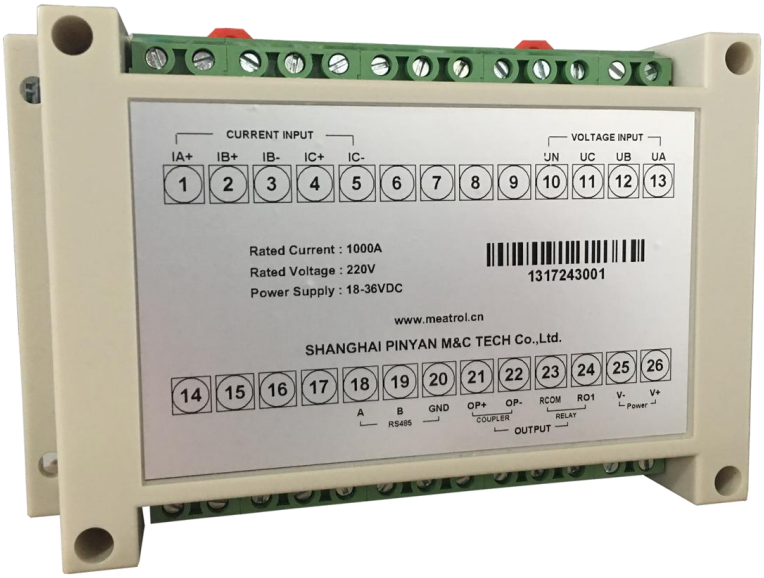
ME531 Three-phase Power Meter



Feature

Specification	
Model	ME531
Product component type	Multifunction power meter
Poles description	3PH4W 3PH3W 1PH2W (L-N); 1PH2W(L-L);1PH3W(L-L-N)
Device application	Power analysis Energy meter
Input type	External CT(333mV only) And External Rogowski coil
Display	None Display
Sampling rate	8k samples per second
Mounting mode	DIN RAIL
Harmonic	52th Max
Mechanical characteristics	
Weight	125g
Dimension	L*W*D:122*87*23mm

Instantaneous rms Values	
Voltage	U，UTH2，UTH3，UTH4(Per Phase, AVG）
Current	I,ITHD2，ITHD3，ITHD4(Per Phase, AVG）
Power	P,Q,S,PF(Per Phase, SUM）
Energy	EP, EQ, ES, Freq (Per Phase, SUM）
	over 1.0 x 10^9k**Wh,value reset**
UTHD(%)	UTHD,THD2,THD3,THD4(Per Phase, AVG）
ITHD(%)	ITHD,THD2,THD3,THD4(Per Phase, AVG）
PF	PFa, PFb, PFc, AVG
Update rate	
Data acquisition rate	400ms
Calibration	
Current	Per phase, all
Voltage	Per phase, all
Power factor	Per phase ,all
Energy	Reset to “0” EP,EQ,ES all phase

MODBUS RS485

Communication	
Transmission mode	RS485 port,Half duplex
RS485 link	3 wires
Communication protocol	MODBUS RTU
Settings	
Communication address	1 to 247 (default 1)
Baud rate(communication speed)	1200 to 57600 baud (default 19200)
Parity	None (default),Old, Even
Data bit	8
Stop bit	1

Certificate

Environmental conditions	
Operating temperature	-25℃ to +55℃
Storage temperature	-40℃ to +85℃
Humidity rating	5 to 95% RH at 50℃(non-condensing)
Pullution degree	2
Overvoltage category	III,for distribution systems up to 277/480VAC
Dielectric withstand	As per IEC61010-1, Doubled insulated front panel display
Altitude	3000m Max
IP degree of protection	IP20 conforming to IEC 60629
Colour	White
Contractual warranty	12months
EMC	
Electrostatic discharge	Level IV(IEC61000-4-2)
Immunity to radiated fields	Level III (IEC61000-4-3)
Immunity to fast transients	Level IV (IEC61000-4-4)
Immunity to surge	Level IV (IEC61000-4-5)
Conducted immunity	Level III (IEC61000-4-6)
Immunity to power frequency magnetic fields	0.5mT (IEC61000-4-8)
Conducted and radiated emissions	Class B (EN55022)
Standard compliance	
EN 62052-11,EN61557-12,EN 62053-21,EN 62053-22,EN 62053-23,EN 50470-1,EN 50470-3, EN 61010-1,EN 61010-2,EN 61010-031	

Specification

Measurement accuracy		
Current	0.5% from 1% to 120%(don't ensure accuracy when <10A)	
Rated current (5 level selectable)	100A(0.5% from 10A to 120A) 600A(0.5% from 10A to 720A) 1000A(0.5% from 10A to 1200A) 3000A(0.5% from 30A to 3600A) 6000A(0.5% from 60A to 7200A)	
Rogwoski coil connect setting	100A	MRC-16
	600A	MRC-36
	1000A	Y-FCT-200 or Y-FCT-350 or NRC-100
	3000A	NRC-150 or Y-FCT-510
	6000A	NRC-200 or Y-FCT-800
Voltage	0.2% from 80V to 400V(or 100 to 500V)	
Power factor	±0.005 from 10% to 120%	
Active/Apparent Power	IEC62053-22 Class 0.5	
Reactive power	IEC62053-21 Class 2	
Frequency	0.01% from 45 to 65Hz	
Active energy	IEC62053-22 Class 0.5s	
Reactive energy	IEC62053-21 Class 2	
Measurement arrange		
Measured voltage	80V to 400V AC(or 100 to 500V)	
Frequency range	50/60Hz	
Input-current characteristics		
Primary current range	Adjustable from 0.1A to 9999A	
Measurement input range	$1/2^{25}$mV-333mV	
Permissible overload	600mV for 10s/hours	
Power		
AC/DC	24VDC	
Output		
Relay	1×digital output(2 ports) from 1pcs relay,rated 24V/800mA, 75mΩmax, 2.5kVrms insulation(controlled by Modbus) Maximum Switching Power ： 0.5A, 125VAC 1A, 30VDC	
Opticalcoupler	Max voltage :80VDC;Max current 50mA Recommend Current :10mA	
Wire diameter for terminals		
Connections-terminals	Screw terminals 2.5mm^2,interval 5.08mm	
Alarm		
Setting	U and I Each phase,AVG	
Output form	Relay	

Port definition

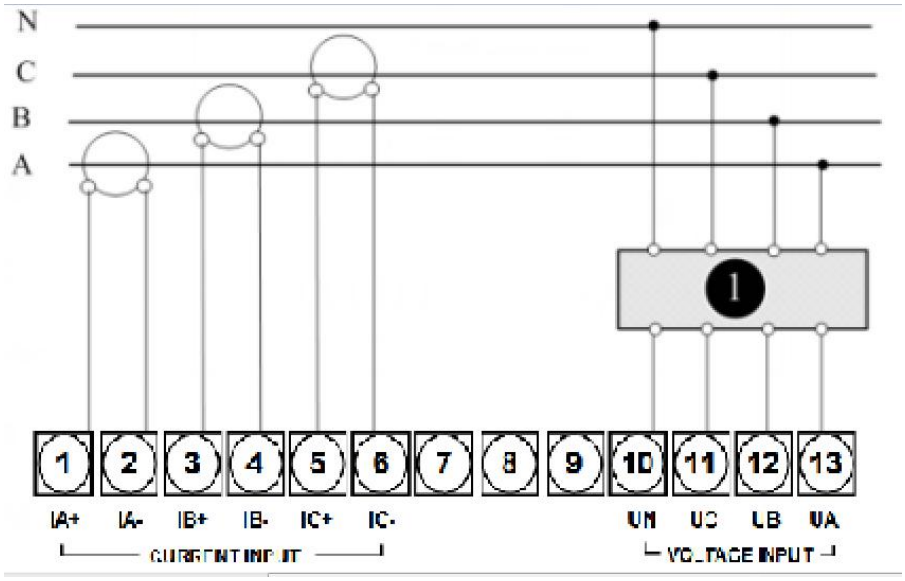
Port number	Port name	Port function	Remarks
1	IA+	A-phase current input positive	A-phase current
2	IA-	A-phase current input negative	
3	IB+	B-phase current input positive	B-phase current
4	IB-	B-phase current input negative	
5	IC+	C-phase current input positive	C-phase current
6	IC-	C-phase current input negative	
7	N/A	To be option	Option
8	N/A	To be option	
9	N/A	To be option	
10	Un	C-phase voltage input	Voltage input
11	Uc	B-phase voltage input	
12	Ub	A-phase voltage input	
13	Ua	N-phase voltage input	
14	N/A	To be option	Option
15	N/A	To be option	
16	N/A	To be option	
17	N/A	To be option	
18	A	RS485 A	RS485 communication
19	B	RS485 B	
20	GND	RS485 GND	
21	OP+	Coupler output +	Coupler output
22	OP-	Coupler output -	
23	RCOM	Relay output -	Relay output
24	RO1	Relay output +	
25	V-	Power supply -	Power 85~265V AC/DC Or 24VDC
26	V+	Power supply +	

Wiring

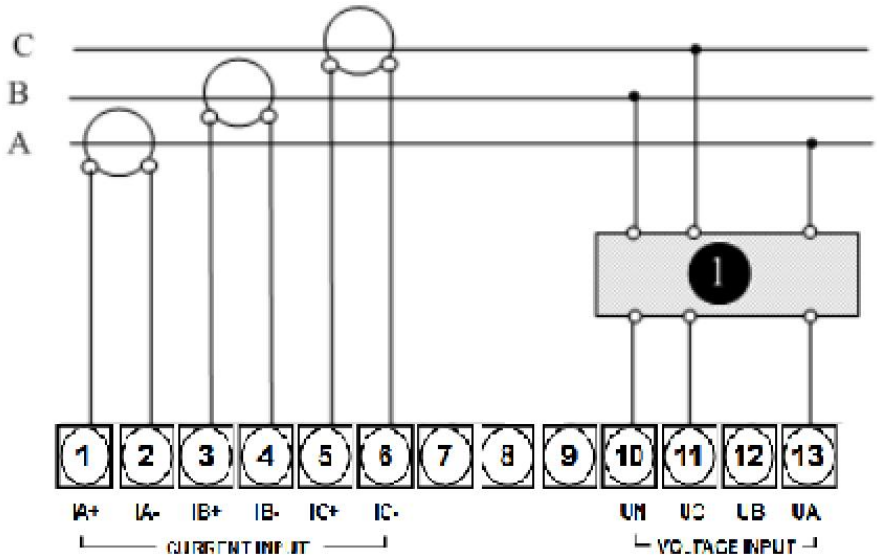
*：Rogowski coil secondary output voltage can not over 333mV rms.

^：CT must be voltage output,secondary output can not over 333mV rms.

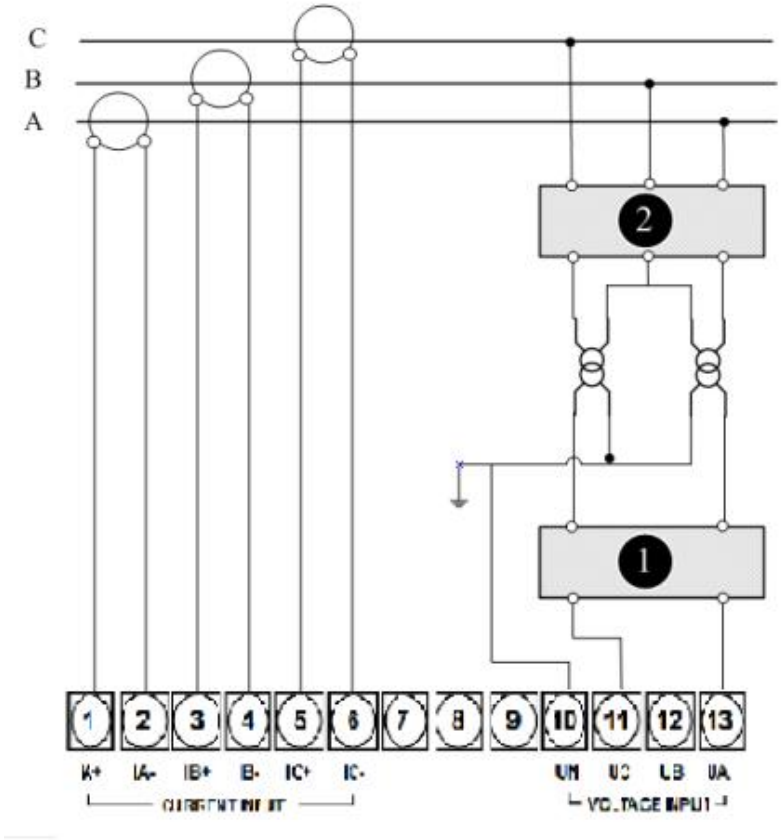
3PH4W no VT



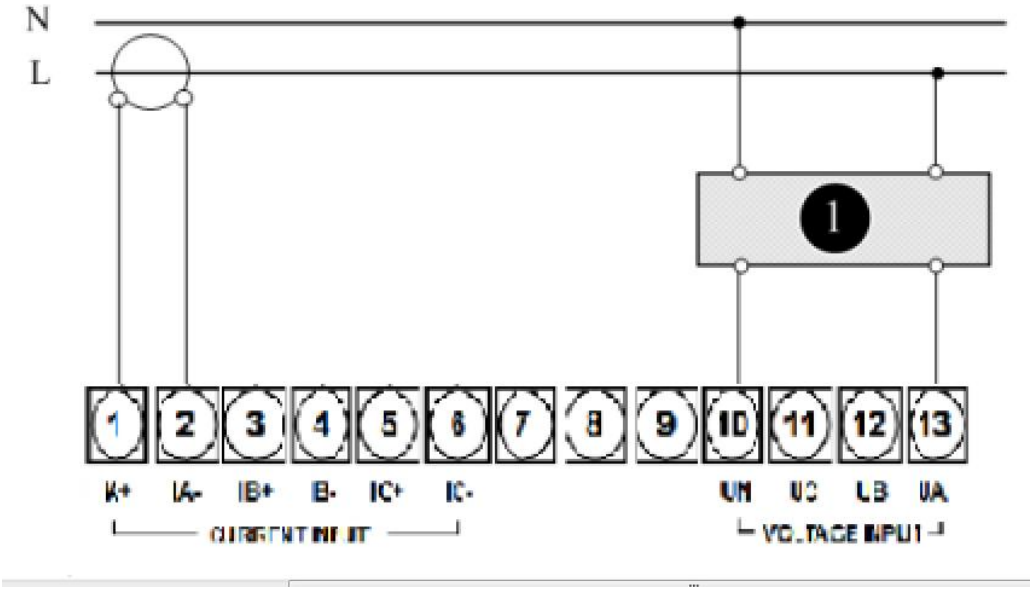
3PH3W no VT



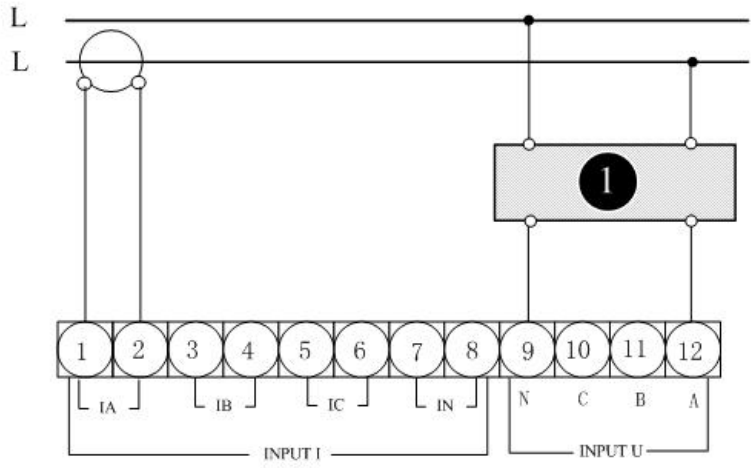
3PH3W with VT



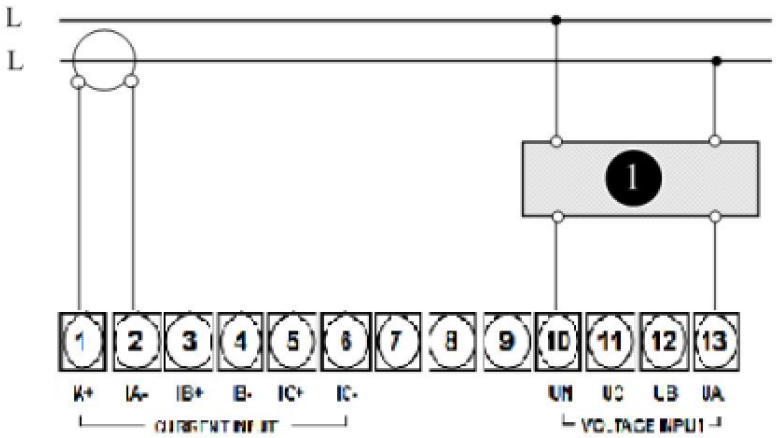
1PH2W L-N



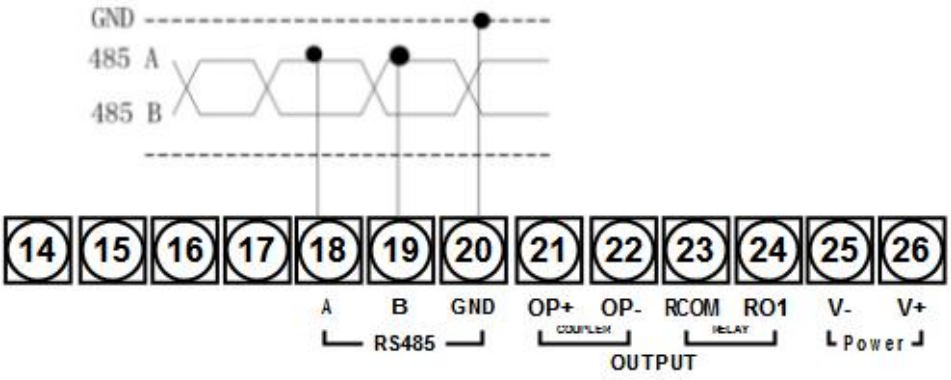
1PH2W L-L



1PH3W L-L-N



ModBus communication &output Wiring diagram



Modbus communications overview

ME531 adopts standard protocol—Modbus-RTU. Baud rate of communication can change to 1200、2400、4800、9600 etc. through program . Error detection: CRC16 (cyclic redundancy check).

Modbus communications default settings

Parameters	Available Values	Default Value
Baud rate	-1200 Baud -2400 Baud -4800 Baud -9600 Baud -19200 Baud -38400 Baud -57600 Baud	19200 Baud
Parity	– Odd – Even – None	None
Data bits	8	8
Stop bits	1	1
Address	1–247	1

Command Request

Slave Address	Function Code	Command Block	CRC
8-Bits	8-Bits	N×8-Bits	16-Bits Checking

Functional code

Functional code tells what function addressed terminal equipment can execute. The following table lists the functional code that used by this instrument, as well as their significance and function.

Function Code		Function Name	Behavior
Decimal	Hexadecimal		
3	03H	Read Holding Registers	Read present HEX from one or more registers.
16	10H	Write Multiple Registers	Write present HEX on multiple registers.

Register table

Register tables have the following columns:

Register Alias	Register Address	Action R/WC	Size	Type	Units	Description

- **Register Alias**: The meaning of the register
- **Register Address**: Modbus address of register encoded in the Modbus frame, in decimal (dec)
- **Action**: The read/write by command register
- **Size**: The data size in Int16
- **Type**: The encoding data type
- **Units**: The unit of the register value
- **Range**: The permitted values for this variable, usually a subset of what the format allows
- **Description**: Provides information about the register and the values that apply

Unit Table

The following data types appear in the Modbus register list:

Type	Description	Range
UInt16	16-bit unsigned integer	0–65535
Int16	16-bit signed integer	-32768–+32767
UInt32	32-bit unsigned integer	0–4 294 967 295
UInt64	64 bit unsigned integer	0–18 446 744 073 709 551 615
UTF8	8-bit field	multibyte character encoding for Unicode
Float32	32-bit value	Standard representation IEEE for floating number (with single precision)
Bitmap	–	–
Date Time	–	-

Date Time Format:

Word	Units															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	Reserved (0)								Year (0–99,year from 2000)							
2	Month (1–12)								Day (1–31)							
3	Hour (0–23)								Minute (0–59)							
4	Millisecond (0–59999)															

Configure Meter

You can configure the power meter by writing command and command parameters to corresponding command registers using Modbus function 16.

Command request

The following table describes a Modbus command request:

Slave Address	Function Code	Command Register Address	Command Register Number	Data Length	Command Register Value	CRC
1-247	16	300(up to 423)	N	N×2		

Command Result

The command result can be obtained by reading registers 424and 425.

The following table describes the command result:

Register Address	Content	Size (Int16)	Data (example)
424	Requested Command Number	1	1001(set Date Time)
425	Result	1	0 = Valid Operation 80 = Invalid Command 81 = Invalid Parameter 82 = Invalid Number of Parameters 83= Operation Not Performed

Command Request Example

Slave Address (8 bits)	Function Code (8 bits)	Command Register Address (16 bits)		Command Register Number (16 bits)		Data Length (8 bits) N x 2	Command Register Value (16 bits) x N				CRC (16bits)	
		High 8 bits	Low 8 bits	High 8 bits	Low 8 bits		Command		Command parameters		High 8 bits	Low 8 bits
							High 8 bits	Low 8 bits	High 8 bits	Low 8 bits		

Function code（0x10=16）Operation

Function code（0x10=16）is used to configure meter, it requests and Responses data format

Request data format:

No.	Alias	Type	Range (decimal)	Description
1	Salve ID	UInt8	1-247	
2	Function code	UInt8	16	
3	Registers Start address	UInt16	-	Big-Endian (Sending order)
4	Registers Numbers	UInt16	1-123	Big-Endian (Sending order)
5	Bytes of Registers Values	UInt8		Registers Numbers *2
6	Value of Register 1	UInt16	-	Big-Endian (Sending order)
7	…	UInt16	-	Big-Endian (Sending order)
8	Value of Register n	UInt16	-	Big-Endian (Sending order)
9	CRC-16 Check	UInt16	-	Little-Endian (Sending order)

Response data format：

No.	Alias	Type	Range (decimal)	Description
1	Salve ID	UInt8	1-247	

2	Function code	UInt8	16	
3	Registers Start address	UInt16	300	Big-Endian
4	Registers Numbers	UInt16	1-123	Big-Endian
5	CRC-16 Check	UInt16	-	Little-Endian

Attention!

Function code（0x10=16） can only write data to “Command Register”，that is to say, only registers start from 300 can be written data.

For example：

Configure “Digital Outputs”(command=1005)

No.	Alias	Type	Range (decimal)	Range (hexadecimal)	Description
1	Salve ID	UInt8	1	01	
2	Function code	UInt8	16	10	
3	Registers Start address	UInt16	300	012C	Big-Endian (Sending order)
4	Registers Numbers	UInt16	2	0002	Big-Endian (Sending order)
5	Bytes of Registers Values	UInt8	4	04	
6	Value of Register 300	UInt16	1005	03ED	Big-Endian (Sending order)
7	Value of Register 301	UInt16	1	0001	Big-Endian (Sending order)
9	CRC-16 Check	UInt16	50093	C3AD	Little-Endian (Sending order)

Request data send as follows：

01 10 01 2C 00 02 04 03 ED 00 01 AD C3

if configure data is right, the meter will response data as follows：

01 10 01 2C 00 02 81 FD

No.	Alias	Type	Range (hexadecimal)	Range (decimal)
1	Salve ID	UInt8	01	1
2	Function code	UInt8	10	16
3	Registers Start address	UInt16	012C	300
4	Registers Numbers	UInt16	0002	2
7	CRC-16 Check	UInt16	81FD	

Function code（0x03=3）Operation

Function code（0x03=3） is used to read registers values, it requests and Responses data format as follows：

Request data format:

No.	Alias	Type	Range(decimal)	Description
1	Salve ID	UInt8	1-247	
2	Function code	UInt8	3	
3	Registers Start address	UInt16	-	Big-Endian (Sending order)
4	Registers Numbers	UInt16	1-125	Big-Endian (Sending order)
5	CRC-16 Check	UInt16	-	Little-Endian (Sending order)

Response data format：

No.	Alias	Type	Range(decimal)	Description
1	Salve ID	UInt8	1-247	
2	Function code	UInt8	3	
3	Bytes of Registers Values	UInt8	-	Registers Numbers *2
4	Value of Register 1		-	Big-Endian
5	…		-	Big-Endian
6	Value of Register n		-	Big-Endian
7	CRC-16 Check	UInt16	-	Little-Endian

For example：

Read Voltage A,B,C value（Address starts 2147）

No.	Alias	Type	Range (decimal)	Range (hexadecimal)	Description
1	Salve ID	UInt8	1	0x01	
2	Function code	UInt8	3	0x03	
3	Registers Start address	UInt16	2147	0x0863	
4	Registers Numbers	UInt16	6	0x0006	
5	CRC-16 Check	UInt16	46647	0xB637	

Request data send as follows：

01 03 08 63 00 06 37 B6

Response data as follows：

01 03 0C 43 5C 00 00 43 5D 00 00 43 5E 00 00 14 AC

No.	Alias	Type	hexadecimal	decimal
1	Salve ID	UInt8	01	1
2	Function code	UInt8	03	3
3	Bytes of Registers Values	UInt8	0C	12
4	Voltage A	float32	435C0000	220V
5	Voltage B	float32	435D0000	221V
6	Voltage C	float32	435E0000	222V
7	CRC-16 Check	UInt16	14AC	

Exception Response

Exception response frame format

No.	Alias	Type	Range (decimal)	Range (hexadecimal)	Description
1	Salve ID	UInt8	1-247	0x01-0xF7	
2	Function code	UInt8	(128+3) (128+16)	(0x80+0x03) (0x80+0x10)	
3	Exception code	UInt8			
4	CRC-16 Check	UInt16			Little-Endian

Exception code of MODBUS

Code (hexadecimal)	Name	Meaning
0x01	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the meter
0x02	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the meter
0x03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for the meter
0x04	DEVICE FAILURE	An unrecoverable error occurred while the server was attempting to perform the requested action.

Command List

Set System Date Time

Command Number	Action R/W	Size	Type	Units	Range	Description
1001	W	1	UInt16	-	2000-2099	Year
	W	1	UInt16	-	1-12	Month
	W	1	UInt16	-	1-31	Day
	W	1	UInt16	-	0-23	Hour
	W	1	UInt16	-	0-59	Minute
	W	1	UInt16	-	0-59	Second

Set Communications

Command Number	Action R/W	Size	Type	Units	Range	Description
1002	W	1	UInt16	-	1-247	Slave Address
	W	1	UInt16	-	0,1,2,3,4,5,6	Baud Rate 0=1200 1=2400 2=4800 3=9600 4=19200 5=38400 6=57600
	W	R/WC	UInt16	-	0,1,2	Parity 0 = ODD 1 = EVEN 2 = None

Set Power System

Command Number	Action R/W	Size	Type	Units	Range	Description
1003	W	1	UInt16	-	0,1,2,3,4	Wiring 0 = 1PH2W L–N 1 = 1PH2W L–L 2 = 3PH4W 3 = 3PH3W 4 = 1PH3W_LLN
	W	1	UInt16	Hz	50,60	Nominal Frequency
	W	2	UInt32	V	-	VT Primary
	W	1	UInt16	V	100,110,115,120	VT Secondary
	W	2	UInt32	A	-	CT Primary
	W	1	UInt16	mV	MaxValue:333mV	CT Secondary
	W	2	UInt32	-	Reserved	Reserved
	W	1	UInt16	-	1,2,3,4,5	Rcoil Rated Current 1=100A（50mV/kA@50Hz） 2=600A（50mV/kA@50Hz） 3=1000A（85mV/kA@50Hz） 4=3000A（85mV/kA@50Hz） 5=6000A（50mV/kA@50Hz）
	W	1	UInt16	-	0,1	Voltage Connection 0 = Direct Connect 1 = VT
	W	1	UInt16	-	0,1	Current Connection 0 = Rogowski coil 1 = CT

Set harmonic times

Command Number	Action R/W	Size	Type	Units	Range	Description
1004	W	1	UInt16	-	2-52	HX harmonic times
	W	1	UInt16	-	2-52	HY harmonic times
	W	1	UInt16	-	2-52	HZ harmonic times

Set Digital Output

Command Number	Action R/W	Size	Type	Units	Range	Description
1005	W	1	UInt16	-	0-1	0 = Relay-Open 1 = Relay-Closed

Reset Energy

Command Number	Action R/W	Size	Type	Units	Range	Description
1006	W	1	UInt16	-	2050-2053	2050：Reset Phase 1 2051：Reset Phase 2 2052：Reset Phase 3 2053：Reset Phase 1,2,3

Modbus Register List

Meter

Register Alias	Register Address	Action R/WC	Size	Type	Units	Description
Meter Model	50	R	20	UTF8	-	
Serial Number	70	R	2	UInt32	-	
Firmware Version	72	R	1	UInt16	-	DLF format: X.Y.ZTT
Date time	73	R/WC	4	Date time	-	Date/Time Reg.73: Year00-99 (year from 2000 to 2099) Reg.74: Month (b15:b8), day (b7:b0) Reg. 75: Hour (b15:b8) ,Minute (b7:b0) Reg. 76: Millisecond

Communications

Register Alias	Register Address	Action R/WC	Size	Type	Units	Description
Address	80	R/WC	1	UInt16	-	1-247
Baud Rate	81	R/WC	1	UInt16	-	0=1200 1=2400 2=4800 3=9600 4=19200 5=38400 6=57600
Parity	82	R/WC	1	UInt16	-	0 = ODD 1 = EVEN 2 = None

Power System

Register Alias	Register Address	Action R/WC	Size	Type	Units	Description
Wiring Type	90	R/WC	1	UInt16	-	0 = 1PH2W L–N 1 = 1PH2W L–L 2 = 3PH4W 3 = 3PH3W 4 = 1PH3W_LLN
Nominal Frequency	91	R/WC	1	UInt16	Hz	
VT Primary	92	R/WC	2	UInt32	V	
VT Secondary	94	R/WC	1	UInt16	V	
CT Primary	95	R/WC	2	UInt32	A	
CT Secondary	97	R/WC	1	UInt16	mV	MaxValue:333mV
-	98	R/WC	2	-	-	Reserved
Rcoil Rated Current	100	R/WC	1	UInt16	-	Rcoil Rated Current 1=100A（50mV/kA@50Hz） 2=600A（50mV/kA@50Hz） 3=1000A（85mV/kA@50Hz） 4=3000A（85mV/kA@50Hz） 5=6000A（50mV/kA@50Hz）
Voltage Connection	101	R/WC	1	UInt16	-	0 = Direct Connect 1 = VT
Current Connection	102	R/WC	1	UInt16	-	0 = Rogowski coil 1 = CT

Digital Outputs

Register Alias	Register Address	Action R/WC	Size	Type	Units	Description
Digital Output				UInt16		0 = Relay-Open

Status	150	R/WC	1		-	1 = Relay-Closed

Command Register

Register Alias	Register Address	Action R/WC	Size	Type	Units	Description
Command	300	R/W	1	UInt16	-	
Parameter 001	301	R/W	1	UInt16	-	
Parameter 002	302	R/W	1	UInt16	-	
…	…	R/W	1	UInt16	-	
Parameter 123	423	R/W	1	UInt16	-	
Requested Command	424	R	1	UInt16	-	
Command Result	425	R	1	UInt16	-	0 = Valid Operation 80 = Invalid Command 81 = Invalid Parameter 82 = Invalid Number of Parameters 83= Operation Not Performed

Basic Data

Power factor ,frequency, harmonics, Current, voltage, power,

Register Alias	Register Address	Action R/WC	Size	Type	Units	Description
Power Factor						
PF1	2000	R	2	Float32	-	Phase 1 Power Factor
PF2	2002	R	2	Float32	-	Phase 2 Power Factor
PF3	2004	R	2	Float32	-	Phase 3 Power Factor
PF Avg	2006	R	2	Float32	-	Average Of PF1, PF2, PF3
DPF1	2008	R	2	Float32	-	Phase 1 Displacement Power Factor
DPF2	2010	R	2	Float32	-	Phase 2 Displacement Power Factor
DPF3	2012	R	2	Float32	-	Phase 3 Displacement Power Factor
DPF Avg	2014	R	2	Float32	-	Average Of DPF1,DPF2, DPF3
Frequency						
Freq1	2016	R	2	Float32	Hz	Phase 1 Frequency
Freq2	2018	R	2	Float32	Hz	Phase 2 Frequency
Freq3	2020	R	2	Float32	Hz	Phase 3 Frequency

FreqAvg	2022	R	2	Float32	Hz	Average of Freq1, Freq2, Freq3
Harmonics Configuration						
HX harmonic times	2024	R/WC	1	UInt16	-	Range:2-52
HY harmonic times	2025	R/WC	1	UInt16	-	Range:2-52
HZ harmonic times	2026	R/WC	1	UInt16	-	Range:2-52
Current Harmonics						
I1THDx	2027	R	2	Float32	%	Phase 1 X times harmonics current distortion
I2THDx	2029	R	2	Float32	%	Phase 2 X times harmonics current distortion
I3THDx	2031	R	2	Float32	%	Phase 3 X times harmonics current distortion
ITHDx Avg	2033	R	2	Float32	%	Average of I1THDx, I2THDx, I3THDx
I1THDy	2035	R	2	Float32	%	Phase 1 y times harmonics current distortion
I2THDy	2037	R	2	Float32	%	Phase 2 y times harmonics current distortion
I3THDy	2039	R	2	Float32	%	Phase 3 y times harmonics current distortion
ITHDy Avg	2041	R	2	Float32	%	Average of U1THDy, U2THDy, U3THDy
I1THDz	2043	R	2	Float32	%	Phase 1 z times harmonics current distortion
I2THDz	2045	R	2	Float32	%	Phase 2 z times harmonics current distortion
I3THDz	2047	R	2	Float32	%	Phase 3 z times harmonics current distortion
ITHDz Avg	2049	R	2	Float32	%	Average of U1THDz, U2THDz, U3THDz
I1THD	2051	R	2	Float32	%	Phase 1 total harmonics current distortion
I2THD	2053	R	2	Float32	%	Phase 2 total harmonics current distortion
I3THD	2055	R	2	Float32	%	Phase 3 total harmonics current distortion
ITHD Avg	2057	R	2	Float32	%	Average of U1THD, U2THD, U3THD
I1THx	2059	R	2	Float32	V	Phase 1 x times harmonics current
I2THx	2061	R	2	Float32	V	Phase 2 x times harmonics current
I3THx	2063	R	2	Float32	V	Phase 3 x times harmonics current
ITHx Avg	2065	R	2	Float32	V	Average of U1THx, U2THx, U3THx
I1THy	2067	R	2	Float32	V	Phase 1 y times harmonics current
I2THy	2069	R	2	Float32	V	Phase 2 y times harmonics current
I3THy	2071	R	2	Float32	V	Phase 3 y times harmonics current
ITHy Avg	2073	R	2	Float32	V	Average of U1THy, U2THy, U3THy
I1THz	2075	R	2	Float32	V	Phase 1 z times harmonics current

I2THz	2077	R	2	Float32	V	Phase 2 z times harmonics current
I3THz	2079	R	2	Float32	V	Phase 3 z times harmonics current
ITHz Avg	2081	R	2	Float32	V	Average of U1THz, U2THz, U3THz
Voltage Harmonics						
U1THDx	2083	R	2	Float32	%	Phase 1 X times harmonics voltage distortion
U2THDx	2085	R	2	Float32	%	Phase 2 X times harmonics voltage distortion
U3THDx	2087	R	2	Float32	%	Phase 3 X times harmonics voltage distortion
UTHDx Avg	2089	R	2	Float32	%	Average of U1THDx, U2THDx, U3THDx
U1THDy	2091	R	2	Float32	%	Phase 1 y times harmonics voltage distortion
U2THDy	2093	R	2	Float32	%	Phase 2 y times harmonics voltage distortion
U3THDy	2095	R	2	Float32	%	Phase 3 y times harmonics voltage distortion
UTHDy Avg	2097	R	2	Float32	%	Average of U1THDy, U2THDy, U3THDy
U1THDz	2099	R	2	Float32	%	Phase 1 z times harmonics voltage distortion
U2THDz	2101	R	2	Float32	%	Phase 2 z times harmonics voltage distortion
U3THDz	2103	R	2	Float32	%	Phase 3 z times harmonics voltage distortion
UTHDz Avg	2105	R	2	Float32	%	Average of U1THDz, U2THDz, U3THDz
U1THD	2107	R	2	Float32	%	Phase 1 total harmonics voltage distortion
U2THD	2109	R	2	Float32	%	Phase 2 total harmonics voltage distortion
U3THD	2111	R	2	Float32	%	Phase 3 total harmonics voltage distortion
UTHD Avg	2113	R	2	Float32	%	Average of U1THD, U2THD, U3THD
U1THx	2115	R	2	Float32	V	Phase 1 x times harmonics voltage
U2THx	2117	R	2	Float32	V	Phase 2 x times harmonics voltage
U3THx	2119	R	2	Float32	V	Phase 3 x times harmonics voltage
UTHx Avg	2121	R	2	Float32	V	Average of U1THx, U2THx, U3THx
U1THy	2123	R	2	Float32	V	Phase 1 y times harmonics voltage
U2THy	2125	R	2	Float32	V	Phase 2 y times harmonics voltage
U3THy	2127	R	2	Float32	V	Phase 3 y times harmonics voltage
UTHy Avg	2129	R	2	Float32	V	Average of U1THy, U2THy, U3THy
U1THz	2131	R	2	Float32	V	Phase 1 z times harmonics voltage
U2THz	2133	R	2	Float32	V	Phase 2 z times harmonics voltage
U3THz	2135	R	2	Float32	V	Phase 3 z times harmonics voltage
UTHz Avg	2137	R	2	Float32	V	Average of U1THz, U2THz, U3THz

Current						
I1	2139	R	2	Float32	A	Phase 1 Current
I2	2141	R	2	Float32	A	Phase 2 Current
I3	2143	R	2	Float32	A	Phase 3 Current
Current Avg	2145	R	2	Float32	A	Average of I1, I2, I3
Voltage						
U1	2147	R	2	Float32	V	Phase 1 Voltage(L-N)
U2	2149	R	2	Float32	V	Phase 2 Voltage(L-N)
U3	2151	R	2	Float32	V	Phase 3 Voltage(L-N)
Voltage Avg	2153	R	2	Float32	V	Average of U1, U2, U3
Power						
P1	2155	R	2	Float32	kW	Active Power Phase 1
P2	2157	R	2	Float32	kW	Active Power Phase 1
P3	2159	R	2	Float32	kW	Active Power Phase 1
PTotal	2161	R	2	Float32	kW	Total Active Power
Q1	2163	R	2	Float32	kVAR	Reactive Power Phase 1
Q2	2165	R	2	Float32	kVAR	Reactive Power Phase 2
Q3	2167	R	2	Float32	kVAR	Reactive Power Phase 3
QTotal	2169	R	2	Float32	kVAR	Total Reactive Power
S1	2171	R	2	Float32	kVA	Apparent Power Phase 1
S2	2173	R	2	Float32	kVA	Apparent Power Phase 2
S3	2175	R	2	Float32	kVA	Apparent Power Phase 3
STotal	2177	R	2	Float32	kVA	Total Apparent Power

Energy

Register Alias	Register Address	Action R/WC	Size	Type	Units	Description
Active Energy						
EP1Imp	4000	R	2	UInt32	kWh	Active Energy Import Phase 1
EP2Imp	4002	R	2	UInt32	kWh	Active Energy Import Phase 2
EP3Imp	4004	R	2	UInt32	kWh	Active Energy Import Phase 3
EPsumImp	4006	R	2	UInt32	kWh	Total Active Energy Import Phase All
EP1Exp	4008	R	2	UInt32	kWh	Active Energy Export Phase 1
EP2Exp	4010	R	2	UInt32	kWh	Active Energy Export Phase 2
EP3Exp	4012	R	2	UInt32	kWh	Active Energy Export Phase 3
EPsumExp	4014	R	2	UInt32	kWh	Total Active Energy Export Phase All
Reactive Energy						
EQ1Imp	4024	R	2	UInt32	kVarh	Reactive Energy Import Phase 1
EQ2Imp	4026	R	2	UInt32	kVarh	Reactive Energy Import Phase 2
EQ3Imp	4028	R	2	UInt32	kVarh	Reactive Energy Import Phase 3
EQsumImp	4030	R	2	UInt32	kVarh	Total Reactive Energy Import Phase All
EQ1Exp	4032	R	2	UInt32	kVarh	Reactive Energy Export Phase 1
EQ2Exp	4034	R	2	UInt32	kVarh	Reactive Energy Export Phase 2

EQ3Exp	4036	R	2	UInt32	kVarh	Reactive Energy Export Phase 3
EQsumExp	4038	R	2	UInt32	kVarh	Total Reactive Energy Export Phase All
Apparent Energy						
ES1Imp	4048	R	2	UInt32	kVAh	Apparent Energy Import Phase 1
ES2Imp	4050	R	2	UInt32	kVAh	Apparent Energy Import Phase 2
ES3Imp	4052	R	2	UInt32	kVAh	Apparent Energy Import Phase 3
ESsumImp	4054	R	2	UInt32	kVAh	Total Apparent Energy Import Phase All
ES1Exp	4056	R	2	UInt32	kVAh	Apparent Energy Export Phase 1
ES2Exp	4058	R	2	UInt32	kVAh	Apparent Energy Export Phase 2
ES3Exp	4060	R	2	UInt32	kVAh	Apparent Energy Export Phase 3
ESsumExp	4062	R	2	UInt32	kVAh	Total Apparent Energy Export Phase All

The energy values automatically resets to 0 when total energy reaches the limit of 1.0 x 10^9 kWh, 1.0 x 10^9 kVarh, or 1.0 x 10^9 kVah

Harmonics calculations

The power quality analysis values use the following abbreviations:

• Fundamental phase current rms: I1

• Fundamental phase voltage rms: V1

• Total harmonic distortion of the phase current

• Total harmonic distortion of the phase voltage

• Harmonic distortion on the phase current

$$HD_{I_x} = \frac{I_x}{I_1}, x = 2, 3, \ldots, N$$

$$HD_{I_y} = \frac{I_y}{I_1}, y = 2, 3, \ldots, N$$

$$HD_{I_z} = \frac{I_z}{I_1}, z = 2, 3, \ldots, N$$

• Harmonic distortion on the phase voltage

$$HD_{V_x} = \frac{V_x}{V_1}, x = 2, 3, \ldots, N$$

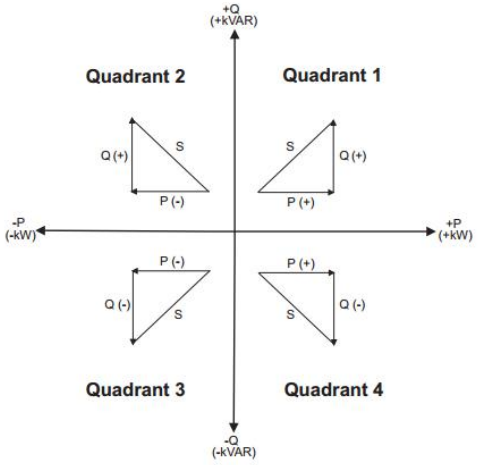
$$HD_{V_y} = \frac{V_y}{V_1}, y = 2, 3, \ldots, N$$

$$HD_{V_z} = \frac{V_z}{V_1}, z = 2, 3, \ldots, N$$

Power, energy and power factor

Power and the PQ coordinate system

The meter uses the values of real power (P) and reactive power (Q) on the PQ coordinate system to calculate apparent power



Power flow

Positive power flow P(+) and Q(+) means power is flowing from the power source towards the load. Negative power flow P(-) and Q(-) means power is flowing from the load towards the power source.

Energy delivered (imported) / energy received (exported)

The meter interprets energy delivered (imported) or received (exported) according to the direction of real power (P) flow.Energy delivered (imported) means positive real power flow (+P) and energy received(exported) means negative real power flow (-P).

Power factor (PF)

Power factor (PF) is the ratio of real power (P) to apparent power (S), and is a number between 0 and 1.
An ideal, purely resistive load has no reactive components, so its power factor is one (PF = 1, or unity power factor). A purely inductive or capacitive load no resistive components, so its power factor is zero (PF = 0).

True PF and displacement PF

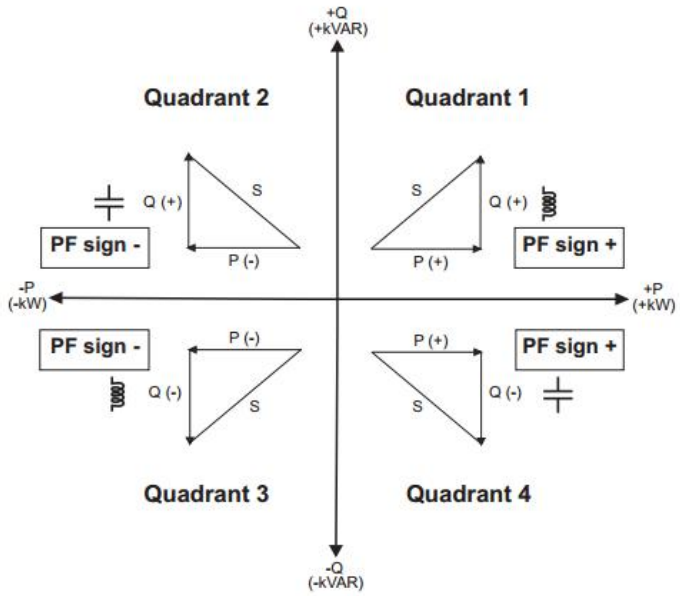
The meter supports true power factor and displacement power factor values:
• True power factor includes harmonic content(PF).
• Displacement power factor only considers the fundamental frequency(DPF).

PF sign convention

The meter shows positive or negative power factor according to IEC standards.

PF sign in IEC mode

The meter correlates power factor sign (PF sign) with the direction of real power (P)flow.
• For positive real power (+P), the PF sign is positive (+).
• For negative real power (-P), the PF sign is negative (-).



Doc Rev.:

Revision	Description	Date	Reviser
V4.2.180716	Fixed default communication 19200 8N1	20180716	Walter
V4.3.181106	Revised Energy registers data type from float32 to UInt32 Revised Energy registers data unit from Wh to kWh deleted 64-bit energy registers deleted total energy registers	20181106	Walter

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