =$(N+Nf) \times 10^{n-4}$ （unit decided by REG 1440）。

(2) Other variables are not given here. Call us if you have a need.

(3) Please note there are many of the data that is not applicable for the non-energy measurement users. These none-energy-related registers only serves for the intension of only one unique register table provided both with flow meter and energy meat.

（4）Meaning in error code

Bit0   no received signal

Bit1   low received signal

Bit2   poor received signal

Bit3   pipe empty

Bit4   hardware failure

Bit5   receiving circuits gain in adjusting

Bit6   frequency at the frequency output over flow

Bit7   current at 4-20mA over flow

Bit8   RAM check-sum error

Bit9   main clock or timer clock error

Bit10   parameters check-sum error

Bit11   ROM check-sum error

Bit12   temperature circuits error

Bit13   reserved

Bit14   internal timer over flow

Bit15   analog input over range

Please try to override these energy-related bits first when in flow-only measurement, （5）Unit code for flow rate

0	Cubic meter/second	1	Cubic meter /minute	2	Cubic meter /hour	3	Cubic meter /day
4	liter/second	5	liter /minute	6	liter /hour	7	liter /day
8	American gallon/second	9	American gallon /minute	10	American gallon /hour	11	American gallon /day
12	Imperial gallon/second	13	Imperial gallon /nimute	14	Imperial gallon /hour	15	Imperial gallon /day
16	American million gallon/second	17	American million gallon /minute	18	American million gallon /hour	19	American million gallon/day
20	Cubic feet/second	21	Cubic feet/minute	22	Cubic feet/hour	23	Cubic feet/day
24	American oil barrel/second	25	American oil barrel/minute	26	American oil barrel/hour	27	American oil barrel/day
28	Imperial oil barrel/second	25	Imperial oil barrel/minute	26	Imperial oil barrel/hour	27	Imperial oil barrel/day

§4.2.2 REGISTER TABLE for the DATE accumulators

（1） REGISTER for accumulators by day

Accumulator data for every past day are stored in a loop queue. Every day has 16 bytes of data and there are 128 days in total. The current pointer which has a range of 0~127 for the day is in REG 0162. if the pointer is decreased by 1 when the pointer is 0, then new pointer value will be 127. Assume REG 0162＝ 1, the data for yesterday are in REG 3337~3344, the data for day before yesterday are in REG3329-3336, and the data for day of 2 days ago are in REG 4345-4352.

REGISTER TABLE for the DAY accumulators

block No	Register	number	variable	format	note
n/a	0162	1	Data pointer	Integer	Range:0~127
	3329	1	Day and Error Code	BCD	Day in high byte
	3330	1	Month and year	BCD	Year in high byte
0	3331-3332	2	Total working time	LONG	
	3333-3334	2	Net total flow for the day	REAL4	
	3335-3336	2	Net total energy for the day	REAL4	
	3337	1	Day and Error Code	BCD	Day in high byte
	3338	1	Month and year	BCD	Year in high byte
1	3339-3340	2	Total working time	LONG	
	3341-3342	2	Net total flow for the day	REAL4	
	3343-3344	2	Net total energy for the day	REAL4	
○○○○	○○○○○○○○○	○○○○○○	○○○○○○○○○○○○○	○○○○○○	○○○○○○○○○○○○○○○○○○
127	4345-4352	8			Data block No.127

note：see the meaning of the error code above.

（2） REGISTER for accumulators by month

The structure of month accumulator is the same as that of the day，please refer to related paragraph。The difference is there are only 63 data blocks for the month accumulator, and day variable always has a value of 0.

REGISTER TABLE for the month accumulators

block No	Register	number	variable	format	Note
n/a	0163	1	Data pointer for the month	Integer	Range: 0~63
	2817	1	Error Code	BCD	
	2818	1	Month and year	BCD	Year in high byte
0	2819-2820	2	Total working time	LONG	
	2821-2822	2	Net total flow for the month	REAL4	
	2823-2824	2	Net total energy for the month	REAL4	
	2825	1	Error Code	BCD	
	2826	1	Month and year	BCD	Year in high byte
1	2827-2828	2	Total working time	LONG	
	2829-2830	2	Net total flow for the month	REAL4	

	2831-2832	2	Net total energy for the month	REAL4	
○○○○	○○○○○○○○○	○○○○○○	○○○○○○○○○○○○○○	○○○○○○	○○○○○○○○○○○○○○○○○○○○○○
63	3321-3328	8			Data block No. 63

（3） There is no direct data for the year, data for the year could be conducted from the data of the months.

§4.2.3 REGISTERs for power-on and power-off

With every t power-on and power-off, the new generation flow meter will record data about the time, duration, statue byte and the flow rate into a data block. Every data block consists 32 bytes of data. There are as many as 32 blocks of data can be recorded, for 32 times of power-on and 32 times of power-off. The data blocks are in a structure of loop queue. The 33rd data block will override the first block by default. The location of the current block is presented in the data pointer. The current power-on data block is pointed by the decease by 1 of the pointer.

MODBUS registers table for the power-on and power-off.

block No	Register	No.	variable	format	Note
n/a	0164	1	Pointer	Integer	Range:0~31
	4353	1	Power-on second and minute	BCD	Second in low byte, minute in high
0	4354	1	Power-on hour and day	BCD	Hour in low byte, day in high
	4355	1	Power-on month and year	BCD	Month in low byte, year in high
	4356	1	Power-on error code	BIT	B15 stand for corrected lost flow.
	4357	1	Power-off second and minute	BCD	Second in low byte, minute in high
	4358	1	Power-off hour and day	BCD	Hour in low byte, day in high
	4359	1	Power-off month and year	BCD	Month in low byte, year in high
	4360	1	Power-off error code	BIT	B15 stand for corrected lost flow
	4361-4362	2	Flow rate when power on	REAL4	Flow rate after 60 seconds when power on
	4363-4364	2	Flow rate when power off	REAL4	
	4365-4366	2	Time duration when off	LONG	In seconds
	4367-4368	2	Corrected lost flow when off	REAL4	In cubic meters
	4369	1	Power-on second and minute	BCD	Second in low byte, minute in high
1	4370	1	Power-on hour and day	BCD	Hour in low byte, day in high
	4371	1	Power-on month and year	BCD	Month in low byte, year in high
	4372	1	Power-on error code	BIT	B15 stand for corrected lost flow.
	4373	1	Power-off second and minute	BCD	Second in low byte, minute in

			minute		high
	4374	1	Power-off hour and day	BCD	Hour in low byte, day in high
	4375	1	Power-off month and year	BCD	Month in low byte, year in high
	4376	1	Power-off error code	BIT	B15 stand for corrected lost flow
	4377-4378	2	Flow rate when power on	REAL4	Flow rate after 60 seconds when power on
	4379-4380	2	Flow rate when power off	REAL4	
	4381-4382	2	Time duration when off	LONG	In seconds
	4383-4384	2	Corrected lost flow when off	REAL4	In cubic meters
○○○○	○○○○○○○○	○○○		○○○○○○	○○○○○○○○○○○○○○○○○○
31	4849-4864	16			The 32nd block

§4.3 The FUJI extended communication protocol

TDS-100M uses the compatible FUJI extended communication protocol with our previous Version7 ultrasonic flow meter, except the commands in red lines in the following table.

Command	Meaning	Data format
DQD(cr) note 0	Returns flow rate per day	±d.ddddddE±dd(cr) note 1
DQH(cr)	Returns flow rate per hour	±d.ddddddE±dd(cr)
DQM(cr)	Returns flow rate per minute	±d.ddddddE±dd(cr)
DQS(cr)	Returns flow rate per second	±d.ddddddE±dd(cr)
DV(cr)	Returns fluid velocity	±d.ddddddE±dd(cr)
DI+(cr)	Returns positive totalizer	±dddddddE±d(cr) note 2
DI-(cr)	Returns negative totalizer	±dddddddE±d(cr)
DIN(cr)	Returns net totalizer	±dddddddE±d(cr)
DIE(cr)	Returns net energy totalizer	±dddddddE±d(cr)
DIE+(cr)	Returns positive energy totalizer	±dddddddE±d(cr)
DIE-(cr)	Returns negtive energy totalizer	±dddddddE±d(cr)
DIT(cr)	Returns net total flow for today	±dddddddE±d(cr)
DIM(cr)	Returns net total flow for this month	±dddddddE±d(cr)
DIY(cr)	Returns net total flow for this year	±dddddddE±d(cr)
DID(cr)	Returns the ID number/address	ddddd(cr) 5 bytes long
E(cr)	Return energy flow rate per hour	±d.ddddddE±dd(cr)
DL(cr)	Returns the signal strength	UP:dd.d,DN:dd.d,Q=dd(cr)
DS(cr)	Returns percentage of AO output	±d.ddddddE±dd(cr)
DC(cr)	Returns current error code	Note 3
DA(cr)	OCT and RELAY output	TR:s,RL:s(cr) note 4

DT(cr)	Returns the current 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)	Mimic key input. @ presents a key	M@(cr)note 5
LCD(cr)	Returns current window display	
LOCK0(cr)	Unlock the system	Has nothing to do with the original password.
LOCK1(cr)	Lock the system	Can be opened by press ENT key
MENUXX(cr)	Go to window XX	
C1(cr)	OCT turns on	
C0(cr)	OCT turns off	
R1(cr)	RELAY(OCT2) turns on	
R0(cr)	RELAY(OCT2)turns off	
FOdddd(cr)	Output n Hz at frequency output	Fdddd(cr)(lf)
AOa(cr)	Output a mA current at AO output	AOa(cr)(lf)Note 6
BA1(cr)	Return the resistance for T1	$\pm$d.ddddddE$\pm$dd(cr)(lf)
BA2(cr)	Return the resistance for T2	$\pm$d.ddddddE$\pm$dd(cr)(lf)
BA3(cr)	Returns the current (0~20mA) at AI3	$\pm$d.ddddddE$\pm$dd(cr)(lf)
BA4(cr)	Returns the current (0~20mA) at AI4	$\pm$d.ddddddE$\pm$dd(cr)(lf)
BA5(cr)	Returns the current (0~20mA) at AI5	$\pm$d.ddddddE$\pm$dd(cr)(lf)
AI1(cr)	Returns the temperature at T1 input	$\pm$d.ddddddE$\pm$dd(cr)(lf)
AI2(cr)	Returns the temperature at T2 input	$\pm$d.ddddddE$\pm$dd(cr)(lf)
AI3(cr)	Returns the value for AI3	$\pm$d.ddddddE$\pm$dd(cr)(lf)
AI4(cr)	Returns the value for AI4	$\pm$d.ddddddE$\pm$dd(cr)(lf)
AI5(cr)	Returns the value for AI5	$\pm$d.ddddddE$\pm$dd(cr)(lf)
ESN(cr)	Returns the ESN number	ddddddd(cr)(lf) note 7
N	Prefix for single byte addressing network	Note 8
W	Prefix for ID string addressing network	Note 8
P	Prefix to returns with check-sum	
&	Command connector to make a super command in one line.	Result commands should not exceed 253 bytes long.
RING(cr)(lf)	Command for modem handshaking	ATA(CR)(lf)
OK(cr)	Output by a modem	
	Output by flow meter to handshake a modem.	AT(CR)(LF)
GA(cr)	Special command for GSM network.	note 9
GB(cr)	Special command for GSM network.	note 9
GC(cr)	Special command for GSM network	note 9

注：

0．（cr）is carriage return, its ASCII value is 0DH. (lf) is line feed, its ASCII value is 0AH.

1．d stand for digit 0~9, a value of 0 is presented by +0.000000E+00

2．d stand for digit 0~9, there will no dot before 'E'.

3．1~6 characters present the current statue of the flow meter. See the meaning of the characters in the chapter diagnostics.

4．s presents one of ON,OFF or UD

For example 'TR:ON,RL:ON' stands for OCT and RELAY are in on state.

'TR:UD,RL:UD" stands for the OCT and RELAY are not assigned.

5．@ is the key value, for example, 30H stand for the '0' key. The command 'M4(cr)' acts just like the number 4 key on the keypad was pressed.

6．'a' stands for the output current. The maximum value should not exceed 20. For example AO2.34567, AO0.2

7．'dddddddd' stands for the Electronic Serial Number

8．If there are more one flow meter or other kinds of meters in a network, a prefix like 'N' or 'W' must be added before the basic command in the above table, or the system will conflict.

9. The returns by the special command for GSM networks contends Chinese characters.

§4.3.1Command prefixes and the command connector

（1） The P prefix

The P prefix can be added before every basic command to make the returned message with a 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） 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.

（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)

（4） The command connecter &

The command connecter '&' adds several basic commands into a one-line super command. The super command should no 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 AI1 input 6) the AI2 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&PBA1&PAI2(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)

§4.4 The easy-to-use water meter communication protocol

In order to replace a water meter in a water meter network, the water meter communication protocol is realized in TDS-100M flow meters.

interface：RS232，RS485

baud rate：9600 by default，select other 15 different baud rate by Menu 62

parity：NONE,EVEN,ODD can be chosen from Menu 62

Data bits：8

Stop bits: 1,2

In the following explanation:

XXh stands for the address (or network ID)of the instrument, range:00h-FFh.

YYh stands for the new address that will be assigned, range:00h-FFh.

ZZh the check-sum, which is obtained by means of binary addition of all the data bytes (take notice to that the addition is for the data bytes, not the controlling and commands bytes, and the carry over 0ffh is discarded.

H stands for that the number is a hexadecimal number.

All five command are like following:

（1）read water meter data (command 4A）

Format: 2Ah XXh 4Ah

Answer: 26h XXh 4Ah   LL(BCD coded) ZZh

In the above, the contents of LL(BCD) are formatted as in the following table:

position	content	bytes	note	
1~4	Flow rate	4	The actual value is divided by 1000, unit in cubic meter per hour.	（2）readi
5~8	Positive total flow	4	The actual value divided by 10, unit in cubic meter	ng
9~12	Total time	4	Unit in hour	the
13	Error code	1	See table below	recor
				ded

meter data (command 49)

Format：2Ah XXh 49h

Answer： 26h XXh 49h   LL（BCD 码） ZZh

The difference between the command 4A and command 49 is that the late command reads out the data which are recorded in the meter by the time which is defined by command 4C.

（3）change the address of the meter (command 4B)

Format： 2Ah XXh 4Bh YYh

Answer:　26h XXh 4Bh YYh

If XXh=YYh, this command can be used to do a loop test the net work, or to scan and find the existed meters in the network. Please pay attention to that the network may lose meters if this command is used in a noisy network.

（4）change or assign a time for meter data recording (command 4C)

Format:　2Ah XXh 4Ch DDh HHh

Answer:　26h XXh 4Ch DDh HHh MMh ZZh

DDh stands for the day, HHh for hour,　MM for minute，data are in BCD code.

DD is the day of this month, for example: 2Ah 86h 4Ch 12h 15h stands for assigning a recording time for the number 86 meter 86. the meter will record the flow rate, total net flow, the working timer and the error code when time is 15:00 the 12th of this month. The recorded date will be read out by command 49.

If DD＝0, it stands that the data recording will take place by 15:00 for every day.

（5）standard date and time broadcasting　（command 4D）

Format: 2Ah AAh 4Dh ssmmhhDDMMYY

Answer: no answer

In above, ssmmhhDDMMYY is the date and time in BCD format.

Diagnostic code:　00h stands that the system is working normally.

02h stands for the pipe may be empty or meter works improperly.

05h stand for there exist hardware failure, repair may needed.

§4.5 Key Value Table

The key values are used in a network application. By use of the key value and a command 'M', we can operate the flow meter through the network on a computer or other kind of terminals. For example, the command 'M0(cr)' acts just like the zero key on the keypad was pressed.

key	Key value (headecimal)	Key value (decimal)	ASCII value	key	Key value (headecimal)	Key value (decimal)	ASCII value
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	?