

## VII. Communication protocol

### 7.1 physical layer

7.1.1 RS485 communication port,asynchronous semiduplex model;

7.1.2 communication speed 1200-9600bps can set,factory default 2400bps;

7.1.3 byte carry format:1 bit is first bit,8 bit data bit,parity test(N81,E81,081) can choose,leave factory default E81.

### 7.2 Digital communication protocol:

meter supply serial asynchronous semiduplex RS 485 communication port,adopt MODBUS-RTU agreement,each kinds data information both carry in communication circuit.In one line circuit can connect more 32pcs network electric meter at same time,each pcs network meter both can set different communication address.different series meter's communication connection terminal number is different.communication connect should use with copper net's STP,stub size no less 0.5mm<sup>2</sup>.In wiring should take the communication wire distance strong electric cables or other strong electric field,recommend adopt T type network's connection tye(see fig.12),no suggest adopt Y-delta or other connection.

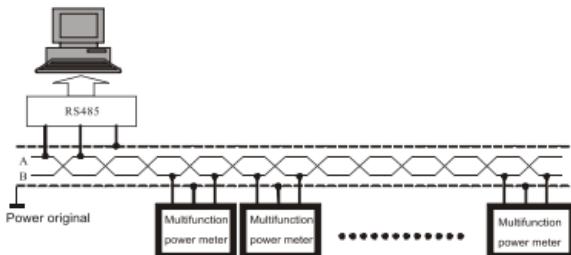
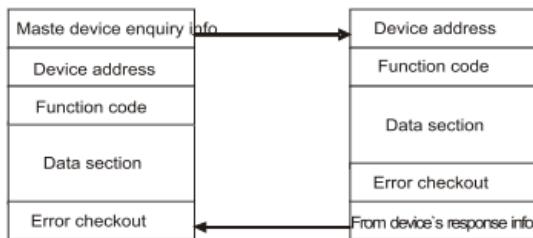


Fig.12

### MODBUS\_RTU communication agreement:

MODBUS agreement in one communication line adopt master-slave response mode. First master computer's signal will find only one address terminal device(slave PC), then terminal device send response signal, transmit opposite side to master PC, namely: in one lonely communication line, signal along with opposite two sides transmit wholes communication data stream(semiduplex work mode). MODBUS agreement allow master(PC,PLC and so on) between terminal device communication(see fig.13), disallow between lonely terminal device exchange the data, so each terminal device can't hold communication lines in initial period, only limit in respond to local enquiry signal.



### Master PC enquiry:

Enquire information frame include device address code, function code, data information code, checkout code. Address code mean selected on slave PC device; function code is select slave device execute which function, like function code 03 or 04 is mean require from device to read register and back to their content; data section include slave device need execute function's other add-ons information, like in read command, data section's add-ons information from in which register begin to read and need read's register quantity; Checkout code use in check one frame information correctness, from slave device supply one validate information content if it's correct way, it adopt CRC16's checkout ruler.

### Slave PC respond:

If slave PC bring one normal respond, in respond news get the slave address code, function code, data new code and CRC16 check out code. Data news code include the slave device collect the data: Like register value or status. If have error, we assume it is slave no do respond. Transmit type is mean one date frame one series independence data structure and transmit date's limit rule, below define MODBUS agree RTU type with compatible's transmit type. each byte's bit: 1 pcs start bit, 8pcs date bit, (parity check bit), 1pcs stop bit (in parity checkout) or 1pcs stop bit (no parity checkout bit).

Data frame's structure:message format) see Table 9

Table 9

Address	Function code	Data code	Checkout code
1 BYTE	1 BYTE	N BYTE	2 BYTE

### Address code:

In frame beginning: One bit (8 bit binary code) consisted, decimal system is 0~255, in our system only use 1~247, other address is keep. This bit mark user point the terminal device's address, this device will receive from relative connection's master data. Each terminal device address must be uniquely, only was found address's terminal will respond include this address enquiry. When terminal send one respond, from the respond's slave address data can get which terminal is do communicate with it.

### Function code:(see table 10)

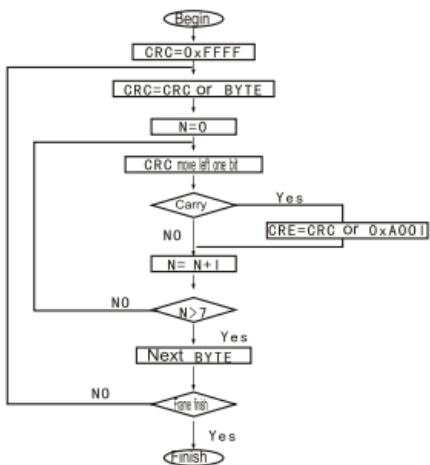
Tell was found address's terminal execute in which function. Below table list support function code, and their mean and function.

Table 10

Code	Mean	Action
01	Read relay output status	Get relay output status
02	Remote switch capacity input status	Get switch capacity output news
03	Read data register value	
05	Remote single unit relay output action	
0F	Remote many units relay output action	Get one or more register's present binary system value
10H	Write preset register	Set binary system value in relative register

### Checkout code:

Error checkout(CRC)field engross 2pcs bit,include one 16 bit's binary system value.CRC value count in transmit device,then additional to data frame,receiving device in receive data then over again count CRC value,then to compare to receive CRC field's value ,if two values no balance,then happen error.



communication message for example:

Read data(function code:03):this function,user can get terminal device collection,record the data,and system parameter.Master once require collect data number no limit,but can't over define address range.The below example is from terminal device address is 12(0CH)'s slave PC,read 3 pcs data la,lb,lc(data frame's frame each address engross 2 byte,la's begin address is 43(2BH)begin,data length is 3 (03H)byte.

Enquiry data frame(Master PC)(as per Table 11)

Table 11

Address	command	originat register address (High)	originat register address (Low)	register quantity (High)	register quantity (Low)	CRC16 (Low)	CRC16 (High)
0CH	03H	00H	2BH	00H	03H	74H	DEH

Respond data frame(Slave PC)(as per Table 12)

Indicate la=1380H (4. 992)、lb=1390H (5. 008)、lc=1370H (4. 976)。

Table 12

Address	command	Data length	Data	123456	CRC16 (Low)	CRC16 (High)
0CH	03H	06H	13H 80H 13H 90H 13H 70H		72H	E5H

Preset data(function code:16):this function allow to change some register's content(Energy meter can use this function to wrote,need emphasize the wrote date is can write property parameter,quantity no over address range,the below example is write into current transformation ratio is 400A/5A=80 communication type.

Enquiry data frame(Master PC)(as per Table 13)

Table 13

Address	command	originat register address (High)	originat register address (Low)	register quantity (High)	register quantity (Low)	Write Data	CRC16 (Low)	CRC16 (High)
0CH	10H	00H	04H	00H	01H	00H 50H	FFH	78H

Respond data frame(Slave PC)indicate data already wrote into (as per Table 14)

Table 14

Address	command	originat register address (High)	originat register address (Low)	register quantity (High)	register quantity (Low)	CRC16 (Low)	CRC16 (High)
0CH	10H	00H	04H	00H	01H	41H	15H

MODBUS address message Table: (see table 15)

table 15

Add	Item	Description	Byte address	Explain
SET message				
1	DZ	meter address	2	one byte,1~254
	TXK	communication control bit	3	as per address explain
2	XSI	quantity of display select	4	keep
	SRS	wiring type select	5	as per address explain
3	PT	voltage multiple rate	6, 7	PT=Voltage 1 time test/2 times test(1~9999)
4	CT	current multiple rate	8, 9	CT=Current 1 time test/2 times test(1~9999)
5	DOS1i	output 1 corresponding item	10	switch(analog quantity) corresponding item(see table 19)
6	DOS2i	output 2 corresponding item	11	switch(analog quantity) corresponding item(see table 19)
7	DOS1V	output 1 corresponding value	12, 13	switch(analog quantity) corresponding item(see table 19)
8	DOS2V	output 2 corresponding value	14, 15	switch(analog quantity) corresponding item(see table 19)
9	DOS3i	output 3 corresponding item	16	switch(analog quantity) corresponding item(see table 19)
10	DOS4i	output 4 corresponding item	17	switch(analog quantity) corresponding item(see table 19)
11	DOS3V	output 3 corresponding value	18, 19	switch(analog quantity) corresponding item(see table 19)
12	DOS4V	output 4 corresponding value	20, 21	switch(analog quantity) corresponding item(see table 19)
13	DISP	boot-strap display	22	boot-strap display content(see Table 6.7.8)
	DISL	Show brightness adjust	23	Show brightness adjust 0001~4000(Only in LED display)
14	DOS1D	Switch capacity output 1 delay time	24	From over alarm value to switch action time (1~120s)
15	DOS2D	Switch capacity output 2 delay time	25	From over alarm value to switch action time (1~120s)
16	DOS3D	Switch capacity output 3 delay time	26	From over alarm value to switch action time (1~120s)
17	DOS4D	Switch capacity output 4 delay time	27	From over alarm value to switch action time (1~120s)
Running message				
33	DIO/Info	switch message	66, 67	0 break,1 make
35	D P T	voltage radix point position	70	
	D C T	current radix point position	71	
36	D P Q	power radix point position	72	
	S I G N	power symbol position	73	See Data format description
37	Ua	A phase voltage	74 75	
38	Ub	B phase voltage	76 77	
39	Uc	C phase voltage	78 79	
40	Uab	AB phase voltage	80 81	
41	Ubc	BC phase voltage	82 83	
42	Uca	CA phase voltage	84 85	
43	Ia	A phase current	86 87	
44	Ib	B phase current	88 89	
45	Ic	C phase current	90 91	
46	Pa	A phase active power	92 93	
47	Pb	B phase active power	94 95	

48	Pc	C phase active power	96 97	$P = (Rx / 10000) * (10^DPQ)$ Power factor $PF = Rx / 1000$ $F = Rx / 100$ Rx is corresponding register's data <b>SIGN</b> is 0 ~ 7, it separate mean $P_a, P_b, P_c, P_s, Q_a, Q_b, Q_c, Q_s$ symbol, 1 is negative 0 is positive
49	Ps	Total active power	98 99	
50	Qa	A phase reactive power	100 101	
51	Qb	B phase reactive power	102 103	
52	Qc	C phase reactive power	104 105	
53	Qs	Total reactive power	106 107	
54	PF a	A phase power factor	108 109	
55	PF b	B phase power factor	110 111	
56	PF c	C phase power factor	112 113	
57	PF s	Total power factor	114 115	
58	Sa	A phase apparent power	116 117	
59	Sb	B phase apparent power	118 119	
60	Sc	C phase apparent power	120 121	
61	Ss	Total apparent power	122 123	
62	F	Frequence	124 125	

63	WPP	forward active power	126 127 128 129	secondary side energy parameter, energy data high byte at front, low byte at back, 4 byte is integral, unit is kWh(kVarh)
65	WPN	reverse active power	130 131 132 133	
67	WQP	forward reactive power	134 135 136 137	
69	WQN	reverse reactive power	138 139 140 141	
71	EPP	forward active power	142 143 144 145	first side energy parameter, adopt IEEE754 floating-point format, 4 byte length, unit kWh(kVarh)
73	EPN	reverse active power	146 147 148 149	
75	EQP	forward reactive power	150 151 152 153	
77	WQN	reverse reactive power	154 155 156 157	

Control word parts			
Parameter		Meaning	
communication control word TXKBIT7654;3210 Function: baud rate and formate	BIT5	Data formate	00 N. 8. 1
	BIT4		01 O. 8. 1
			10 E. 8. 1
			00 9600
Communication speed BIT1 BIT0			01 4800
			10 2400
			11 1200
meter work mode identifier SRS	BIT7		Three phase four wires : three phase three wires

## 8.Function output

### 8.1 Energy measure and pulse output

This series meter adopt 3 r now 12 bit digital to display once energy,VH-0 show total active power,VH-1 show reverse active power,VAHO show reverse reactive power,VAH1 show reverse reactive power,pulse normal value is 8000imp/kwh.

### 8.2 switch capacity,transmit module part:

This series meter supply 4 ways switch capacity input function and 4 ways switch capacity output function,4 ways switch input adopt dry contact resistance switch signal input type,meter inside prepare 12V work power,no need outside supply power source.When outside is make.go through meter switch input module DI collect is make message,show 1;when outside is break,go through meter switch input module DI collect is break message show 0.switch input module not only can collect and display local switch message, and meanwhile can through meter's digital port RS485 come true remote transmit function,namely"remote communication"function".4 way optical relay's switch output function,relay output is make,show 1, when in switch output is closed,relay output is break,show 0.

#### 8.2.1 electric parameter

switch input DI:make resistance R<5000;closed break resistance>100KΩ switch output DO:AC 250V,0.1A

#### 8.2.2 Register(see Table 16)

DIO message register(address 33):this register mean 4 ways switch input and 4 way switch output status message. (see Table 16)

DI 0 register	BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Corresponding switch port	D04	D03	D02	D01	D14	D13	D12	D11
Reset	0	0	0	0	0	0	0	0

DIO message register's low 4 bit(BIT3,BIT 2,BIT 1,BIT 0)is switch input status message.If register content is 0 000 0 1 0 1 m mean switch input port 1,3 way is make;2, 4 way is close break;DIO message register's high 4 bit(BIT 7,BIT 6,BIT 5,BIT 4) is switch output status message.If register's content is 1 1 0 1 0 0 0 mean port 15 and 16,19 and 20,21 and 22 make;17 and 18 closed break,all DIO message in meter board can show.If first way adopt address is 10.. 11.. 12 ( BYTE2.. BYTE1.. BYTE0 ) 3pcs byte to save.Address lowest byte(address 10)save alarm output.

Object's parameter,like Ua's low alarm parameter is 1,high alarm parameter is 129;0 is mean remote mode,other 2 byte(address 11.. 12) is alarm over limit parameter.Other 3 ways is similar.Corrresponding address space can as per the table(See table 7)

Item	Variable	Mean: DOS1 (BYTE2, BYTE1, BYTE0)
Switch output 1	DOS1	BYTE2(1~255),alarm's item,1-26 separate corresponding energy address's corresponding 26 pcs measure energy low alarm;over 12 of 28 9-154 is corresponding's high alarm,0.m mean keep type,detail as per switch capacity output,transmit output energy parameter parallel table BYTE1..0 (1~9999),alarm 1 limit parameter,parameter fromate same energy m message,notice the radix point m mean.
Switch output 2	DOS2	
Switch output 3	DOS3	
Switch output 4	DOS4	

Table 17

#### 8.2.3 Application example:

##### A.switch input function:

Switch module have 1 2 way switch input collect function.After input signal,meter panel board show"make 1" or "break 0" message.use in switch signal's local monitor.Take the meter change to switch message display status,meanwhile "DI" indication light is light,detail as per No. Page 17 DISP=12,No.page DISP=15 diagram.Through meter RS485 digital port,can take switch message register(D10) message transmit to remote PC end terminal.

##### B. switch output,analog output function:

Remote function:Through upper machine to D10 message register wrote control message,can control 4 way switch output port's make and break,wrote 1 corresponding port make,wrote 0 corresponding port break,if write enter binary system1 0 1 1 0 0 0 0,mean 1 way,3 way,4 way output port make,3 way is break.This function can't with switch output module's other over limit alarm output function use in same time,if use remote function,need set the energy object's parameter set is 0, and close alarm output function,when meter in switch capacity output function setting No.2 line parameter is 0.See page 17 DISP=13,NO.page 24 DISP=17,NO.Page 30 DISP=16 fig.in remote status mean No.4 way,No.1 way,No.3 way is make status,No.2 is break status.Switch output module's other one function is over limit alarm output.set electric parameter range,when in measure the electric parameter over set range,corresponding switch output port is make status.panel correspoding postion show 1,when signal back in parameter range then show 0.

Meter inside's DOS(3byte)is switch set register,through meter's communication port write to parameter, and come true alarm set; and also can direct through panel button to operation,to alarm object and alarm value to set.

#### 8.2.4 programme example(see table 18)

To 10kV/100V,400A/5A's meter to set D01 is  $U_a > 11kV$  alarm,DOS2 is  $I_a > 400A$  alarm, DOS3 is  $PF < 0.9$  alarm,DOS4 is  $F > 51.00Hz$  alarm,the control word should write:

Table 18

Sort	Alarm condition	Control word(high byte at front)		
		BYTE2	BYTE1	BYTE0
switch output 1	$U_a > 11.00kV$	128+1=129	1100 (04H4CH)	
switch output 2	$I_a > 400A$	128+7=135	4000 (0FHAAH)	
switch output 3	$PF < 0.90$	21	900 (03H84H)	
switch output 4	$F > 50.00Hz$	128+26=154	5100 (13HECH)	

switch capacity set parameter DOS1 also can through board's button to set programme,in programme operation,DOS1 menu item parameter value is corresponding DOS1 relative parameter(see table 19).In fig.8 alarm set:D0-1 mean set item is switch output module 1:0129 is select alarm energy item is  $U_a$  high alarm,6000 is alarm value,when  $U_a > 6000(U_a > 600V)$ ,D01 output alarm signal,namely:relay is make.

Table 19

Item	switch capacity output item TYPE		Transmit output item TYPE
	Corresponding parameter low alarm	Corresponding parameter high alarm	Corresponding parameter(4~3mA)
$U_a(A$ phase voltage)	1	129	129
$U_b(B$ phase voltage)	2	130	130
$U_c(C$ phase voltage)	3	131	131
$U_{ab}(AB$ wires voltage)	4	132	132
$U_{bc}(BC$ wires voltage)	5	133	133
$U_{ca}(CA$ wires voltage)	6	134	134
$I_a(A$ phase current)	7	135	135
$I_b(B$ phase current)	8	136	136
$I_c(C$ phase current)	9	137	137
$P_a(A$ phase active power)	10	138	138

$P_b(B$ phase active power)	11	139	139
$P_c(C$ phase active power)	12	140	140
$P_s(\text{total phase active power})$	13	141	141
$Q_a(A$ phase reactive power)	14	142	142
$Q_b(B$ phase reactive power)	15	143	143
$Q_c(C$ phase reactive power)	16	144	144
$Q_s(\text{total reactive power})$	17	145	145
$P_f a(A$ phase power factor)	18	146	146
$P_f b(B$ phase power factor)	19	147	147
$P_f c(C$ phase power factor)	20	148	148
$P_f s(\text{total power factor})$	21	149	149
$S_a(A$ phase apparent power)	22	150	150
$S_b(B$ phase apparent power)	23	151	151
$S_c(C$ phase apparent power)	24	152	152
$S_s(\text{total apparent power})$	25	153	153
$F(\text{frequency})$	26	154	154
$V(\text{Voltage unbalancedness})$		155	155
$I(\text{Current unbalancedness})$		156	156
$L(\text{Linkage(closed)})$		157	
$U(\text{Linkage(Break)})$		158	
$-P_s(\text{two way active power})$			159
$-Q_s(\text{two way reactive power})$			160
$-F(\text{two way frequency})$			161
$-PF(\text{two way power factor})$			162
$R(\text{Residual current})$		163	163

Analog capacity leave factory default set.Analog capacity output according secondary current to count:

No.1 way is A phase current:TYPE is 135,UAL is 5000;5000 corresponding secondary side current 5A  
 No.2 way is B phase current:TYPE is 136,UAL is 5000;5000 corresponding secondary side current 5A  
 No.3 way is C phase current:TYPE is 137,UAL is 5000;5000 corresponding secondary side current 5A  
 No.4 way is A phase voltage:TYPE is 129,UAL is 3800;3800 corresponding secondary side voltage 380V  
 Total active power:TYPE is 141,UAL is 300;3300 corresponding secondary power value is 3300W  
 Total power factor:TYPE is 149,UAL is 1000;1000 corresponding secondary power factor value is 1.000  
 Frequency:TYPE is 154,UAL is 5000;5000 corresponding secondary frequency value is 50.00Hz  
 Notice:when TYPE set is 0000,mean "remote"status.

Menu explain:

(a)"F" is frequency two way transmit, mean transmit frequency range  $50\pm x$  Hz, corresponding transmit output 0~10~20mA(or 4~12~20mA). For example set full scale value is 6000, it mean transmitted frequency range 40.00~50.00~60.00Hz) corresponding 0~10~20mA(or 4~12~20mA) transmit output.

(b)"Ps(-Qs)" is active/reactive power's two way transmit, can choose: 0~10~20mA(or: 4~12~20mA). Like three phase four wires, input signal is 380V 5A's meter. Set power full scale value is 5700W. The transmit corresponding relative as follow: -5700W~0W~+5700W transmit is 0~10~20mA(or 4~12~20mA).

(c)"PF" is two way power factor transmit, full scale value is 1000, mean power factor-1~0~+1 corresponding 0~10~20mA(or 4~12~20mA) transmit output.

## 9. Common problem and solution

### 9.1 About communication

#### 1) Meter no back data

Ans:

First make ensure the meter's communication set message like slave address, baud rate, check type if fit master PC requirement. If present some pieces meter communication can't back data, detect to present communication total wires's connection if correct and reliable, RS485 transfer is in normal. If only one piece or less meter communication in abnormal, also can check corresponding communication wires, and revised the abnormal and test normal meter slave PC's address, remove or confirm the master software problem, or through exchange abnormal and normal meter's installation position to test, remove or confirm meter fault.

#### 2) Meter back the data is not exact

Ans:

This series digital multifunction network power meter's communication open to customer's date have one time net float type data and secondary net int/long type data. Please read careful in the communication address table list about data save address and save format's explain. Make ensure to according corresponding data format change.

### 9.2 About U, I, P measure no exact

Ans:

First make sure the correct voltage and current signal already connect to meter. It can use multimeter to measure voltage signal, in necessary to use Power Clamp Meter to measure current signal. Second, make sure signal wire's connection is correct. Like current signal's same name port (also is input port), and each phase's phase sequence if have problem. This series product meter can observe power interface display, only in opposite transmitted electrical status, active power is negative, as usual status, active power symbol is positive, if power active symbol is negative, might current input wires incorrect connection, or maybe phase sequence incorrect also will result power display abnormal. Other should notice is meter display the power energy is first net value, if meter inside set's voltage current transformer multiple rate is different with practice use, also result no exact in meter energy display. The measurement range can't change after leaving factory.

Connect network can according present practice connection to revised, but programme menu's connection set must be same as practice, otherwise will result error display message.

### 9.3 About the energy move word no exact

Ans:

Meter's energy accumulating basic to measure the power, first observe meter's power value if accord with practice load. This series multifunction energy meter can support two way energy accumulation, under the incorrect connection condition, total active power is negative, energy accumulating to reverse active power. Forward active power can't accumulation. The most problem happen in practice use is current transformer input and output opposite connection. This series product both can see split phase with symbol's active power, if power is negative might is connection error, otherwise phase sequence connect wrong will result the move word of meter in abnormal.

### 9.4 Meter no light

Ans:

Make ensure fit auxiliary power (as per product practicality specification sticker) already additional meter's auxiliary power terminal. over the range, auxiliary power voltage will damage meter and can't resume. It can use the multimeter to measure auxiliary power's voltage value, if power voltage in normal, meter no any display, and can consider break then make again. If meter no normal display can contact our technical dep.

## 9.5 Meter no respond operation

Ans:

Press meter button “

## 9.6 Other abnormal condition

Ans:

Please contact our technical in time.User can list detail description present condicton.