

EN9620

Intelligent Electric Meter

Operation Manual

Cataloguep

1. Features.....	1
1.1 Real time parameters.....	1
1.2 Real time accumulative electric parameters.....	1
1.3 Interface.....	1
2. Technical parameters.....	2
2.1 Input signal.....	2
2.2 Measurement accuracy.....	2
2.3 Communication.....	2
2.4 Environment.....	2
2.5 Safety.....	2
2.6 Outline size and weight.....	2
2.7 Power.....	2
3. Terminal.....	3
3.1 Terminal position.....	3
4. Wire connection.....	4
4.1 3-phase-4-line system, 400V, Y-connection, voltage direct input, 3CT.....	4
4.2 3-phase-4-line system, 100V, Y-connection, 3PT, 3CT.....	4
4.3 3-phase-4-line system, 100V, Δ -connection, 2PT, 2CT.....	5
5. Installment and operation precautions.....	6
5.1 Input voltage.....	6
5.2 Input current.....	6
5.3 Communication wiring.....	6
5.4 Power.....	6
6. Display and operation.....	7
6.1 Panel display.....	7
6.2 Operation.....	8
6.2.1 System power on.....	8
6.2.1 Key operation.....	8
6.2.2 Select and display of work mode.....	8
6.2.2.1 Change of work model.....	8
6.2.3 Electric parameter display mode.....	9
6.2.3.1 Change of electric parameter display.....	9
6.2.3.2 Operation and display of voltage and current display submode.....	9
6.2.3.3 Operation and display of multi-parameter display submode.....	10
6.2.3.4 Operation and display of auto multi-parameter display submode.....	11
6.2.4 Setting mode.....	12
6.2.4.1 Operation procedure of setting mode.....	12
6.2.4.2 Function of "FUN" key and "V/A" key.....	12
6.2.4.3 Table of setting.....	13
7. Communication.....	16
7.1 Description of ModBUS protocol.....	17
7.2 Message transmit and receive.....	17
7.3 Message format.....	17
7.4 Message type and description.....	19

7.4.1 Read digit output message (function code: 0x01)	20
7.4.2 Read digit input message (function code: 0x02)	21
7.4.3 Read register message (function code: 0x03)	23
7.4.4 Modify digit output message (function code: 0x05)	24
7.4.5 Modify register message (function code: 0x10)	25
8. Application of meter and parameter address table	26
8.1 Relation of register memory value, communication value and actual value.....	26
8.2 Parameter address table.....	27
8.3 Parameter and address.....	28
9 Maintenance and troubleshooting	32
9.1 Troubleshooting	32
9.2 FAQ and solve method of RS-485.....	33
9.2.1 Communication distance of RS-485.....	33
9.2.2 Network topological structure of RS-485.....	33
9.2.3 Terminal matched resistance of RS-485.....	33
9.2.4 Polarity of RS-485 cable.....	33
9.2.5 Cable of RS-485.....	33
9.2.6 Isolation and anti-interfere of RS-485 communication circuit.....	33

1. Features:

Model EN9620 intelligent electric meter is a multi-function instrument by which can measure and real-time monitor every kind of electric parameter of 3-phase AC circuit, such as voltage, current, power, kilowatt hour, power factor, frequency, etc. This meter can input signal directly from voltage or current mutual inductor, the transformation ratio of voltage mutual inductor PT and current mutual inductor CT can be set arbitrarily, so can measure electric parameter in a wide range.

Model EN9620 intelligent electric meter has RS-485 communication interface and ModBUS protocol. The acquired electric parameter can be sent out through communication interface, and can connect with other electric monitor system, also can connect with SCADA or PLC system, the baud rate and communication address can be preset, also can communicate with other software such as Intouch, Fix, Citect, Group King, etc.

Model EN9620 intelligent meter provides 2 on-off input and 2 on-off relay output. The input is node input; the communication interface real-time monitor the state of switch. The relay output is controlled by communication interface.

1.1 Real time parameters of model EN9620

- Voltage (every single phase, line-to-line, line-to-earth, 3-phase)
- Current (every single phase, neutral line, 3-phase)
- Active power (every single phase, sum of 3-phase)
- Inactive power (every single phase, sum of 3-phase)
- Apparent power (every single phase, sum of 3-phase)
- Power factor (every single phase, total power factor of 3-phase)
- Frequency

1.2 Real time accumulative electric parameters of model EN9620

- Input active kilowatt hour
- Output active kilowatt hour
- Input inactive kilowatt hour
- Output inactive kilowatt hour
- Sum of absolute value of active kilowatt hour
- Sum of active kilowatt hour
- Sum of absolute value of inactive kilowatt hour
- Sum of inactive kilowatt hour

1.3 Interface of EN9620

The meter connect with outer circuit through the upper and lower terminals.

The function of terminals:

1	Power	Power supply
2	Voltage input	Voltage to be measured input
3	Current	Current to be measured input
4	On-off input/output	Digit input/output terminal (on-off output or pulse output)
5	RS-485 communication interface	Communication interface, connected with outer circuit by ModBUS protocol.

2. Technical parameters:

2.1 Input signal:

Input voltage:

- Rating: 100V~400VAC, 25% over rating value is allowed.
- overload: 2 times rating value (continuous); 2500VAC / 1s (non-circular)
- measured value: RMS
- load: < 0.2VA

Input current:

- Rating: 5A, 20% over rating value is allowed.
- overload: 2 times rating value; 100A / 1s (non-circular)
- measured value: RMS
- load: <0.2VA

Input frequency

- 26~100Hz

2.2 Measurement accuracy:

- Voltage/current: grade 0.2
- Frequency: 0.1Hz
- Other parameters: grade 1
- Temperature drift: 100PPM / °C (0~50 °C)

2.3 Communication:

- RS-485 interface
- Baud rate: 600 bps ~38400 bps selectable
- ModBUS-RTU protocol

2.4 Environment:

- Working temperature: -20 °C ~ 50 °C
- Storage temperature: -40 °C ~ +85 °C
- Relative humidity: 5% ~ 95 %, no moisture condensation.

2.5 Safety:

- Withstand voltage and insulating strength: power supply and voltage input loop > 2KV
- Current loop > 2.5 KV

2.6 Outline size and weight:

- Outline size: 96×96×75mm
- Weight: 1Kg (include bracket)

2.7 Power supply:

- 220V +/-10% AC, 50/60Hz
- Power consumption: < 4W
- Other power supply selectable: 85V~265V AC, 50/60Hz or 120V~380VDC
- The voltage of power supply should be within the range, otherwise, the meter may be damaged.

3. Terminal description:

3.1 EN9620 terminal position:

12 terminals in upper row:

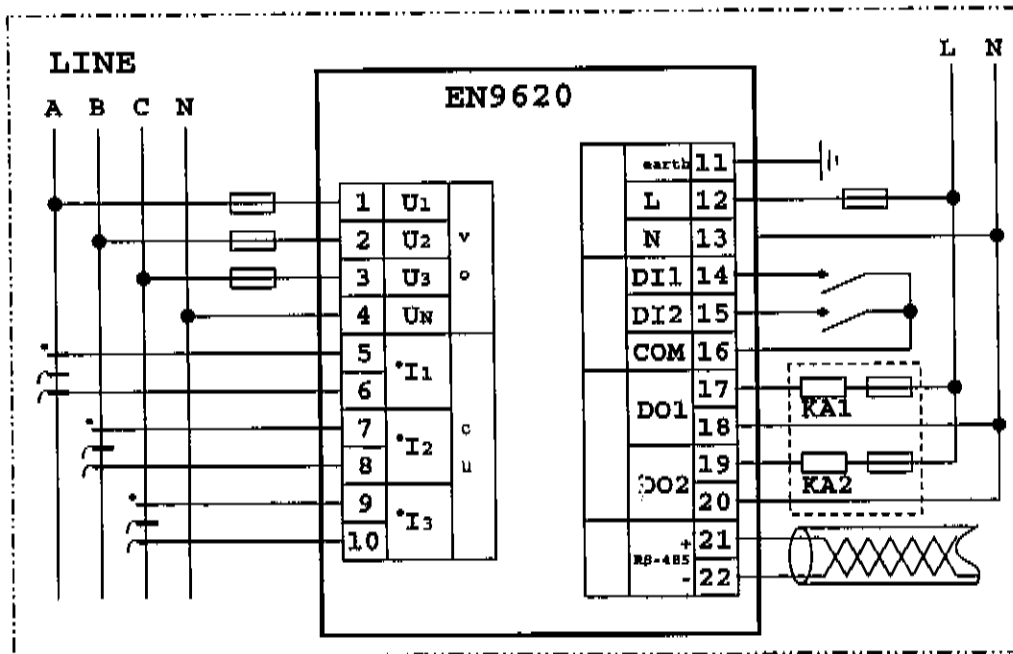
11	12	13	14	15	16	17	18	19	20	21	22
G	L	N	DI1	DI2	COM	DO11	DO12	DO21	DO22	+	-
Power earth	Live wire	Zero line	Switch input 1	Switch input 2	Common port	Switch output 1		Switch output 2		B	A
Subsidiary power supply			digit (switch) input			digit (switch) output			RS-485		

10 terminals in lower row:

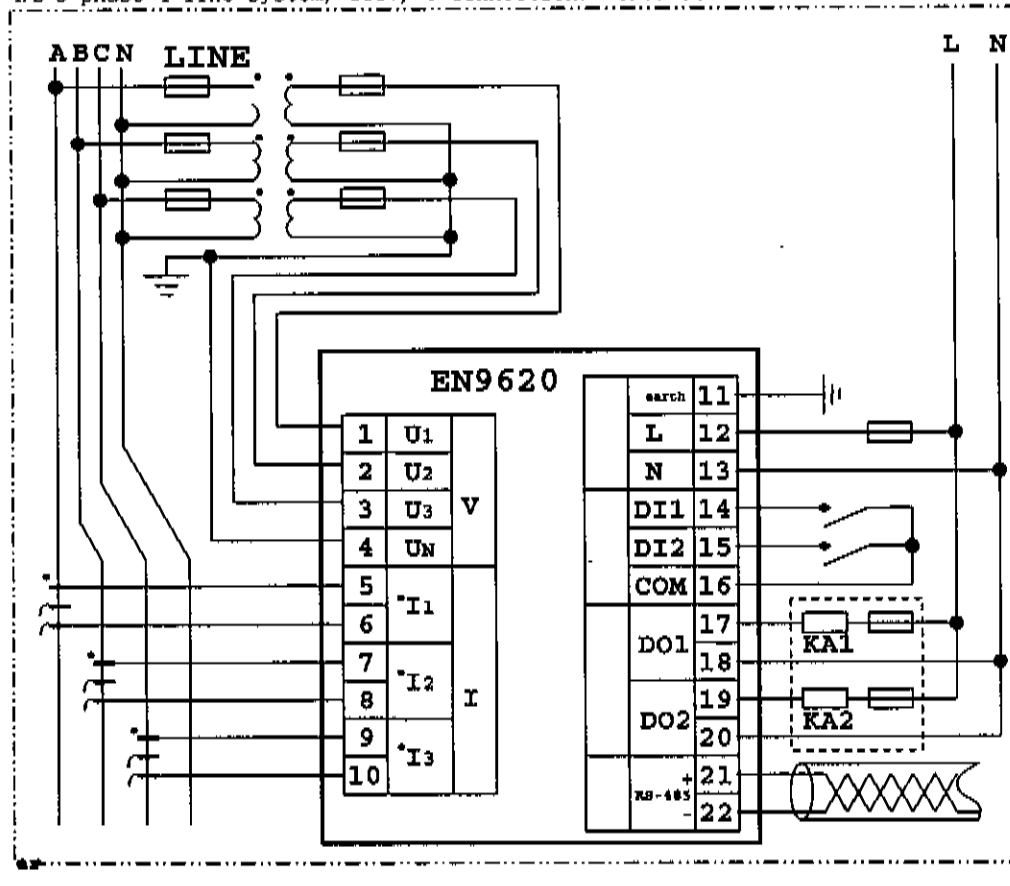
1	2	3	4	5	6	7	8	9	10
V1	V2	V3	VN	I11	I12	I21	I22	I31	I32
Phase A	Phase B	Phase C	Zero line	Phase + A		Phase + B		Phase + C	
Voltage input				Current input					

4. Wiring method:

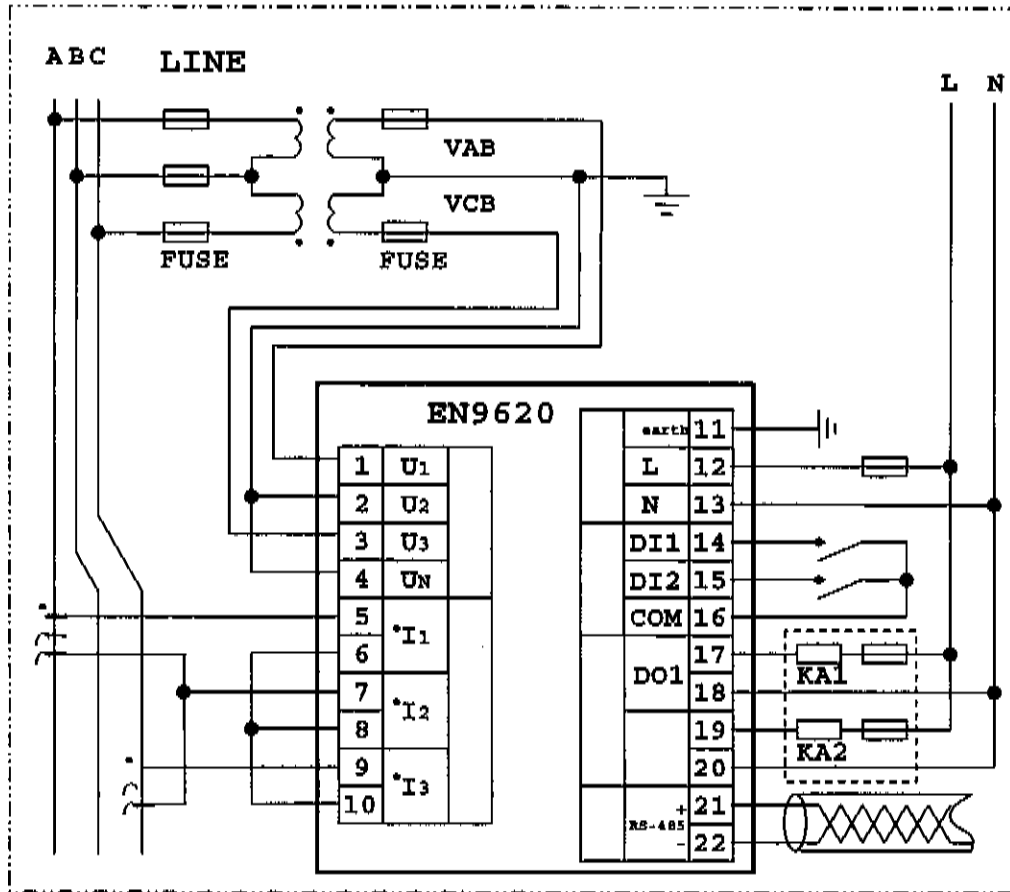
4.1 3-phase-4-line system, 400V Y-connection, voltage direct input, 3 C T



4.2 3-phase-4-line system, 100V, Y-connection, 3PT, 3CT



4.3 3-phase-4-line system, 100V, Δ -connection, 2PT, 2CT



5. Installment and operation precautions:

The installment, operation and maintenance of this instrument should be carried out only by qualified technician. Otherwise, may cause death or serious injure for those untrained personnel to use this meter. The company bears no responsibility for those consequence caused by improper operation.

5.1 Input voltage:

The input voltage should not exceed the rated input voltage (400V), otherwise, an outer PT should be used.

1A fuse should be connected in the voltage input terminal.

The phase order and polarity of input voltage and current should be correct, otherwise, the data or sign may be error.

5.2 Input current:

The input current should not exceed the rated input current 5A, otherwise, an outer CT should be used.

The phase order and polarity of input voltage and current should be correct.

The CT should be connected in series with other instrument if needed.

The primary loop of CT should be power off or its second loop should be short-circuit before detaching this meter or changing the current input line.

5.3 Communication wiring:

EN9620 provides serial asynchronous semiduplex RS-485 interface. One bus can connected with as many as 32 instruments simultaneously and every instrument has its own address.

The communication wire should be shielded twisted-pair wire, the diameter of wire should be more than 0.5 mm² (international type: AWG18, Chinese type: RVVP 1×2×0.5mm²)

The communication wire should keep away from high voltage cable or other strong electric field.

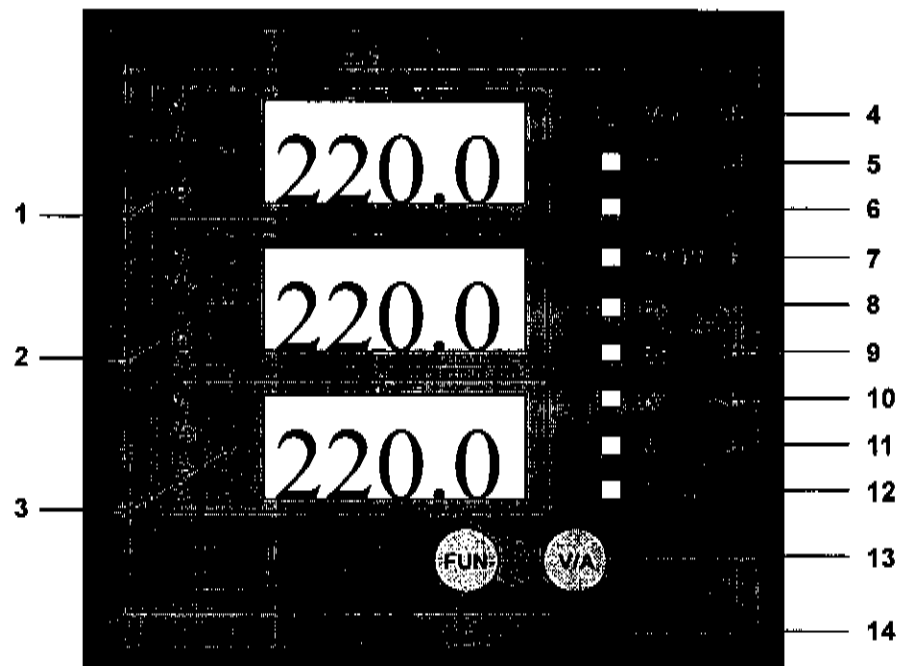
5.4 Power supply:

The power supply: 220V +/-10% AC, phase and zero wires. The wire should be connected after power off, otherwise, may cause death or serious injure.

6. Display and operation

6.1 Panel display:

Panel description of EN9620:



EN9620 panel

Description of panel:

SN	Name	State	Function
1	LEDA	220.0	Data display
2	LEDB	220.0	Data display
3	LEDC	220.0	Data display
4	V _{LN} indicator	lighten	Phase voltage
5	V _{LL} indicator	lighten	Line voltage
6	I indicator	lighten	Current
7	PQS indicator	lighten	Active power, inactive power, apparent power
8	EP indicator	lighten	Active kilowatt hour
9	EQ indicator	lighten	Inactive kilowatt hour
10	K indicator	lighten	Magnitude is "thousand"
11	M indicator	lighten	Magnitude is "mega"
12	C _{omm} indicator	glitter	Communication indicator
13	FUN function key	Press down	Function key for operating and setting
14	V/A function key	Press down	V/A key for operating and setting

6.2 Operation:

This meter has different operation mode according to working mode.

6.2.1 System power on:

The meter will automatically enter "Electric parameter display mode" when power on to display the electric parameter measured.

When power on, the meter will automatically calculate "kilowatt hour" parameter.

6.2.1 Key method:

This meter accepts and interprets three type of key-press method:

- Press "FUN" key only, then release it.
The meter will interpret it as pressing "FUN" key once.
- Press "V/A" key only, then release it.
The meter will interpret it as pressing "V/A" key once.
- Press and hold down "FUN" key, then press "V/A" key, then release "FUN" key and "V/A" key.

The meter will interpret it as pressing "FUN" key+ "V/A" key once.

This type of key-press is recorded as: "FUN" + "V/A".

In these three key-press methods, the meter will continuously accept and interpret respective key-in if press and hold down the key.

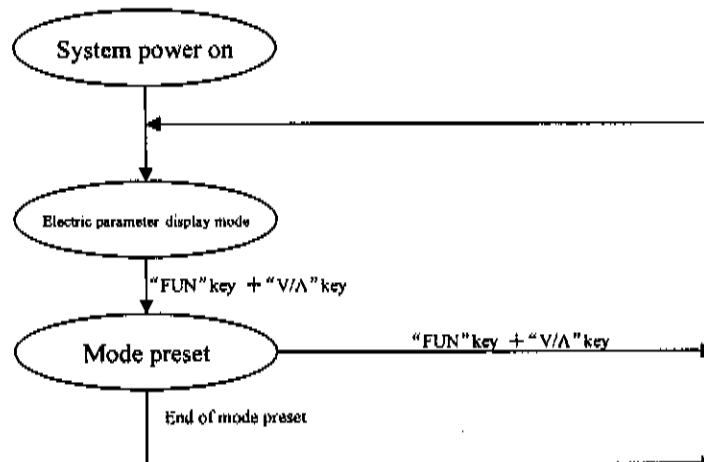
6.2.2 Select and display of work mode:

This meter has two work modes listed as below:

- Electric parameter display mode
To display every kind of electric parameter
- Setting mode
Preset work parameter.

Press simultancously "FUN" key and "V/A" key to change work mode.

6.2.2.1 Change of work mode:

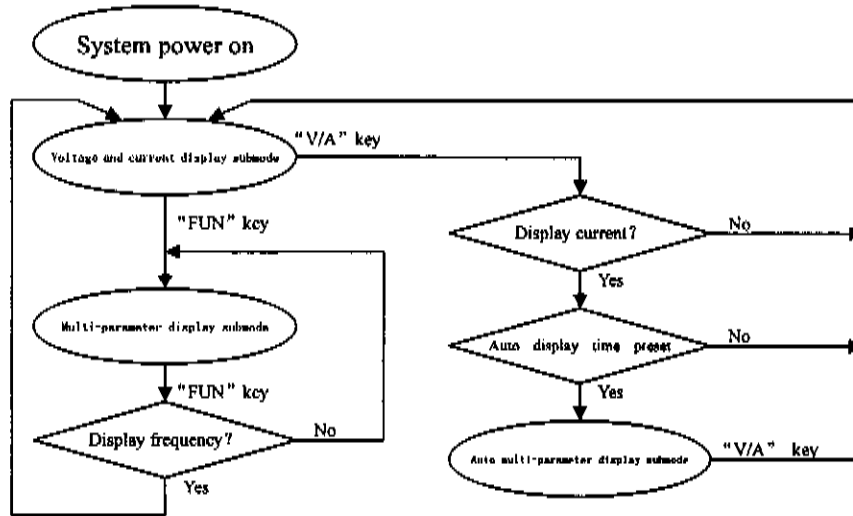


6.2.3 Electric parameter display mode:

This mode has three submodes to display electric parameters:

1. Voltage and current display submode
2. Multi-parameter display submode
3. Auto multi-parameter display submode

6.2.3.1 Change between submodes of electric parameter display mode:



6.2.3.2 Operation and display of voltage and current display submode:

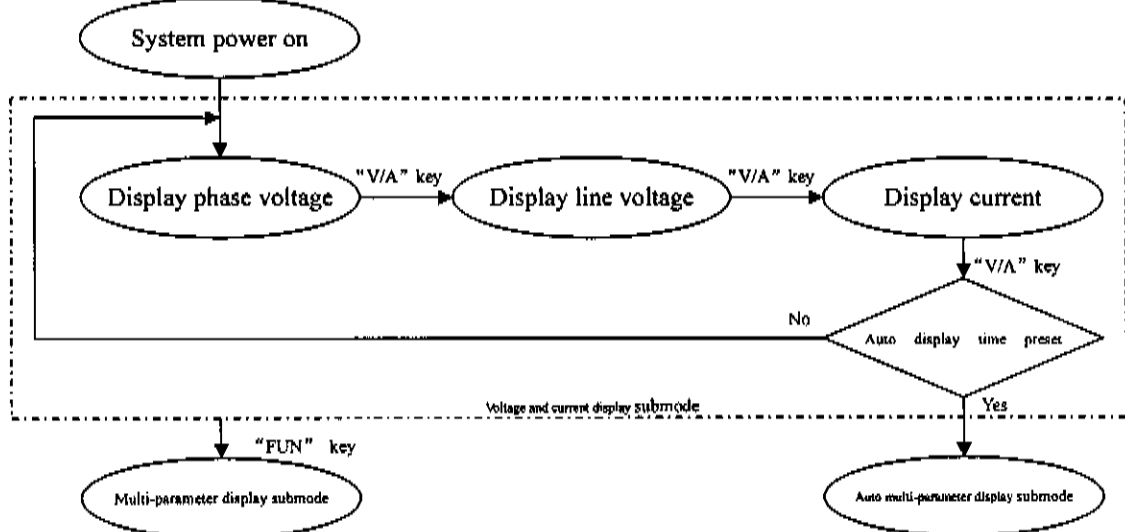
Press "V/A" key to display:

- RMS value of phase voltage: V_{ln}
- RMS value of line voltage: V_{ll}
- RMS value of current: I

In case of "auto display time" preset already, and currently display RMS value of current I , just press "V/A" key to change to "auto multi-parameter display" submode.

Press "FUN" key to change to "multi-parameter display" submode.

Flow chart of "voltage and current display" submode:



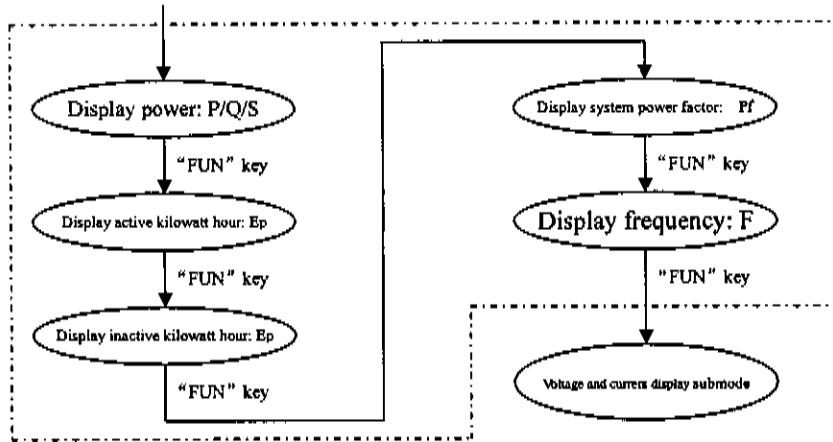
6.2.3.3 Operation and display of multi-parameter display submode:

Press "FUN" key to display:

- Power P/Q/S
- Active kilowatt hour: Ep
- Inactive kilowatt hour: Eq
- System power factor: PF
- Frequency: F

In case the meter currently display frequency, just press "FUN" key to change to "voltage and current display" submode.

Flow chart of multi-parameter display submode:



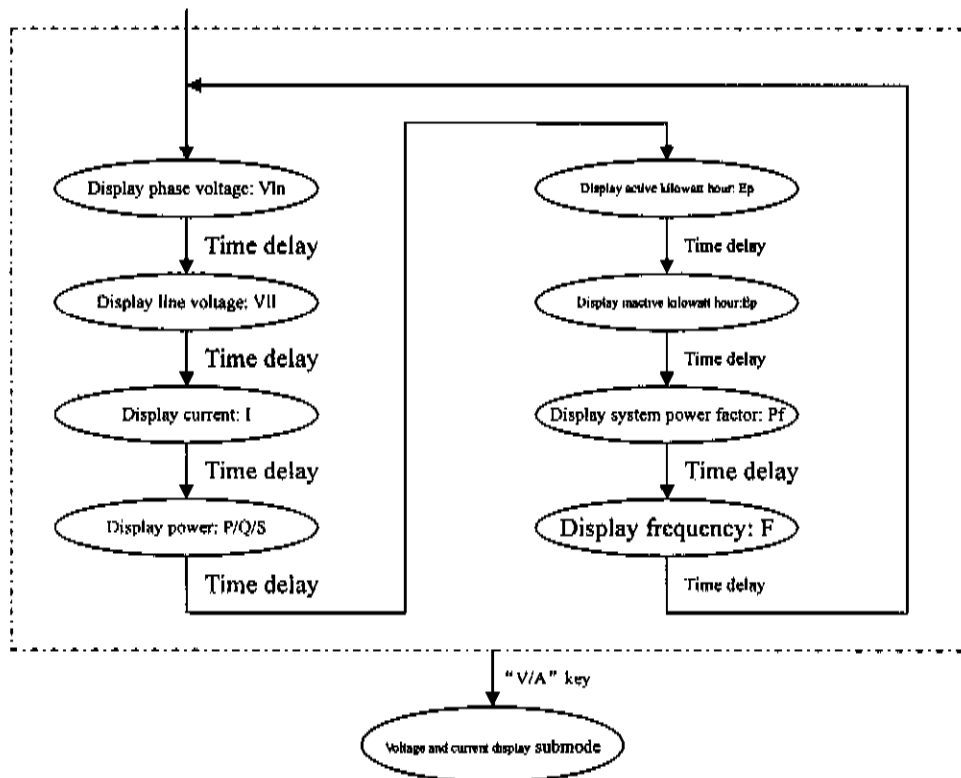
6.2.3.4 Operation and display of auto multi-parameter display submode:

In this mode, the meter will automatically display electric parameters orderly according to preset time interval.

- RMS value of voltage: V_{In}
- RMS value of voltage: V_{II}
- RMS value of current: I
- Power: $P/Q/S$
- Active kilowatt hour: E_p
- Inactive kilowatt hour: E_q
- System power factor: PF
- Frequency: F

Press "V/A" key to change to "voltage and current display" submode.

Flow chart of multi-parameter display submode:



6.2.4 Setting mode:

There are two states in setting mode listed as below:

- Item select state:
In this state, press "FUN" key to select next item need to be edit.
Press "V/A" key to enter "item edit state" of current item.
- Item edit state:
In this state, press "FUN" key to next data need to be edit. When press "FUN" key, if all data have been edited, the meter will enter "item select state" of next edit item.
In this state, press "V/A" key to change the data been edit.

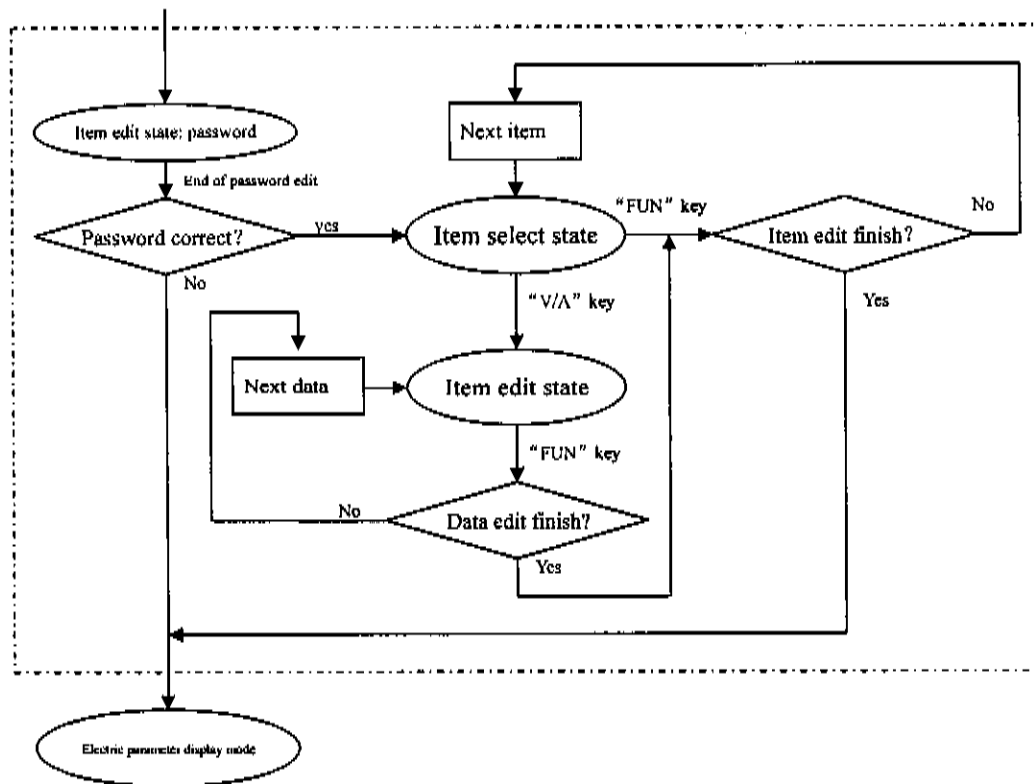
The "Item" means the editable data displayed by LED.

The editable row should be that have glittered data.

In setting mode, the meter will automatically enter "item edit state" to edit first item.

Password is required for first item.

6.2.4.1 Operation procedure of setting mode:



6.2.4.2 Function of "FUN" key and "V/A" key:

- In the "item select state", press "FUN" key to skip from current setting to next one. Press and hold down "FUN" key until all items skipped, the meter will exit from setting mode and return to "electric parameter display" mode. In this state, just press "V/A" key to enter "item edit state" of current item.
- In the "item edit state", press "V/A" key to change the data glittered, press "FUN" key to edit next data of this row. In case the data been edited is the last editable data of this row, press "FUN" key to return to "item select state" and change to next item.

6.2.4.3 Table of setting:

S/N	Display	Description	Range of Edit/display	Default
1	PASS 0000	Enter password, change to next item if correct, otherwise, return to "electric parameter display" mode.	0~9999	1000
2	di	Display the state of two input DI. DI is wet node, the meter provides 24VDC test power, no external power is required. 01 display "0" means contact 1 break, 02 display "1" means contact 2 close.	0-1	/
	01 0			
	02 1			
3	do	Preset separately the state of two output relays DO. 01 display "0" means relay 1 break, 02 display "1" means relay 2 close. The contact state of relay will change according to the setting if DO mode preset as relay mode. If DO mode preset as "1" and relay preset as pulse mode, DO will return to "0" after a fixed time been preset. If the relay preset as level mode, then keep "1" state.	0-1	0
	01 0			
	02 1			
4	bus	Preset MODBUS address.	1-247	2
	Addr			
	247			
5	bAud	Preset serial baud rate. The value 0~6 means:	0-6	4
	0 3	0 600 bps		
	8400	1 1200 bps		
		2 2400 bps		
		3 4800 bps		
		4 9600 bps		
		5 19200 bps		
	6 38400 bps			
6	Pt1	Preset PT1 value and primary value of voltage transformer.	100~2200000	220
	220	This value is edited in two rows, the edit value = value of second row × 10000 + value of third row		
	0000	After editing second row, press "FUN" key to change to third row. Press "A/V" key to edit third row, or press "FUN" key to skip to next item. The edit value in diagram is 2200000		
7	Pt2	Preset PT2 value and secondary value of voltage transformer.	0-2	1
	1	The value 0~2 means:		
	220	0 100 1 220 2 380		
8	Ct1	Preset CT1 value and primary value of current transformer.	5-6000	5
	0005	The secondary value of current transformer is fixed as 5 which means 5A.		
9	Auto	Preset time interval of display exchanging under "auto multi-parameter display" mode, unit: s.	0-10	0
	diSP			

	10	0 means this mode ineffective.		
10	do	Preset DO output on-off mode:	0~1	1
	1	0~1 means:		
	rELy	0 EPLS electric pulse mode 1 rELy relay mode If selecting electric pulse mode, other parameters of this mode should be preset, change to S/N 11-14 for presetting, then change to S/N 19 for other presetting. If selecting relay mode, other parameters of this mode should be preset, change to S/N 15-18 for presetting, then change to S/N 19 for other presetting.		
11	do1E	Preset electric pulse output of DO1 output switch 1, 0~8	0~8	0
	0	means:		
	EPIp	0 EPIp absorbed active kilowatt hour: Ep_imp 1 EPEP emitted active kilowatt hour: EP_exp 2 EqiP absorbed inactive kilowatt hour: Eq_imp 3 EqEP emitted inactive kilowatt hour: EP_exp 4 EPtL total of absolute value of active kilowatt hour: EP_total 5 EPnt total of active kilowatt hour: EP_net 6 EqtL total of absolute value of inactive kilowatt hour: Eq_total 7 Eqnt total of inactive kilowatt hour: Eq_net 8 no E (no output)		
12	do2E	Preset electric pulse output of DO2 output switch 2, 0~8	0~8	0
	0	means:		
	EPIp	0 EPIp absorbed active kilowatt hour: Ep_imp 1 EPEP emitted active kilowatt hour: EP_exp 2 EqiP absorbed inactive kilowatt hour: Eq_imp 3 EqEP emitted inactive kilowatt hour: EP_exp 4 EPtL total of absolute value of active kilowatt hour: EP_total 5 EPnt total of active kilowatt hour: EP_net 6 EqtL total of absolute value of inactive kilowatt hour: Eq_total 7 Eqnt total of inactive kilowatt hour: Eq_net 8 no E (no output)		
13	do	Preset width of output electric pulse, unit: 10ms	1~40	2
	PuLS			
	02			
14	do	Preset the kilowatt hour value of every output pulse, unit: pulse/kilowatt hour. When the value preset in S/N 13 and	1~6000	10
	PARA			

	0010	<p>14 are improper, DO may output high level continuously. e.g.</p> <p>S/N 13 preset as 10 which means width of pulse is $10 \times 10 = 100\text{ms}$. i.e. max. output pulse per second is $1000/100=10$.</p> <p>S/N 14 preset as 10 which means outputting 10 pulses per kilowatt hour.</p> <p>When actual electric meter increases 2 kilowatt hour per second, then 20 pulses should be output in one second. This has exceeded the pulse output number per second preset in S/N 13, so may cause continuous high level output. After this presetting, change automatically to S/N 19 for other presetting.</p>		
15	rLy1	Preset work mode of relay 1.	0~1	0
	Q	0~1 means:		
	LEvL	<p>0 LevL level mode</p> <p>1 PuLS pulse mode</p> <p>If select level mode, no need to preset even more parameters, after setting, automatically change to S/N 17 for other setting.</p> <p>If select pulse mode, other parameters of this mode need to be preset, after setting, change to S/N 16 for other presetting.</p>		
16	rLy1	Preset the pulse width of relay 1 under pulse mode, unit:	1~600	5
	PuLS	10ms.		
	002			
17	rLy2	Preset work mode of relay 2	0~1	0
	Q	0~1 means:		
	LEvL	<p>0 LevL level mode</p> <p>1 PuLS pulse mode</p> <p>If select level mode, no need to preset even more parameters, after setting, automatically change to S/N 19 for other setting.</p> <p>If select pulse mode, other parameters of this mode need to be preset, after setting, change to S/N 18 for other presetting.</p>		
18	rLy2	Preset the pulse width of relay 2 under pulse mode, unit:	1~600	5
	PuLS	10ms.		
	002			
19	SEt	Preset password.	0000~9999	1000
	PASS			
	1000			
20	CLrE	Electric reset.	0~1	0
	Q	0~1 means:		

	no	0 no No reset when pressing "FUN" key 1 yES All eight kilowatt-hour display will reset when pressing "FUN" key. After presetting this item, press "FUN" key to return to electric parameter display mode.		
--	----	---	--	--

7. Communication:

This meter provides one RS-485 communication interface, so can act as terminal equipment for communication.

The host (PC, PLC etc) can control and inquire this meter through the communication interface.

Description of communication interface:

- In a pair of communication wires, totally isolated RS-485 communication interface.
- RS-485 employs master-slave response mode and semiduplex work mode.
- Asynchronous communication mode, the data format is: 1 starting digit, 8 data digits, no check digit and 1 stop digit.
- The communication rate can be selected, the setting of communication rate please refer to S/N 5, the rate selectable listed as below: 600BPS, 1200BPS, 2400BPS, 4800BPS, 9600BPS, 19200BPS, 38400BPS.
- ModBUS—RTU communication protocol.

7.1 Description of ModBUS protocol

EN9620 supports ModBUS protocol which implement master-slave response through one pair of communication wire.

The main control equipment (PC, PLC, etc) acts as master and this instrument as slave, several instruments can connect onto one pair of communication wire as well as master, every slave has an exclusive address in order to distinguishing from other slave.

Communication between master and slave employs message inquire-response method.

When master and slave receive message, they will firstly carry out CRC check, and only response those correct message. In case there is no error in transmission of message, yet the message itself is unreasonable and inexplicable, the slave will send back an "error" message when receive it.

7.2 Message transmit and receive

The master control or inquire slave through software. After send out message, the master waits for response of slave, during waiting time, the master set free the communication wire for slave's use.

The slave normally is under receiving state to check whether there is message from master. Whenever the slave receives message, it will check the address, if the address is same with the slave's address, then slave will take up communication wire and send a response message. After sending response message, the slave will set free the communication wire.

When master receiving the response message from slave, this fulfill one transmitting-receiving process. The master ends waiting state and change to next transmitting-receiving process. If the master does not receive message from slave after waiting for a long time, it may end waiting state and exit from transmitting-receiving process.

7.3 Message format:

The message is formatted by byte (8 bit) and several bytes compose a message. The data in message is divided into 4 sections:

- Address section (Address), 1 byte (8bits)
- Function section (Function), 1 byte (8bits)
- Data section (Data), N byte (n x 8bits), N: number of byte
- Check section (Check), 2 byte (16bits)

8-bits	8-bits	N x 8-bits	16-bits
--------	--------	------------	---------

Address section (Address)

The address section located at the first byte in message (8bits) . The effective address is 1~247, others are reserved. Every equipment connected onto one bus has an exclusive address. The master selects the slave through this address. The address section in the repose message also makes one know which slave responds the order or inquiry of master.

Function section (Function)

This section (1 byte) follows by address section, and it specifies the purpose and function of message, the meaning is listed as below:

0x01	Read DO state	Read the state of digit output (relay)
0x02	Read DI state	Read the state of digit input
0x03	Read data register	Read the value of register
0x05	Modify DO output	Modify the state digit output (relay)
0x10	Modify data register	Modify the value of register

Data section (Data)

Data section follows by function section and before check section. This data is related with function code in function section, and it should be the value of register or value of DI or DO.

Check section (Check)

The check section is the last two bytes in message, and it is used for transmitting the value of CRC-16 which is for checking whether there is an error in transmission of data.

The equipment transmitted message will calculate the value of CRC-16 and attach it into check section. The equipment received message will calculate the value of CRC-16 again and compare it with the value of CRC-16 received. If these two values are unequal, this means there is an error in message.

The procedure of calculating the value of CRC-16 lists as below:

- 1) preset 16 bit register as 0xFFFF (i.e. all digits are 1), this register is call as CRC register.
- 2) make Boolean Exclusive or the first 8 bits in message and lower bits in CRC register (16 bits), and put the result into CRC register.
- 3) right shift 1 bit in CRC register (to lower bit), the most high bit filled by 0, and check the lowest bit been shift out.
- 4) if the lowest bit is 0, repeat No. 3 again, if the lowest bit is 1, make Boolean Exclusive or the value of CRC register and polynomial value 0xA001.
- 5) repeat No.3 and 4, until right shift 8 times, this is the end of 8 bits data.
- 6) repeat No.2 to 5 for the next data until all data been handled.
- 7) the final value of CRC register is the value of CRC.

7.4 Message type and description

The message been cataloged as below according to function:

- read digit output state
- read digit input state
- read value of register
- modify digit output state
- modify value of register

the format of message lists as below:

0x28	0x03	0x00	0x00	0x00	0x03	0x02	0x32
------	------	------	------	------	------	------	------

Address: slave' s address

Function: function code

Data Start Reg hi: high byte of starting address in data register

Data Start Reg lo low byte of starting address in data register

Data # of Reg hi: read high byte of number of data register

Data # of Reg lo: read low byte of number of data register

CRC-16 lo: low byte of CRC-16 circular redundant check code

CRC-16 hi: high byte of CRC-16 circular redundant check code

In addition, another message attached: error message.

Error message is used for responding the message from master. When the slave receives message and its CRC is correct, yet the data section of message is logically error, e.g. no address or the number of data exceeds limit, then the slave will send an error message.

The definition of error message is the most high bit of function code is 1, other bits are unaltered. The data section includes two bytes data, the first byte is the number of byte of data section minus 1. In this message, the following number 1 means there is another data in data section. The last byte is 0xFF which is error code.

For example, the master ask to read a register, however, the register address in the message transmitted is out of limit, the slave will send an error message when receive the message from master.

0x28	0x83	0x01	0xff	0xB9	0xBC
------	------	------	------	------	------

If the CRC in the message received by slave is wrong, the slave will does not respond this message.

7.4.1 Read digit output message (function code: 0x01)

- Read D0 message

Read D0 message is sending from master to slave, which used for reading the state of D0 digit output (relay) of slave.

Read D0 message includes slave address, function code (0x01), starting address of D0 register, number of data, CRC-16.

Starting address of D0 register:

- Address of D01 (digit output 1) register is 0x0000
- Address of D02 (digit output 2) register is 0x0001

Number of data:

- When the starting address of D0 register is 0x0000, the number of data may be 1 or 2. 1 means read only D01, 2 means read both D01 and D02.
- When the starting address of D0 register is 0x0001, the number of data can only be 1, which means read only D02.

For example, the master read D01 and D02 from slave(address is 0x28).

0x28	0x01	0x00	0x00	0x00	0x02	0xBA	0x32
------	------	------	------	------	------	------	------

- Responding D0 message

Responding D0 message is used for slave responding D0 message read from master.

When the slave receiving "read D0" message from master, it will send a responding message to master.

The "responding D0" message includes slave address, function code (0x01), byte count of data, data, CRC-16.

The first byte in data section indicates the byte count, the value is 1.

The second byte includes the state of D01 and D02, the value of D01 places in B0 (bit0) and value of D02 places in B1 (bit1).

0	0	0	0	0	0	D02	D01
---	---	---	---	---	---	-----	-----

- "1" means switch on (ON)
- "0" means switch off (OFF)

For example, the responding D0 message as below:

0x28	0x01	0x01	0x02	0xD8	0x15
------	------	------	------	------	------

In this example, D02 = "1", D01 = "1".

- Error message:

The slave may send an error message when it responding the "read D0" message from master.

If the address is non-exist or number of data is wrong in the "read D0" message, the slave will send an error message to master.

7.4.2 Read digit input message (function code: 0x02)

- Read DI message

Read DI message is sending from master to slave, which used for reading the state of DI digit input of slave.

Read DI message includes slave address, function code (0x02), starting address of DI register, number of data, CRC-16.

Starting address of DI register:

- Address of DI1 (digit output 1) register is 0x0000
- Address of DI2 (digit output 2) register is 0x0001

Number of data:

- When the starting address of DI register is 0x0000, the number of data may be 1 or 2. 1 means read only DI1, 2 means read both DI1 and DI2.
- When the starting address of DI register is 0x0001, the number of data can only be 1, which means read only DI2.

For example, the master read DI1 and DI2 from slave (address is 0x28).

0x28	0x02	0x00	0x00	0x00	0x02	0xFE	0x32
------	------	------	------	------	------	------	------

- Responding DI message:

Responding DI message is used for slave responding DI message read from master.

When the slave receiving "read DI" message from master, it will send a responding message to master.

The "responding DI" message includes slave address, function code (0x02), byte count of data, data, CRC-16.

The first byte in data section indicates the byte count, the value is 1.

The second byte includes the state of DI1 and DI2, the value of DI1 places in B0 (bit0) and value of DI2 places in B1 (bit1).

0	0	0	0	0	0	DI2	DI1
---	---	---	---	---	---	-----	-----

- "1" means switch on (ON)
- "0" means switch off (OFF)

For example, the responding DI message:

0x28	0x02	0x01	0x02	0x28	0x15
------	------	------	------	------	------

In this example, DI2 = "1", DI1 = "1".

- Error message:

The slave may send an error message when it responding the "read DI" message from master. If the address is non-exist or number of data is wrong in the "read DI" message, the slave will send an error message to master.

7.4.3 Read register message (功能码 0x03)

- Read register message

Read register message is sending from master to slave, which is used for reading out the data from register of slave. This data includes data acquired from equipment and system parameter. Read register message includes slave address, function code (0x03), starting address of register, number of register, CRC-16.

The starting address of register:

- System setting registers: 0x0100~0x0112
- Electric parameter registers: 0x0130~0x0153
- Kilowatt-hour registers: 0x0156~0x0165

The number of register:

The number of register read out in one inquiry by master is no restrict, however, it could not exceed the range of register address. Every register can two bytes data, i.e. 16 bits.

For example, the master read out the value in data register acquired by slave:

(The address of registers Freq, Va, Vb is 0x0130, 0x0131, 0x0132; the starting address of register is 0x0130, number of data is 0x0003.)

0x28	0x03	0x01	0x30	0x00	0x03	0x03	0xC1
------	------	------	------	------	------	------	------

- Responding "read register" message:

This message is used for slave responding the "read register" message from master.

When the slave receiving "read register" message from master, it will send a responding message to master.

The responding "read register" message includes slave address, function code (0x03), byte count of data, data in register, CRC-16.

The first byte in data section indicates the byte count, the value is (byte count) minus 1.

Other byte in data section is value in register read out.

For example, the responding message from slave (address:0x28) to master:

0x28	0x03	0x06	0x13	0x88	0x08	0x9D	0x08	0x9E	0x25	0xBE
------	------	------	------	------	------	------	------	------	------	------

Among them:

Freq=0x1388, in decimal system is 5000, equivalent to 50.00Hz;

Va=0x089D, in decimal system is 2205, equivalent to 220.5V;

Vb=0x089E, in decimal system is 2206, equivalent to 220.6V

- Error message:

The slave may send an error message when it responding the "read register" message from master.

If the address is non-exist or number of data is wrong in the "read regist" message, the slave will send an error message to master.

7.4.4 Modify digit output state message (function code: 0x05)

- Modify DO digit output state message

Modify DO digit output state message is send from master to slave, which used for modifying the value of state register of slave DO digit output (relay).

Modify DO digit output state message includes slave address, function code (0x05), DO register address, DO register data, CRC-16.

DO state register address:

- D01 (digit output 1) register address is 0x0000
- D02 (digit output 2) register address is 0x0001

DO state register value:

- 0xFF00 means DO digit output (relay) is switch on (ON)
- 0x0000 means DO digit output (relay) is switch off (OFF)

For example, the master modifies the slave's D01 (address: 0x28) as "ON" state:

0x28	0x05	0x00	0x00	0xFF	0x00	0x8B	0xC3
------	------	------	------	------	------	------	------

- Responding "modify DO digit output state message"

Responding "modify DO digit output state message" is used for slave responding "modify DO message" from master.

When slave receives "modify DO message" from master, it will send a responding message to master.

This message includes slave address, function code (0x05), DO register address, DO register data, CRC-16.

For example, the slave's D01 (address: 0x28) has been modified as "ON" state.

0x28	0x05	0x00	0x00	0xFF	0x00	0x8B	0xC3
------	------	------	------	------	------	------	------

- Error message:

The slave may send an error message when it responding the "modify DO digit output state message" from master.

If the address is non-exist or number of data is wrong in the "modify DO digit output state message" from master, the slave will send an error message to master.

7.4.5 Modify register message (function code: 0x10)

- Modify register message

Modify register message is sending from master to slave, which is used for modifying the value in the register of slave, these values include system parameter of slave and kilowatt-hour.

Modify register message includes slave address, function code (0x10), starting address of register, number of register, number of byte, register value, CRC-16.

The starting address of register:

- System setting registers: 0x0100~0x0112
- Kilowatt-hour registers: 0x0156~0x0165

Number of register:

The master can once write data into 16 registers (32 bytes) maximally. The number of register should not exceed the range of register address. Every register can store 2 bytes data, i.e. 16 bits.

Byte Count:

This is the sum of byte of data been modified.

For example, the master modify the value of the absorbed active kilowatt-hour register (EP_imp) of slave as 12539787.8KWH.

The address of register EP_imp: occupy two register address 0x0156 and 0x0157.

The unit of register EP_imp: 0.1KWH, so the data written should be 125397878, in hexadecimal system is 0x07796B76. The register occupies 4 bytes.

0x28	0x10	0x01	0x56	0x00	0x02
------	------	------	------	------	------

0x04	0x07	0x79	0x6B	0x76	0x80	0x0E
------	------	------	------	------	------	------

- Responding "modify register message"

Responding "modify register message" is sending from slave to master.

When slave receives "modify register message" from master, it will send a responding message to master.

This message includes slave address, function code (0x10), starting address of register, number of register, CRC-16.

For example, the slave (address: 0x28) responds master:

0x28	0x10	0x01	0x56	0x00	0x02	0xA7	0xDD
------	------	------	------	------	------	------	------

- Error message:

The slave may send an error message when it responding the "modify register message" from master. If the address is non-exist or number of data is wrong in the "modify register message" from master, the slave will send an error message to master

8. Application of meter and parameter address table

8.1 Relation of register memory value, communication value and actual value

register memory value: Val_reg

communication value: Val_tran

actual value: Val_fact

Voltage: V1, V2, V3, V12, V23, V31	Val_tran = Val_reg Val_fact = Val_tran × (PT1/PT2) /10	Volt (V)
Current: I1, I2, I3	Val_tran = Val_reg Val_fact = Val_tran × (CT1/5) /1000	Ampere (A)
Power: P1, P2, P3, Q1, Q1, Q3, S1, S2, S3 Psum, Qsum, Ssum	Val_tran = Val_reg Val_fact = Val_tran × (PT1/PT2) × (CT1/5)	Watt (W) Var (Var) Volt-ampere (VA)
Kilowatt-hour: EP_imp, EP_exp, EP_total, EP_net, EQ_imp, EQ_exp, EQ_total, EQ_net	Val_tran = Val_reg Val_fact = Val_tran/10	KWh KVarh
Power factor: PF1, PF2, PF3, PF	Val_tran = Val_reg Val_fact = Val_tran/1000	-----
Frequency: Freq	Val_tran = Val_reg Val_fact = Val_tran/100	Hz

Note: PT1/PT2 is the ratio of voltage transformer, CT1/5 is the ratio of current transformer.
For example, the communication value of V1 is 2208, PT1=220, PT2=220, so the actual value of V1 is:

$$V1 = 2208 \times (220/220) / 10 = 220.8 \text{ (V)}$$

8.2 Parameter address table

Definition and description of parameter address table

BIT	bit	0~1 binary system
WORD	16 bit integer (no sign)	0~65535
Integer	16 bit integer (with sign)	-32768~32767
DWORD	32 bit integer (no sign)	0~4294967295
Long	32 bit integer (with sign)	-2147483648 ~ 2147483647
R	Readable, can be read out through ModBUS—RTU protocol.	
W	Writable, can be write through ModBUS—RTU protocol.	
	<ul style="list-style-type: none"> ● Shown by a 32-bit data, the range of absolute value is 0~999999999. ● Actual value = parameter/10 ● Automatically change to 0 when the absolute value is more than 999999999. ● The data of kilowatt-hour does not affect each other. ● The creeping test standard for kilowatt-hour is 0.5%, i.e. the creeping voltage is 0.5V, creeping current is 0.025A. The electric energy starts calculation only when both voltage and current reach these value. ● Every kilowatt-hour update once every second. ● The display value of kilowatt-hour is absorbed active kilowatt-hour (Ep_imp) and absorbed inactive kilowatt-hour (Eq_imp). Other parameters can be read out in communication. ● Every kilowatt-hour is stored in non-volatile memory for about 6s, the data won't lost even power off. ● The kilowatt-hour can be reset by hand, also can be altered through ModBUS—RTU protocol. 	
	DO can select output mode of relay or that of kilowatt-hour, the address of register is 0x0109.	
	<ul style="list-style-type: none"> ● When set as kilowatt-hour output mode, the corresponding setting of relay (register: 0x0000, 0x0001, 0x0110, 0x0111) will be ineffective. ● When set as relay mode, the corresponding setting of electric pulse (register: 0x010A, 0x010B, 0x010C, 0x010D) will be ineffective. 	
	When set as pulse mode (register: 0x010E, 0x0110) and DO output 1, the system will output pulse of suitable width according to the setting (register: 0x010F, 0x0110), then reset relay, after this, read DO as "0".	

8.3 Parameter and address

0x0000	DI1	R	0~1	0 : OFF; 1 : ON	BIT
0x0001	DI2	R	0~1	0 : OFF; 1 : ON	BIT

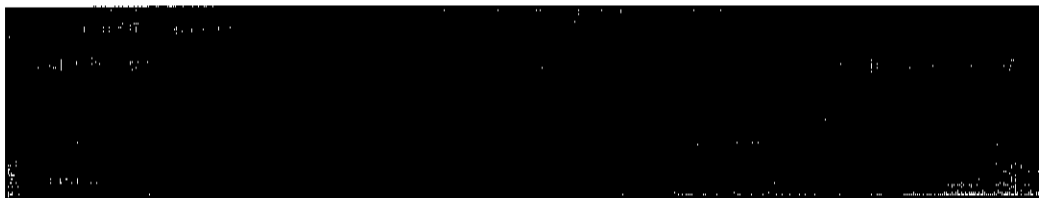
0x0000	DO1	R/W	0~1	0 : OFF; 1 : ON	BIT
0x0001	DO2	R/W	0~1	0 : OFF; 1 : ON	BIT

0x0100	Password	R/W	0~9999	1000	WORD	
0x0101	Communication address	R/W	1~247	2	WORD	
0x0102	Baud rate	R/W	0~6 means: 600, 1200, 2400, 4800, 9600, 19200, 38400 BPS	4 means: 9600BPS	WORD	
0x0103~0x0104	Retain	—	—	—	—	
0x0105	PT1 high byte (hi)	R/W	0	1~220	0	WORD
0x0106	PT1 low byte (lo)	R/W	100~9999	0 ~ 9999	220	WORD
			PT1 = hi×10000+lo PT1range : 100 ~ 2200000			
0x0107	PT2	R/W	0~2 corresponds value of PT2: 100, 220, 380	1 corresponds value of PT2: 220	WORD	
0x0108	CT1	R/W	5~6000	5	WORD	
0x0109	DO work mode	R/W	0~1 0: electric pulse mode 1: relay mode	Relay mode	WORD	
0x010A	Kilowatt-hour	R/W	0~8	0	WORD	

	type of DO1 pulse output		0 : 5: Ep_net Ep_imp 6 :	EP_imp	
0x010B	Kilowatt-hour type of DO2 pulse output	R/W	1 : Eq_total Ep_exp 7: Eq_net 2 : 8 : no Eq_imp output 3 : Eq_exp 4 : Ep_total		WORD
0x010C	Width of DO electric pulse	R/W	1~40 (unit: 10ms)	2 (20ms)	WORD
0x010D	Constant of DO electric pulse	R/W	1~6000 unit: pulse number /KWh	10 10pulses/KWh	WORD
0x010E	Work mode of relay 1	R/W	0~1 0: level mode 1: pulse mode	0	WORD
0x010F	Pulse width of relay 1	R/W	1~600 (unit: 10ms)	5 (50ms)	WORD
0x0110	Work mode of relay 2	R/W	0~1 0: level mode 1: pulse mode	0	WORD
0x0111	Pulse width of relay 2	R/W	1~600 (unit: 10ms)	5 (50ms)	WORD
0x0112	Auto display time interval	R/W	0~10 (unit: s)	0 means non-auto	WORD
0x0113~ 0x0117		—			—

0x0130	Frequency Freq	R	2600~10000	WORD
0x0131	Phase voltage V1	R	0~65535	WORD
0x0132	Phase voltage V2	R	0~65535	WORD
0x0133	Phase voltage V3	R	0~65535	WORD
0x0134	Retain	—	—	—
0x0135	Line voltage V12	R	0~65535	WORD
0x0136	Line voltage V23	R	0~65535	WORD
0x0137	Line voltage V31	R	0~65535	WORD
0x0138	Retain	—	—	—
0x0139	Current I1	R	0~65535	WORD
0x013A	Current I2	R	0~65535	WORD

0x013B	Current I3	R	0~65535	WORD
0x013C	Retain	—	—	—
0x013D	retain	—	—	—
0x013E	Split phase active power P1	R	-32768~32767	Integer
0x013F	Split phase active power P2	R	-32768~32767	Integer
0x0140	Split phase active power P3	R	-32768~32767	Integer
0x0141	Retain	—	—	—
0x0142	Split phase inactive power Q1	R	-32768~32767	Integer
0x0143	Split phase inactive power Q2	R	-32768~32767	Integer
0x0144	Split phase inactive power Q3	R	-32768~32767	Integer
0x0145	Retain	—	—	—
0x0146	Split phase apparent power S1	R	0~65535	WORD
0x0147	Split phase apparent power S2	R	0~65535	WORD
0x0148	Split phase apparent power S3	R	0~65535	WORD
0x0149	Retain	—	—	—
0x014A	Split phase power factor PF1	R	-1000~1000	Integer
0x014B	Split phase power factor PF2	R	-1000~1000	Integer
0x014C	Split phase power factor PF3	R	-1000~1000	Integer
0x014D	System power factor PF	R	-1000~1000	Integer
0x014E (hi) 0x014F (lo)	System active power Psum	R	-65535~65535	Long
0x0150 (hi) 0x0151 (lo)	System inactive power Qsum	R	-65535~65535	Long
0x0152 (hi) 0x0153 (lo)	System apparent power Ssum	R	-65535~65535	Long



0x0156 (hi) 0x0157 (lo)	Absorbed active kilowatt-hour EP_imp	R/W	0~999999999 (Unit: 0.1KWH)	DWORD
0x0158 (hi) 0x0159 (lo)	Absorbed active kilowatt-hour EP_exp	R/W	0~999999999 (Unit: 0.1KWH)	DWORD
0x015A (hi) 0x015B (lo)	absorbed inactive kilowatt-hour (inductive) EQ_imp	R/W	0~999999999 (Unit: 0.1KVarH)	DWORD
0x015C (hi) 0x015D (lo)	emitted inactive kilowatt-hour (capacitive) EQ_exp	R/W	0~999999999 (Unit: 0.1KVarH)	DWORD
0x015E (hi) 0x015F (lo)	total of absolute value of active kilowatt-hour EP_total	R/W	0~999999999 (Unit: 0.1KWH)	DWORD
0x0160 (hi) 0x0161 (lo)	total of active kilowatt-hour EP_net	R/W	-999999999~999999999 (Unit: 0.1KWH)	Long
0x0162 (hi) 0x0163 (lo)	total of absolute value of inactive kilowatt-hour EQ_total	R/W	0~999999999 (Unit: 0.1KVarH)	DWORD
0x0164 (hi) 0x0165 (lo)	total of active kilowatt hour EQ_net	R/W	-999999999~999999999 (Unit: 0.1KVarH)	Long

9 Maintenance and troubleshooting:

9.1 Troubleshooting:

Switch on the control power, yet no display.	The meter does not connect with power supply.	Check the phase line (L, #12) and neutral line (N,#13), connect with power supply.
The data displayed is incorrect	Improper earthing	Check and make sure proper earthing according to this manual.
	Wrong setting	Check and make sure the setting is correct. e.g. PT, CT etc.
	Wrong voltage input	Check voltage input (1, 2, 3, 4), make sure the voltage input is correct and sufficient.
	Wrong wiring	Check the wiring of PT and CT, and the polarity. Please refer to wiring diagram.
PC cannot communicate with this meter.	Wrong communication address.	Check address setting, make sure every meter has an exclusive address.
	Wrong baud rate setting	Check baud rate setting, make sure the setting is same in communication equipments.
	Wrong communication wiring.	Check and make sure correct wiring.
	The terminal adapter resistance on communication wire is incorrect.	Check and make sure correct resistance and wiring.
	Communication interface malfunction.	Measure the resistance between RS-485 communication terminals by ohmmeter. The normal value should be over 4000 Ω , if the value is less than 200 Ω , maybe some parts damage.

9.2 FAQ and solve method of RS-485

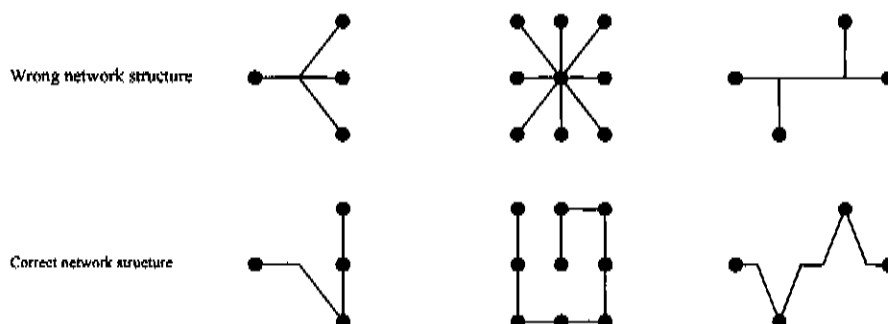
9.2.1 Communication distance of RS-485:

The Max. transmission distance of RS-485 is 1219m, the Max. transmission rate is 10Mbits/s. The length of double-twist wire is inversely proportional to transmission rate, the Max. cable length only can be used when transmission rate is 100Kbits/s. The shortest transmission distance acquires the Max. transmission rate. Normally, the transmission rate is 1Mbits/s for 100m double-twist wire.

9.2.2 Network topological structure of RS-485

The network topological structure of RS-485 usually employs terminal matched bus type, and does not support loop or star type network. It is best to connect serially several junctions by a bus, the wire between bus and every junction should be as short as possible in order to decrease the influence of reflection signal to bus signal.

Some wrong and correct network structure show as below:



Those wrong network structures shown as above, though in some cases (short distance, low transmission rate) may work normally, however, its disadvantage will be even more when the communication distance and rate increasing. Therefore, it is recommended to select correct network structure.

9.2.3 Terminal matched resistance of RS-485:

Two terminal matched resistances are needed for RS-485 bus, the value of resistance should be equal to characteristic impedance of cable. In most cases, the resistance should be $100\ \Omega$ - $120\ \Omega$. This resistance is no needed when transmission distance is less than 300m. The resistances are connected at the two ends of bus.

9.2.4 Polarity of RS-485 cable:

RS-485 cable consists of two wires, which marked by A and B. The voltage of wire B is higher than that of A under idle condition. Wire A is negative and wire B is positive.

9.2.5 Cable of RS-485:

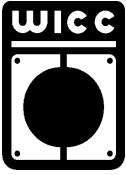
The cable of RS-485 should meet international and China standards.

International standard: diameter of wire should be larger than specification of AWG18.

China standard: RVVP $1 \times 2 \times 0.5\text{mm}^2$.

9.2.6 Isolation and anti-interfere of RS-485 communication circuit

The bus of RS-485 normally employs shielded double-twist cable. The shielding layer of cable should be connected onto the shielding terminal of RS-485. The shielding layer can be grounding in one point.



W.I.C.C. Ltd
 119 MULLER RD
 PO Box 252
 WASHINGTON IL 61571
 (309)-444-4125
 FAX (309)-444-3313

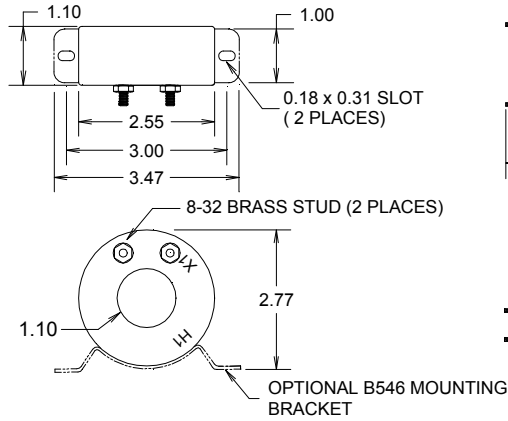
CURRENT TRANSFORMER MODEL 546

1.10" I.D.

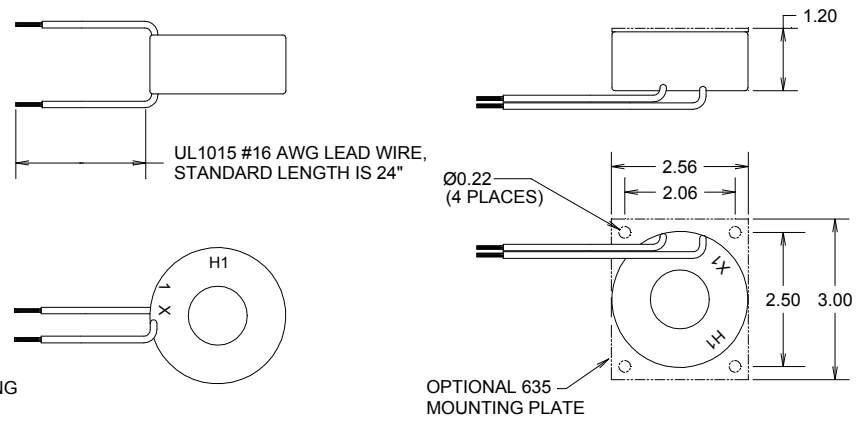
PAGE No

REV 03/19/99

TERMINAL OPTION



LEAD WIRE OPTION



NOTE:
 1) ALL DIMENSIONS IN INCHES
 2) ALL DIMENSIONS REF ONLY

Specifications

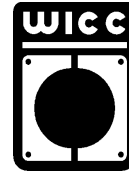
- Secondary sources 5 amps AC at rated F.S. primary current
- Nominal operating frequency range is 50-400HZ
- Thermal rating factor is 1.33 @ 30C for all ratios
- Insulation voltage class is 0.6KV BIL 10KV
- For indoor applications only
- Conforms to provisions of IEEE C57.13 and IEC 44-1
- Enclosure is glass-filled nylon, color is black
- Optional plate is XX phenolic, optional bracket is steel

Options, contact Factory for information

- UL and Canadian UL Recognized Component. File E100575
- 2.0, 5.0, and 10 VAC output at F.S. primary amperage. Other non-standard ratings also available.
- 1.0, 0.2, and 0.1 A output at F.S. primary amperage. Other non-standard ratings also available
- 8-32 Brass Stud Terminals or #16 AWG UL 1015 Lead Wires
- Custom lead wire lengths and types
- Thermal ratings above 1.33 for selected ratios.
- Center tap and custom multi tap winding arrangements

1.10" I.D.

CURRENT TRANSFORMER
MODEL 546

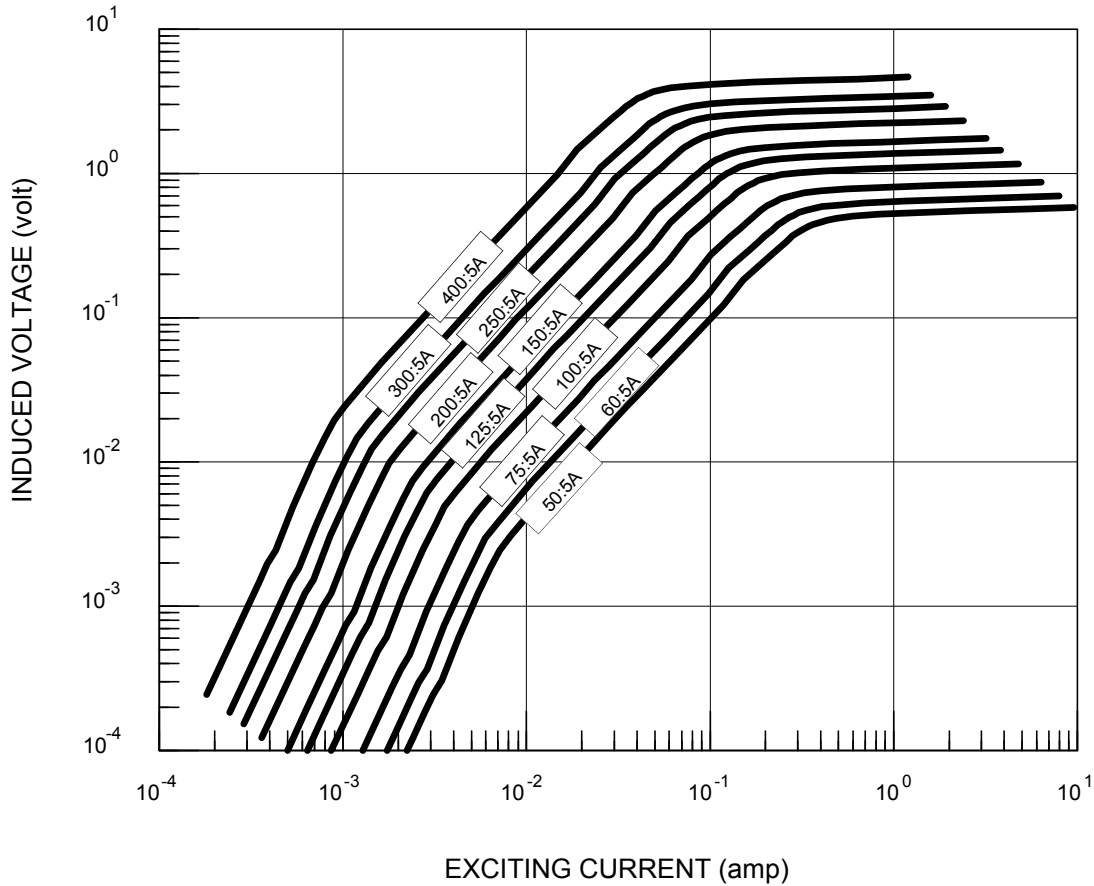


W.I.C.C. Ltd
 119 MULLER RD
 PO Box 252
 WASHINGTON IL 61571
 (309)-444-4125
 FAX (309)-444-3313

PAGE No

REV 04/15/99

TYPICAL EXCITATION CURVE for WICC MODEL 546 at 60HZ



W.I.C.C. PART NUMBER *	RATIO	ACCURACY @ 60HZ, pf = 0.95		NOMINAL WINDING RESISTANCE (ohm)
		± %	BURDEN (VA)	
546-050-00-xxx	50:5A	3.0	2.0	0.007
546-060-00-xxx	60:5A	2.0	2.0	0.008
546-075-00-xxx	75:5A	2.0	2.0	0.01
546-100-00-xxx	100:5A	1.0	2.0	0.02
546-125-00-xxx	125:5A	1.0	2.5	0.025
546-150-00-xxx	150:5A	1.0	4.0	0.03
546-200-00-xxx	200:5A	1.0	5.0	0.04
546-250-00-xxx	250:5A	1.0	7.5	0.052
546-300-00-xxx	300:5A	1.0	10	0.062
546-400-00-xxx	400:5A	1.0	15	0.083

* "xxx" describes termination: "T" FOR BRASS STUDS, "Lyyy" FOR LEAD WIRES (Where "yyy" is the lead length in inches. For example, "L24" represents 24 inch long lead wires.)