54119/PD76-24C-M7F

Digital Indicating Panel Mounted Electrical Measuring Instruments

User Manual

Table of Contents

I.Introduction

1.1 General

PD76-24C-M7F Digital indicating Panel Mounted Electrical Measuring Instrument is designed for the electrical monitoring for utilities, industrial mining corporations, intelligence towers and communities. It adopts large scale IC, digital sampling technology and SMT technology. It can measure all the common electrical parameters with high accuracy, such as three-phase voltage, three-phase current, active power, reactive power, frequency, power factor, active energy, reactive energy and four quadrant energy. The durable LED displays the parameters measured and the performance information of electrical network system. With high speed RS485 communication port and conformance to the Modbus protocol. There are four programming pushbuttons in the faceplate, it is very convenient for users to achieve switching display and meter's parameters program setup at site, with high flexibility.

There are many extended functions to choose, for instance, the function of 4 analog（0～20mA/4～20mA ） output is for energy and electricity transportation output, and the function of 4 switching input and output is for local or remote switching signal monitoring and control output ("remote communication" and " remote control" function).

PD76-24C-M7F with excellent performance and reasonable price, it can replace the normal electricity transportation instrument, measurement indicating meter, energy measuring meter and other related accessorial units.

PD76-24C-M7F can be used widely for energy management system, transformer substation automatization, switching network automatization, industrial automatization, intelligence buildings, intelligence switchboards and switch cabinets, it is characteristic of convenient installation, simple wiring, easy maintenance, and less works. It also can be connected with PLC and industry control computers.

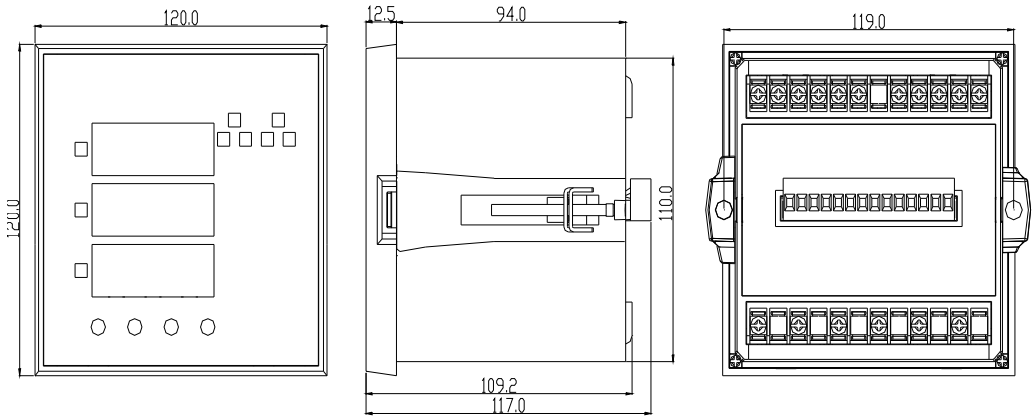
1.2 Technical data

Technical Parameters			value
Input	Network		Three-phase three-wire, three-phase four-wire
	Voltage	Rated voltage	AC 100V, 220V, 400V
		Overload	lasting：1.2 times momentary：double times /30s
		Power consumption	<0.5VA(per phase)
		Resistance	>500K Ω
	Current	Rated current	AC 1A 、5A
		Overload	lasting：1.2 times momentary：20 times/1s
		Resistance	<20m Ω (per phase)
	Frequency		45～65Hz
Output	Energy impulse		Two impulse output
	Constant		Active:10000imp/kwh Reactive:10000imp/kvarh
	Communication	Mode	RS-485

		Protocol	MODBUS-RTU/ASCII
		Baud rate	1200、2400、4800、9600
	Display		LED
Accuracy	Voltage,current		±0.2%
	Active power, reactive power, apparent power		±0.5%
	Frequency		±0.2%
	Active energy		±0.5%
	Reactive energy		±2%
Power supply	Range		AC、DC 80～300V
	Power consumption		<5VA
Security	Voltage endurance	Input and auxiliary power supply	>2KV50Hz/1min
		Input and output	>2KV50Hz/1min
		Output and auxiliary power supply	>2KV50Hz/1min
	Insulated resistance		Input, output and auxiliary power supply against the watchcase >100MΩ
	Case anti-fire		V0
Electromagnetic compatibility	Electrostatic discharges		±15KV
	Fast transient burst		±4KV
	Electromagnetic RF fields		80MHz～1000MHz 10V/m
Ambient temperature	Temperature		Operation ： -10～60℃， Storage ： -25～70℃
	Humidity		≤95%RH，(without dew, corrosive gas)
	Altitude		≤3000m

Ⅱ.Outline & Installation

2.1 Installation Dimension



Picture 1 Installation Diagram

2.2 How To Install

① Drill a hole (size:111mm×111mm) in the switching cabinet

② Take out the meter,clamps and screws.

③ Insert the meter into the hole

④ Fix the clamps and fasten the screws

2.3 Terminals Layout

Upper row：Current, test and communication terminals

Current terminals							Test terminals			RS485	
*1	2	*3	4	*5	6	7	8	9	10	11	12
IA		IB		IC			P+	Q+	P- Q-	A	B

Picture 2 Current, test and communication terminals

Note: "P+" —active impulse output positive "P-" —active impulse output earthed

"Q+" — reactive impulse output positive "Q-" — reactive impulse output earthed

Middle row：Input and output terminals

Output terminals								Switching output terminals					
+25	26	+27	28	+29	30	+31	32	33	34	35	36	37	38
OUT1		OUT2		DOUT3		OUT4		IN1	IN2	IN3	IN4	COM	

Picture 3 Input and output terminals

Note：According to the type of meter, there are two kinds of output terminals: switching output terminals and analog output terminals

COM—switching input earthed

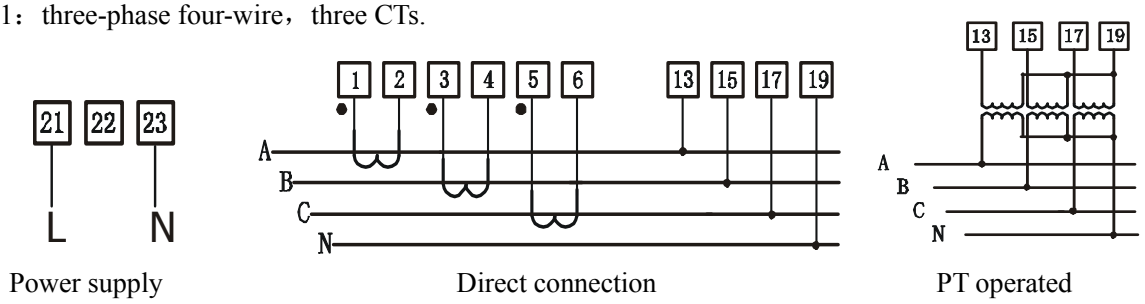
Bottom row: Voltage and power supply terminals

Voltage terminals								Power supply			
13	14	15	16	17	18	19	20	21	22	23	24
UA		UB		UC		UN		L		N	

Picture 4 Signal terminals

The meter has different wiring methods for different types of load

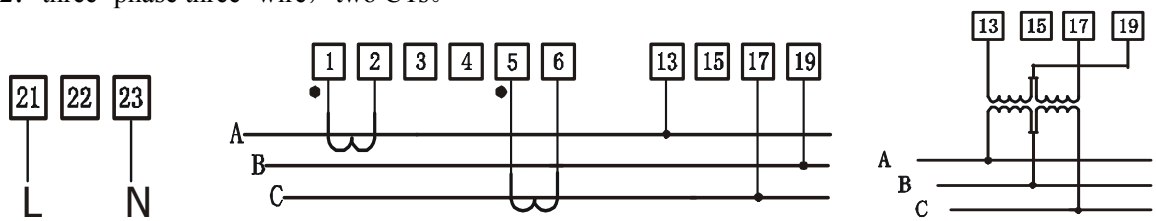
Type 1：three-phase four-wire，three CTs.



Power supply Direct connection PT operated

Picture 5 Wiring method

Type 2：three- phase three- wire，two CTs。



Power supply Direct connection PT operated

Picture 6 Wiring method

Note：

A. Voltage input: input voltage should not be higher than the meter's rated voltage（100V or 400V）, otherwise, it should adopt PT, and 1A fuse is required.

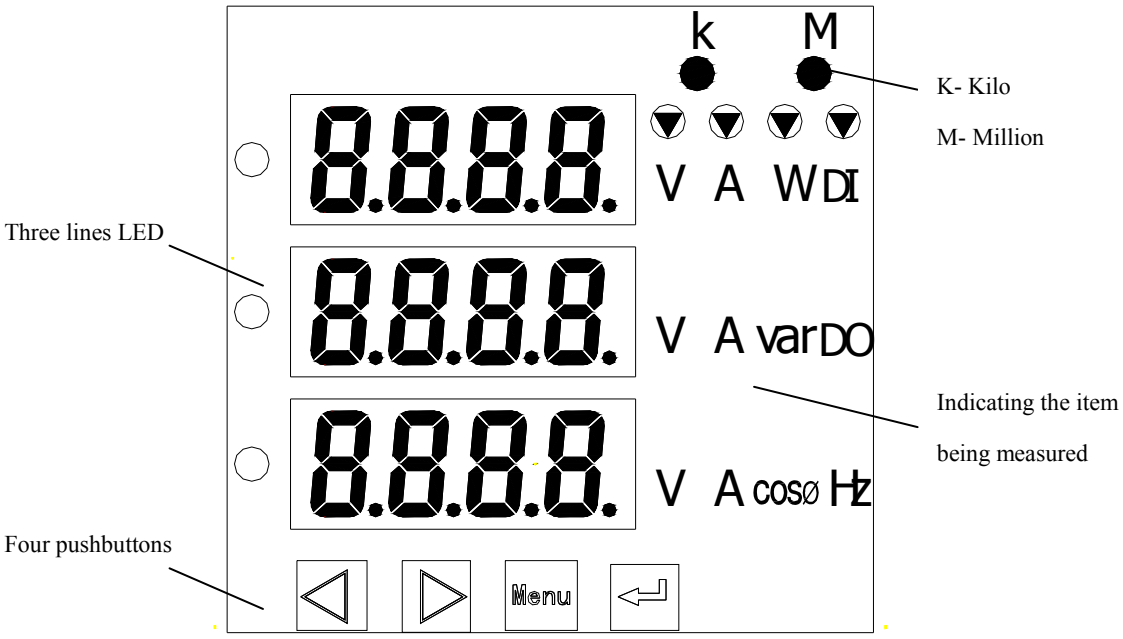
B. Current input：the rated input current is 5A.outside CT is required in the case of the input current >5A.if there are other meters also connected to the same CT, the meters should be connected in series. Before disconnecting current input, first make sure the CT is off. In order to remove conveniently, we suggest use socket instead connected to the CT directly.

C. Make sure the voltage and current line connected correctly, phase and direction in sequence,otherwise, the value and symbol can't be shown normally (power and energy) .

D. Power supply. the voltage range of power supply is AC/DC 80~270V.In order to protect the meter, we suggest install 1A fuse for the phase line when adopting alternating current power supply. In the region where the quality of electricity is poor, we suggest use surge suppresser and fast impulse suppresser.

III. Operation instruction

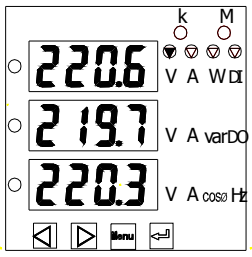
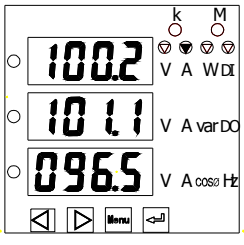
3.1 Nameplate

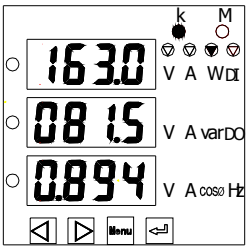
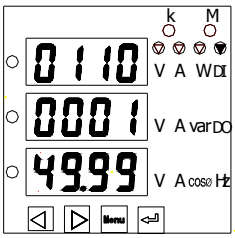
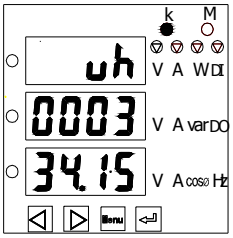
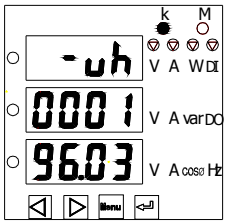
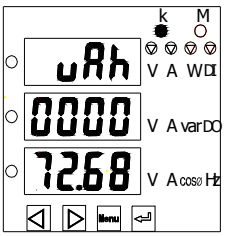
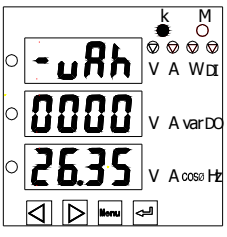


Picture 7 Nameplate outline

3.2 Display

By setting the DCW（display control word）to program display modes. Or push "◄" , "►" to switch display mode manually, it will return to previous display mode after 30 seconds.The details of the display modes as following：

Display mode	Sample	Description
0	-	Automatic circle display
1		Displays three-phase voltage UA UB UC (three-phase four-wire)， UAB UBC UCA(three-phase three-wire) The picture left is showing: phase A voltage is 220.6V, phase B voltage is 219.7V，phase C voltage is 220.3V
2		Displays three-phase current The picture left is showing: phase A current is 100.2A， phase B current is 101.1A，phase C current is 96.5A

Display mode	Sample	Description
3		Displays active power、reactive power、power factor The picture left is showing: active power is 163.0kW，reactive power is 81.5kvar，power factor is 0.894
4		Displays the state of switching and frequency. The picture left is showing: the first and fourth switching input is disconnected, the second and third switching input is connected. Frequency is 49.99Hz
5		Displays positive active energy The picture left is showing: positive active energy is 334.15kWh
6		Displays negative active power The picture left is showing: negative active power is 196.03kWh
7		Displays positive reactive energy The picture left is showing: positive reactive energy is 72.68kvarh
8		Displays negative reactive energy The picture left is showing: negative reactive energy is 26.35kvarh

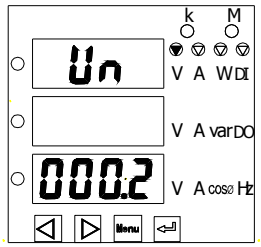
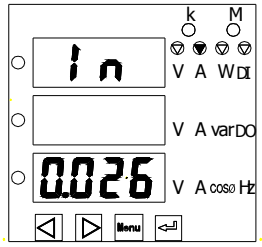
Display mode	Sample	Description
9		Displays neutral wire voltage (only there is neutral wire) The picture left is showing. Voltage of neutral wire is 0.2V
10		Displays neutral wire current (only there is neutral wire, otherwise, the value is zero) The picture left is showing. current of neutral wire is 0.026A

Figure 1 Display modes

3.3 Program operation

Under program operation, the meter provides menu for setup, input, communication, and analog output. Use LED displays hierarchical management: the first line displays first layer menu information, the second line displays the second layer menu information, the third line displays the third layer menu information.

The functions of the four pushbuttons are as the follows:

“MENU”: When the meter under measurement display mode, the pushbutton is for entering program mode. Press it, the meter will ask user to input password, programming and setting is available only after entering correct password. During programming, this pushbutton is for returning to upper menu.

“◄”and“►”: When the meter under measurement display mode, these two pushbuttons are for circle display manually. During programming, they are for making the menu forth/back or the number increase/decrease. When inputting number, press it to increase/decrease the number quickly, or push “◄” or “►” together with “↵” or “MENU” to change the number as 10 or100.

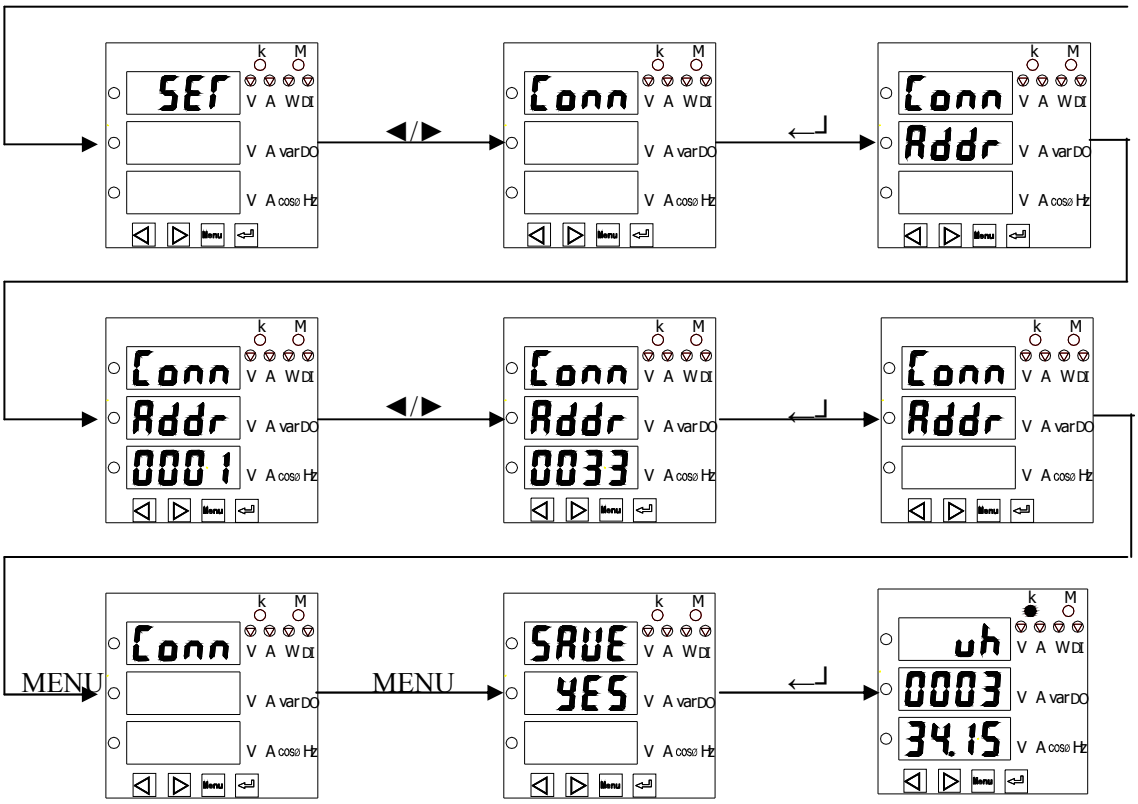
“↵”: When programming, the pushbutton is for confirming the modification and returning to upper menu. When displaying voltage, press it to switch displaying phase voltage and line voltage.

When return from programming mode to measurement display mode, the meter will show “save yes” to remind user if any parameter has been modified, press “menu” to quit without saving the settings. If you want to save the settings, then press “↵”. When restore the system as factory settings, the settings will effect directly, so it should be very carefully when restore system, so that to avoid losing data.

The menu's structure is as follows, users can set the proper parameters as per their own requirements.

The first layer	The second layer	The third layer	explanation
PSUD	-	8888	Input password, only correct password can enter program
SET	DISP	0-10	Set display control word
	BRT	1-16	Display brightness ， 1-darkest ， 16-lightest
	TURN	1-99	Turning time, it effects when DISP set as 0.
	DI_T	0-99	Switching input stable time, unit: second
	DO_T	0-99	Switching output stable time, unit: second
	CLR.E	YES	The data of meter reset after confirmation
	RSET	YES	Restore the parameters as factory setting after confirmation
INPT	nET	n.3.4 or n.3.3	Set the electrical netting three-phase three-wire or four-wire
	RAT.U注1	1-9999	Set voltage coefficient。
	RAT.I注1	1-9999	Set current coefficient。
CONN	ADDR	1-247	Modbus communication address。
	BAUD	1200-38400	Baud rate: 1200、2400、4800、9600、19200、38400。
	DATA	3 formats	NONE、ODD、EVEN。
	PROT	RTU/ASCII	2 communication transfer modes Modbus-RTU、Modbus-ASCII。
AO-x注2	Parameter 1 AOSIx	Parameter 2 AOSx	analog output setting, under item parameter 1, choose electric energy parameter, under item parameter 2, set electric energy parameter according to the full scale of the output. This function needs installing the analog output module, otherwise the setting is invalid.
DO-x注2	Parameter 1 DOSIx	Parameter 2 DOSxL	Switching output setting, under item parameter 1, choose electric energy parameter, under parameter 2 and parameter 3, set alarm lower limit and upper limit separately.(when set lower limit and upper limit,the second LED displays "-Lo-" and "-HI-"
		Parameter 3 DOSxH	

Figure 2 Menu structure



Picture 8　　Process of program operation

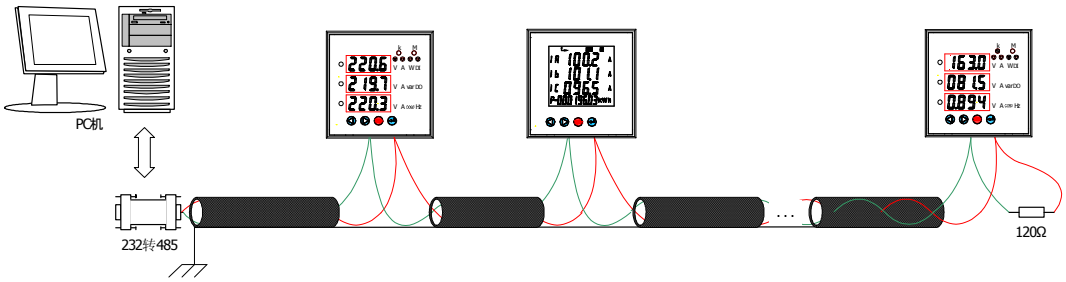
Note：1.The product of voltage and current variation rate should be≤100000，otherwise some displayed data will be overflow

2. when x is 1、2、3 or 4，it　is　for no.1, no.2, no.3, or no.4 analog (or switching) output setting

IV. Communication

4.1 Forward

PD76-24C-M7F provides RS485 communication port, adopts Modbus (both Modbus-RTU and Modbus-ASCII) communication protocol. Up to 32 meters can be connected together with single communication wire, you can set its own communication address for each of them. Different series meter varies in the number of communication wiring terminals. it should use twisted-pair wire for communication connecting, and diameter of the twisted-pair wire should not be less than 0.5mm^2 .The communication wire should be away from strong electric cable or strong electric field，maximal communication distance is 1200 meters，the typical wiring method is as picture 9 shown. User can also select other proper wiring method according to site situation。



Picture 9　Communication connecting

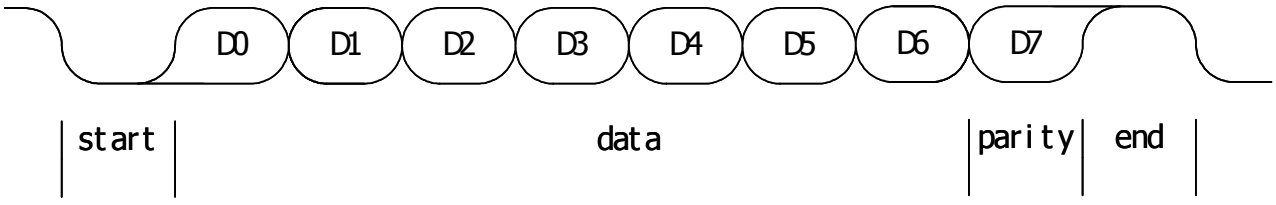
Modbus protocol uses a master-slave technique, in which firstly one device (the master) initiates transactions (queries). The other devices (the slaves) respond by supplying the requested data to the master, or by taking the action requested in the query. The work mode is semi-duplex.

Modbus protocol only allows the communication between master（PC，PLC,etc）and slaves，and does not allow the data exchange between independent terminal devices. As a result, the terminal devices will not use communication line when initialization, only response the query signal.

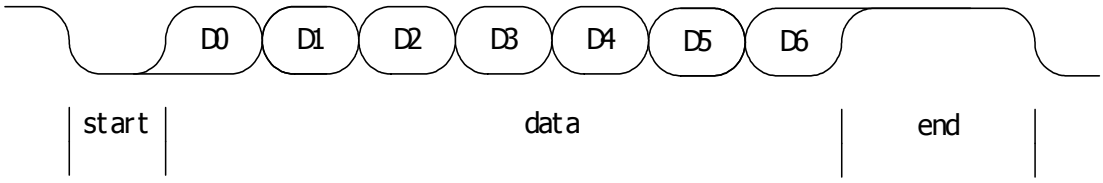
4.2 Byte format

4.2.1 ASCII mode

When controllers are setup to communicate on a Modbus network using ASCII mode, each eight-bit byte in a message is sent as two ASCII characters. The main advantage of this mode is that it allows time intervals of up to one second to occur between characters without causing an error. Each transmission contains 10 bit serial data. During transmission, lower bit first, then higher bit. User can select odd, even or without parity. The transmission sequence of both types are as follows:



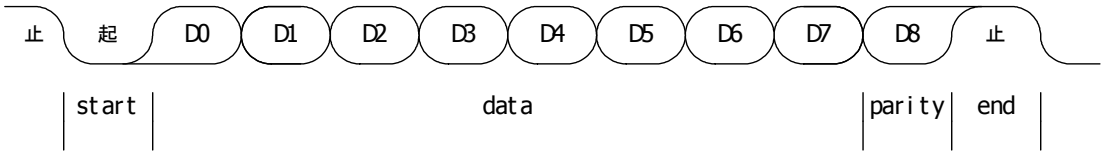
Picture 10 transmission sequence with parity bit（ASCII mode）



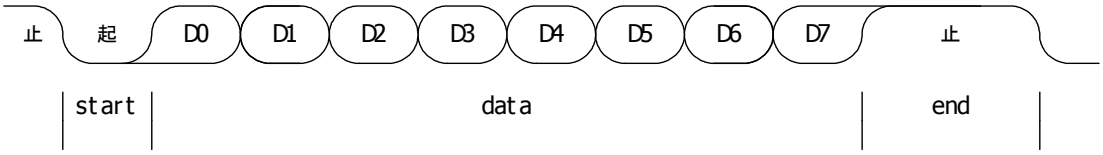
Picture 11 transmission sequence without parity bit (ASCII mode)

4.2.2 RTU mode

When controllers are setup to communicate on a Modbus network using RTU mode，each byte in the frame can be used for transaction directly. So its greater character density allows better data throughput than ASCII for the same baud rate. Each transmission contains 11 bit serial data. During transmission, lower bit first, then higher bit. User can select odd, even or without parity. The transmission sequence of both types are as follows:



Picture 12 transmission sequence with parity bit (RTU mode)



Picture 13 transmission sequence without parity bit (RTU mode)

4.3 Frame Format

Frame is the basic unit for transaction message. In Modbus protocol, master and slave use the same frame format. In ASCII mode, messages start with a colon (:) character (ASCII 3A hex),and end with a carriage return-line feed (CRLF) pair (ASCII 0D and 0A hex) . The allowable characters transmitted for all other fields are hexadecimal 0 ... 9, A ... F. The frame format as shown in figure 3.

Start addressing	Address code	Function code	Data field	LRC check	End
: (3AH)	2 bytes	2 bytes	N bytes	2 bytes	0DH, 0AH

Figure 3 ASCII frame format

In RTU mode, messages start with as well as end at a silent interval of at least 3.5 character times. The entire message frame must be transmitted as a continuous stream. If a silent interval of more than 1.5 character times occurs before completion of the frame, the receiving device flushes the incomplete message and assumes that the next byte will be the address field of a new message. RTU message format as shown in figure 4.

Start	Address code	Function code	Data field	LRC check	end
4-bytes interval time	1 byte	1 byte	N byte	2 bytes	4-bytes interval time

Figure 4 RTU frame format

4.3.1 Address code（Address）

Address code is to specify which slave communicates with the master, each slave has its unique address code. Both address code sending to or response from the slave indicates its address. Available addresses are 1-247, the rest are reserved.

4.3.2 Function code（Function）

Function code is to specify what function the slave to perform. The supported function codes and their definition as well as their operation are listed below.

Function code	Definition	Operation
03/04H	Read register	Read data from the register(s)
10H	Write one or more continuous registers	Write n*16-bit binary number into.n regesters

Figure 5　Function code

4.3.3 Date field（Data）

Data field are different because of different function code. These data can be numerical value, reference address, etc. for instance, function code 03H specifies the value which meter read register, then the data field much contain the start address and read length of the register.

4.3.4 Verify code

Verify code is to estimate the data received correct or not for the master and slave, it guarantees the communication system more reliable.

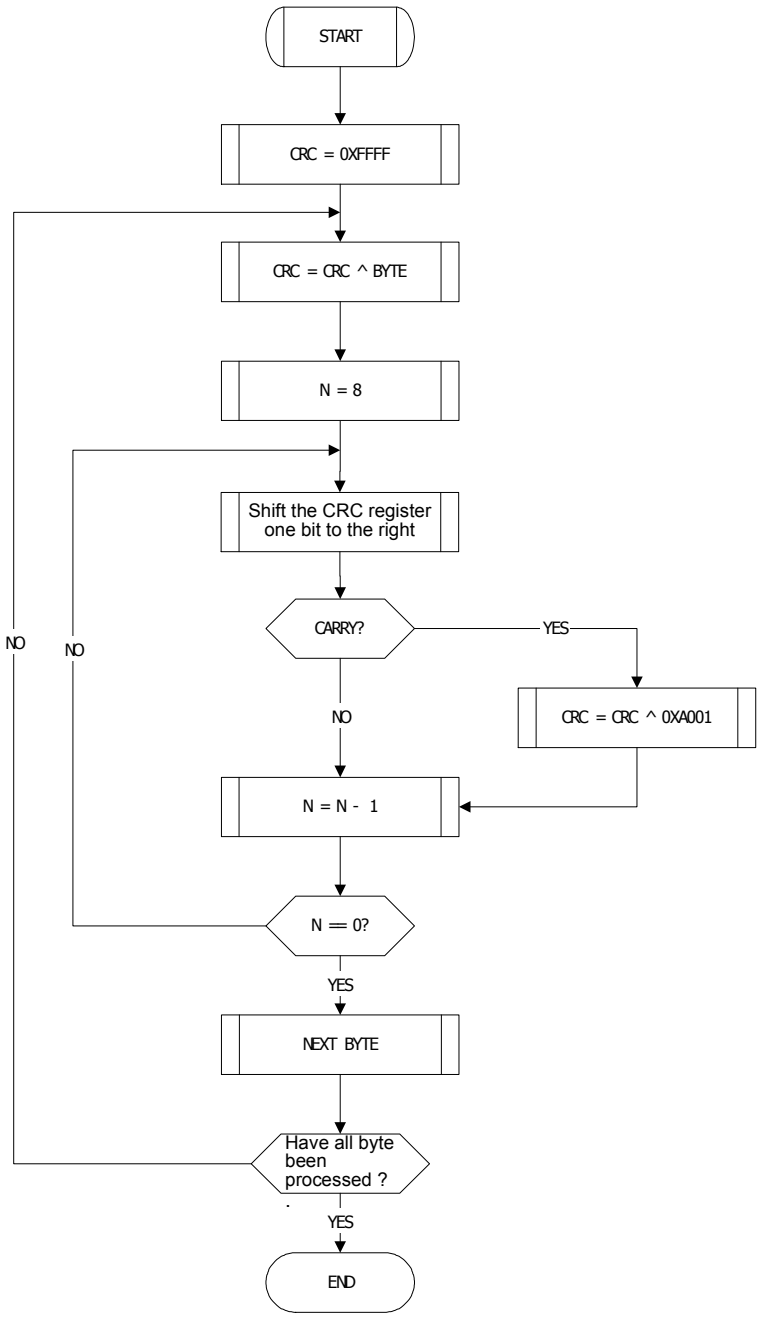
Modbus-ASCII adopts the LRC to verify, The LRC is calculated by adding together successive eight-bit bytes in the message, discarding any carries, and then two's complementing the result. The LRC is an eight-bit field, therefore each new addition of a character that would result in a value higher than 255 decimal simply rolls over the field's value through zero. Because there is no ninth bit, the carry is discarded automatically.

Modbus-RTU adopts the CRC-16 to verify, it contains a 16-bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results.

The CRC is started by first preloading a 16-bit register to all 1's. Then a process begins of applying successive eight-bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits, and the parity bit, do not apply to the CRC.

During generation of the CRC, each eight-bit character is exclusive ORed with the register contents. The result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB was a 1, the register is then exclusive ORed with a preset, fixed value. If the LSB was a 0, no exclusive OR takes place.

This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next eight-bit character is exclusive ORed with the register's current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the characters of the message have been applied, is the CRC value. The calculating process of CRC-16 is as follow.



Picture 14, calculating progress of CRC-16 verify code

4.4 Error management

The meter will response message when it has examined error which out of the error codes, the highest bit of function code is 1. That is, the function code slave response is what it received plus 128. The format of error message frame which rebound from the slave is as follows:

Address code	Function code （highest bit 1）	Error code	Verification code	
			Low byte	High byte
1 byte	1 byte	1 byte	1 byte	1 byte

Figure 6 Invalid message frame format return from the slave

Error code as follows：

01H	Invalid function code	Meter doesn't support the function code received
02H	Invalid data address	The data address received is out of range
03H	Invalid data value	The date value received is out of range

4.5 Samples of Communication message

4.5.1 Read Register （function code 03/04H）

This function allows user to obtain the data and system parameters which the meter sampling and recording. The maximal register number which master requests is 125. The following sample is reading three basic data IA、IB、IC from the client which address code is 01H （the length of each register is 2 bytes, the start address of IA is 0100H，number of register is 3）。

	ASCII code	HEX code
Start	:	3AH
Address code	01	30H 31H
Function code	03	30H 33H
Original register address	0107	30H 31H 30H 37H
Number of register	0003	30H 30H 30H 33H
Verification code	F1	46H 31H
Stop	<CR><LF>	0DH 0AH

Figure 7 read register master demand data frame (ASCII code)

Start		4 bytes time interval
Address code		01H
Function code		03H
Original register address	High byte	01H
	Low byte	07H
Number of register	High byte	00H
	Low byte	03H
Verification code	Low byte	B5H
	High byte	F6H
Stop		4 bytes time interval

Figure 8 Read register master inquire data frame(RTU mode)

The data return from the master indicating IA＝03EDH(1.005)、IB＝03F0H(1.008)、IC＝03E0H(0.992)，the actually value of current can be gained according to the appendix.

	ASCII code	HEX code
Start	:	3AH
Address code	01	30H 31H
Function code	03	30H 33H

Byte	06	30H 36H
Register 1 data	03ED	30H 33H 45H 44H
Register 2 data	03F0	30H 33H 46H 30H
Register 3 data	03E0	30H 33H 45H 30H
Verification code	30	33H 30H
Stop	<CR><LF>	0DH 0AH

Figure 9 Write register slave response data frame

Start		4 bytes time interval
Address code		01H
Function code		03H
Byte		06H
Register 1 data	High byte	03H
	Low byte	EDH
Register 2 data	High byte	03H
	Low byte	F0H
Register 3 data	High byte	03H
	Low byte	E0H
Verification code	Low byte	8CH
	High byte	5EH
Stop		4 bytes time interval

Figure 10 Read register slave response data frame

4.5.2 Write multiple register（10H）

This function is for the master to write multiple data into register, the register should be writable, and the number should be within the range of address. The maximal number of registers which Modbus communication protocol allows to save into is 60. Following is the example of setting LED display to the lightest (grade 16th)

	ASCII code	HEX code
Start	:	3AH
Address code	01	30H 31H
Function code	10	31H 30H
Original register address	000A	30H 30H 30H 41H
Number of register	0001	30H 30H 30H 31H
Write bytes	02	30H 32H
Write data	0010	30H 30H 31H 30H
Verification code	D2	44H 32H
Stop	<CR><LF>	0DH 0AH

Figure 11 write register server enquire data frame（ASCII mode）

Start		4 bytes time interval
Address code		01H
Function code		10H
Original register address	High byte	00H
	Low byte	0AH
Number of register	High byte	00H
	Low byte	01H
Write byte		02H
Write data	High byte	00H
	Low byte	10H
Verification code	Low byte	A7H
	High byte	36H
Stop		4 bytes time interval

Figure 12　Write register master enquire data frame（RTU mode）

	ASCII code	HEX code
Start	:	3AH
Address code	01	30H 31H
Function code	10	31H 30H
Original register address	000A	30H 30H 30H 41H
Number of write register	0001	30H 30H 30H 31H
Verification code	E4	45H 34H
Stop	<CR><LF>	0DH 0AH

Figure 13　Write register slave response data frame（ASCII mode）

Start		4 bytes time interval
Address code		01H
Function code		10H
Original register address	High byte	00H
	Low byte	0AH
Number of register	High byte	00H
	Low byte	01H
Verification code	Low byte	21H
	High byte	CBH
Stop		4 bytes time interval

Figure 14　Write register slave response data frame（RTU mode）

Appendix

1. Address information

System parameters				
Address	Factory setting	Item	Description	Property
0000H	-	SERH	Serial number higher-byte	R
0001H	-	SERL	Serial number lower-byte	R
0002H	-	STATE	System performance state (reserved)	R
0003H	8888	PSW	Password for programming setting	R/W
0004H	1	ADDR	Meter address	R/W
0005H	9600	CBS	communication baud rate select	R/W
0006H	1.8.N.2	CDS	Communication data format select	R/W
0007H	RTU	CPS	Communication protocol select	R/W
0008H	0	DCW	Display control word	R/W
0009H	2	DTT	When DCW=0, displays automatic switching time. Unit: second.	R/W
000AH	8	BCW	Brightness control word	R/W
000BH	0	NET	Type of electrical network （0－three-phase four -wire，1－three- phase three- wire）	R/W
000CH	1	URATIO	Voltage ratio -Note1	R/W
000DH	1	IRATIO	Current ratio - Note1	R/W
000EH	-	WRST	Energy accumulated value reset	R/W -Note2
000FH	0	AOSI1	Analog output 1 item setting	R/W
0010H	9999	AOS1	Full scale output of analog output 1 related parameters setting	R/W
0011H	0	AOSI2	Analog output 2 item setting	R/W
0012H	9999	AOS2	Full scale output of analog output 2 related parameters setting	R/W
0013H	0	AOSI3	Analog output 3 item setting	R/W
0014H	9999	AOS3	Full scale output of analog output 3 related parameters setting	R/W
0015H	0	AOSI4	Analog output 4 item setting	R/W
0016H	9999	AOS4	Full scale output of analog output 4 related parameters setting	R/W
0017H	0	DOSI1	Switching output 1 item setting	R/W

0018H	0000	DOS1L	Switching output 1 warning lower limit value	R/W
0019H	9999	DOS1H	Switching output 1 warning upper limit value	R/W
001AH	0	DOSI2	Switching output 2 item settings	R/W
001BH	0000	DOS2L	Switching output 2 warning lower limit value	R/W
001CH	9999	DOS2H	Switching output 2 warning upper limit value	R/W
001DH	0	DOSI3	Switching output 3 item settings	R/W
001EH	0000	DOS3L	Switching output 3 warning lower limit value	R/W
001FH	9999	DOS3H	Switching output 3 warning upper limit value	R/W
0020H	0	DOSI4	Switching output 4 item settings	R/W
0021H	0000	DOS4L	Switching output 4 warning lower limit value	R/W
0022H	9999	DOS4H	Switching output 4 warning upper limit value	R/W
0023H	0	DIDLY	Switching input stabilize time	R/W
0024H	0	DODLY	Switching output stabilize time	R/W
Performance information				
Address	Factory settings	Item	Description	Property
0100H	-	DIO	Switching state	R
Energy data				
Address	Energy address	Item	Description	Property
0101H	1/129	UA/UAB	A phase voltage(three-phase four-wire)/AB wire voltage(three- phase three -wire)	R
0102H	2/130	UB/UBC	B phase voltage(three- phase four-wire)/BC wire voltage (three-phase three- wire)	R
0103H	3/131	UC/UCA	C phase voltage (three -phase four -wire)/CA wire voltage(three- phase thre- wire)	R
0104H	4/132	UAB	A B wire voltage (three- phase four- wire)	R
0105H	5/133	UBC	B C wire voltage (three- phase four -wire)	R
0106H	6/134	UCA	C A wire voltage (three-phase four- wire)	R
0107H	7/135	IA	A phase current	R
0108H	8/136	IB	B phase current	R
0109H	9/137	IC	C phase current	R
010AH	10/138	PS	Total active power	R
010BH	11/139	PA	A phase active power	R
010CH	12/140	PB	B phase active power	R
010DH	13/141	PC	C phase active power	R
010EH	14/142	QS	Total reactive power	R
010FH	15/143	QA	A phase reactive power	R
0110H	16/144	QB	B phase reactive power	R

0111H	17/145	QC	C phase reactive power	R
0112H	18/146	PFS	Total power factor	R
0113H	19/147	PFA	A phase power factor	R
0114H	20/148	PFB	B phase power factor	R
0115H	21/149	PFC	C phase power factor	R
0116H	22/150	SS	Total apparent power	R
0117H	23/151	SA	A phase apparent power	R
0118H	24/152	SB	B phase apparent power	R
0119H	25/153	SC	C phase apparent power	R
011AH	26/154	FR	Frequency	R
Energy data				
address	Factory setting	Item	Description	Property
011BH	-	+Wh(H)	Positive active energy high bit	R-Note3
011CH	-	+Wh(L)	Positive active energy low bit	R
011DH	-	-Wh(H)	Negative active energy high bit	R
011EH	-	-Wh(L)	Negative active energy low bit	R
011FH	-	+varh(H)	Positive reactive energy high bit	R
0120H	-	+varh(L)	Positive reactive energy low bit	R
0121H	-	-varh(H)	Negative reactive energy high bit	R
0122H	-	-varh(L)	Negative reactive energy low bit	R

Figure 15, Address information

Note：1. the product of voltage and current rate should not be exceed 100000，otherwise some displayed data will be overflow

2. when the value read is zero, write 0AA55H to reset accumulated energy data, other values are invalid.

3. write 0AA55H into WRST（000EH）for energy data resetting.

2. Energy data transform

All the energy data response from the meter is regulated as 2 bytes (4 bytes for energy), the negative is shown by offset according to a formula. The details of formula is as 16 shown，PT-voltage variation rate，CT-current variation rate。

Item	Formula	Value range	Symbol	Note
voltage	U = RX×PT×0.01	0~65535	No symbol	UA,UB,UC,UAB,UBC,UCA
current	I = RX×CT×0.001	0~65535	No symbol	IA,IB,IC
Frequency	F = RX×0.01	0~65535	No symbol	FR
Power factor	PF = RX×0.0001	-10000~10000	No symbol	PFA,PFB,PFC,PFS
Active power	P = RX×PT×CT	-32768~32767	No symbol	PA,PB,PC,PS
Reactive power	Q = RX×PT×CT	-32768~32767	No symbol	QA,QB,QC,QS

Apparent power	S = RX×PT×CT	0~65535	No symbol	SA,SB,SC,SS
Energy	W = RX×PT×CT×10	0~2^{32}-1	No symbol	+Wh,-Wh,+varh,-varh

Figure 16: date variety formula

3.Backligh control word（BCW）

BCW	1－16	1－darkest，16－lightest

Figure 17: Backlight control word

4. Communication control word

CBS Baud rate	00H	1200bps	-
	01H	2400bps	-
	02H	4800bps	-
	03H	9600bps	-
	04H	19200bps	-
	05H	38400bps	-
CDS Data format	00H	NONE	No verification
	01H	ODD	Odd verification
	02H	EVEN	Even verification
CPS Communication protocol	00H	RTU	Modbus- RTU
	01H	ASCII	Modbus- ASCII

Figure 18: Communication control word

5. Switching state（DIO）

DIO low byte：

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
-	-	-	-	DI3	DI2	DI1	DI0

DI0~DI3 stand for switching input state, 0-input signal disconnected. 1-input signal connected

DIO high byte：

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
-	-	-	-	DO3	DO2	DO1	DO0

DO0~DO3 stand for switching output condition, 0-output signal disconnected. 1-output signal connected

6. Analog output setting

AOSIx	output item	0	Close the channel of analog output
		1~26	26 energy consumption measured, output 0~20mA
		129~154	26 energy consumption measured, output 4~20mA
AOSx	Output parameter value	1~9999	corresponding with the parameter value of 20mA output

Figure 19 Analog output setting

All setting data of analog output is standardized to 2 bytes (SX) according to a formula. The value is range from 1 to 1999(absolute value) .The formula follows Figure 21.

Example: for 10kV/100V meter, set the first analog output （4～20mA）corresponding with UA , we get AOSI1 and PT should be set to 129 and 100 according to Figure 19.We also get AOS1 (AOS1 = U/PT×10 = 10kV/100×10 = 1000) according to Figure 21.When the first side voltage is 10kV, the first analog output 20 mA current.

7. Switching output settings

DOSIx	Switching output items	0	The switching output channel is off
		1~26	For 26 measuring energy
		128	The switching output channel is on
DOSxL	Warning lower limit value	0~9999	Output warning when measured value is less than this value
DOSxH	Warning upper limit value	0~9999	Output warning when measured value is higher than this value
Note：1. refer to table 15 for energy address 2. when warning lower limit is 0, lower limit warning will be invalid ; when warning upper limit is 9999,upper limit warning will be invalid			

Figure 20 Switching output settings

All setting data of switching output is standardized to 2 bytes (SX) according to a formula. The value is range from 1 to 1999(absolute value).details of the formula as shown in figure 4. The meter has 10 units Schmitt sections when calculating alarm output. For example, if the measurement value is less than warning lower limit at first, then it must be higher than warning upper limit with10 units in order to end warning. Likewise, the measurement value must be less than warning upper limit 10 units in order to stop warning. So, warning upper limit should be higher than warning lower limit with 20 units.The maximal warning lower limit is 9979 and the least warning upper limit is 0020

For example: for 10kV/100V meter, set the first switching output corresponding with UA warning when UA<8kV or UA>12kV. We know DOSI1 (DOSI1=1) and PT (PT= 100) according to Figure 20. Likewise, we know DOS1L and DOS1H(DOS1L = UL/PT×10 = 8kV/100×10 = 800，DOS1H= UH/PT×10 = 12kV/100×10 = 1200)

According to Figure 21.So when the first side voltage is less than 8kV or more than 12kV, the first switching output closed.

Item	Formula	Value range	Symbol	Note
voltage	Sx = U/PT×10	1~9999	No symbol	UA,UB,UC,UAB,UBC,UCA
current	Sx = I/CT×1000	1-9999	No symbol	IA,IB,IC
Frequency	Sx = F×100	1-9999	No symbol	FR
Power factor	Sx = PF×1000	1-9999	No symbol	PFA,PFB,PFC,PFS
Active power	Sx = P/PT/CT	1-9999	No symbol	PA,PB,PC,PS
Reactive power	Sx = Q/PT/CT	1-9999	No symbol	QA,QB,QC,QS
Apparent power	Sx = S/PT/CT	1-9999	No symbol	SA,SB,SC,SS
Note: PT-voltage variation rate CT-current variation rate				

Figure 21 Formula details