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Programming Manual

UTE9800+ Series Smart Digital Power Meter

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Software Version

00.00.01

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Chapter 1 SCPI

1.1 SCPI Introduction

SCPI (Standard Commands for Programmable Instruments)is a standardized instrument programming language that builds on existing standards IEEE 488.1 and IEEE 488.2 and follows the floating point rules of IEEE 754 standard, ISO 646 message exchange 7-bit encoding notation (equivalent to ASCII programming) and many other standards.

This section introduces the format, symbols, parameters, and abbreviations of the SCPI command.

1.1.1 Instruction Format

Command is consisting of a keyword, separator, parameter domain and end marke. Take the following command as an example.

:VOLTage:RANGe 150
VOLTage、RANGe is keyword, ":" and blank is separator, "150" is parameter (some commands have multiple parameters and separated by ","), the line separator or carriage return after the command is the end mark.

For the convenience of description, the following conventions are adopted for subsequent symbols.

- Square Brackets "[ ]"
  The contents in square brackets (command keywords) can be omitted.

- Braces "{ }"
  It represents the parameter in command string.

- Angle Braces "< >"
  The parameter enclosed in the angle brackets must be a numerical parameter.

- Vertical Bar "|"
  It is used to separate multiple parameters.

- End Mark: line separator <LF> (0x0A)or carriage return <CR> (0x0D)

1.1.2 Parameter Description

The data type of programming parameters include numeric, character and Boolean type. Regardless of the type, it is expressed as an ASCII. For more details, see the following table.

Symbol	Meaning	Example
<NR1>	Integer	123, 0123
<NR2>	Fixed Floating point number	123., 12.3, 0.123, .123
<NR3>	Floating point number	123, 12.3, 123E+3

<NRF>	It may be <NR1>, <NR2> or <NR3>	
<Boolean>	Boolean data	0|1|ON|OFF

1.1.3 Shorthand Rule

All the commands are case-insensitive. The commands can be all input in uppercase letters or in lowercase letters. For abbreviations, it should enter all the uppercase letters that exist in the command syntax.

1.2 Communication Interface and Setting

The detailed description can refer to “Chapter 6 Communication Setting” and “Chapter 8 Communication Interface in UTE9800+ User’s Manual.

1.3 SCPI Command

1.3.1 Command List

UTE9802+ Command List

Insturction	Function
*IDN?	Query the instrument information.
*RST	Restore to the factory setting.
*STB?	Query status byte register.
*SAV	Save the current setting into nonvolatile memory for next time use.
:HOLD	Turn on or off hold mode.
:MODE	Set the measurement mode of voltage/current.
:VOLTage:RANGe	Set the voltage range.
:VOLTage:AUTo	Turn on or off auto range of voltage.
:CURRent:RANGe	Set the current range.
:CURRent:AUTo	Turn on or off auto range of current.
:RATe	Set update rate.
:AVERaging	Set the average switch and average count.
:MUTe	Turn on or off mute.
:ALARm:FLAG?	Query the alarm state.
:ALARm:CURRent:HIGH	Set the upper limit of current alarm.
:ALARm:CURRent:LOW	Set the lower limit of current alarm.

:ALARm:POWer:HIGH	Set the upper limit of power alarm.
:ALARm:POWer:LOW	Set the lower limit of power alarm.
:ALARm:TIMe	Set alarm delay.
:UPDAte:COUNt?	Query the current update count.
:MEASure:FREQuency:VOLTage?	Query the measured frequency of voltage.
:MEASure:VOLTage?	Query the currently measured value of voltage.
:MEASure:CURRent?	Query the currently measured value of current.
:MEASure:POWer:ACTive?	Query the currently measured value of power.
:MEASure:PFACtor?	Query the currently measured value of power factor.
:SYSTem:ERRor?	Query error information
:LOCK	Set the lock key on the front panel.

UTE9806+ Command List

Instruction	Function
*IDN?	Query the instrument information.
*RST	Restore to the factory setting.
*STB?	Query status byte register.
*SAV	Save the current setting into nonvolatile memory for next time use.
:HOLD	Turn on or off hold mode.
:VOLTage:RANGe	Set the voltage range.
:VOLTage:AUTo	Turn on or off auto range of voltage.
:CURRent:RANGe	Set the current range.
:CURRent:AUTo	Turn on or off auto range of current.
:RATe	Set update rate.
:AVERaging	Set the average switch state and average count.
:MUTe	Turn on or off mute key.
:ALARm:FLAG?	Query the alarm state.
:ALARm:VOLTageFLAG?	Query the voltage alarm state.
:ALARm:CURRentFLAG?	Query the current alarm state.
:ALARm:ACTiveFLAG?	Query the alarm state of active power.
:ALARm:APParentFLAG?	Query the alarm state of apparent power.
:ALARm:FACTorFLAG?	Query the alarm state of power factor.
:ALARm:SWItch:Total	Set the main switch of alarm.
:ALARm:SWItch:VOLTage	Set the voltage alarm switch.
:ALARm:SWItch:CURRent	Set the current alarm switch.
:ALARm:SWItch:POWer:ACTive	Set the alarm switch of active power.
:ALARm:SWItch:POWer:APParent	Set the alarm switch of apparent power.
:ALARm:SWItch:POWer:FACtor	Set the alarm switch of power factor.

:ALARm:SWItch:Oout	Set the alarm switch of zero point.
:ALARm:SWItch:LEDf	Set the alarm switch of LED.
:ALARm:ALARmpar:VOLTage:HIGH	Set the upper limit of voltage alarm.
:ALARm:ALARmpar:VOLTage:LOW	Set the lower limit of voltage alarm.
:ALARm:ALARmpar:CURRent:HIGH	Set the upper limit of current alarm.
:ALARm:ALARmpar:CURRent:LOW	Set the lower limit of current alarm.
:ALARm:ALARmpar:POWer:ACTive:HIGH	Set the upper limit of active power.
:ALARm:ALARmpar:POWer:ACTive:LOW	Set the lower limit of active power.
:ALARm:ALARmpar:POWer:APParent:HIGH	Set the upper limit of apparent power.
:ALARm:ALARmpar:POWer:APParent:LOW	Set the lower limit of apparent power.
:ALARm:ALARmpar:POWer:FACTor:HIGH	Set the upper limit of power factor.
:ALARm:ALARmpar:POWer:FACTor:LOW	Set the lower limit of power factor.
:ALARm:ALARmpar:DELy	Set alarm delay times.
:ALARm:ALARmpar:BEEp	Set alarm beeper times.
:MEASure:FREQuency:VOLTage?	Query the measuring frequency of voltage.
:MEASure:FREQuency:CURRent?	Query the measuring frequency of current.
:MEASure:VOLTage?	Query the currently measured value of AC voltage.
:MEASure:VOLTage:PEAK+?	Query the currently measured value of voltage positive peak.
:MEASure:VOLTage:PEAK-?	Query the currently measured value of voltage negative peak.
:MEASure:CURRent?	Query the currently measured value of current.
:MEASure:CURRent:PEAK+?	Query the currently measured value of current positive peak.
:MEASure:CURRent:PEAK-?	Query the currently measured value of current negative peak.
:MEASure:POWer:ACTive?	Query the currently measured value of active power.
:MEASure:POWer:APParent?	Query the currently measured value of apparent value.
:MEASure:POWer:FACTor?	Query the currently measured value of power factor.
:SYSTem:ERRor?	Query error information.
:LOCK	Set the lock key state on the front panel.

UTE9811+ Command List

Insturction	Function
*IDN?	Query the instrument information.
*RST	Restore to the factory setting.
*STB?	Query status byte register.
*SAV	Save the current setting into nonvolatile memory for next time use.
:DISPlay:MODe	Set measurement mode

:DISPlay:SELect	Select window 4 to display power factor or frequency
:HOLD	Turn on or off hold mode.
:VOLTage:RANGe	Set the voltage range.
:VOLTage:AUTo	Turn on or off auto range of voltage.
:CURRent:RANGe	Set the current range.
:CURRent:AUTo	Turn on or off auto range of current.
:RATe	Set update rate.
:AVERaging	Set the average switch state and average count.
:MUTe	Turn on or off mute.
:ALARm:FLAG?	Query the alarm state.
:ALARm:CURRent:HIGH	Set the upper limit of current alarm.
:ALARm:CURRent:LOW	Set the lower limit of current alarm.
:ALARm:POWer:HIGH	Set the upper limit of power alarm.
:ALARm:POWer:LOW	Set the lower limit of power alarm.
:ALARm:TIMe	Set alarm delay.
:UPDAte:COUNt?	Query the current update count.
:MEASure:DATa:TYPe	Query the type of measurement data
:MEASure:FREQuency:VOLTage?	Query the measured frequency of voltage.
:MEASure:VOLTage?	Query the currently measured value of voltage.
:MEASure:CURRent?	Query the currently measured value of current.
:MEASure:POWer:ACTive?	Query the currently measured value of power.
:MEASure:PFACtor?	Query the currently measured value of power factor.
:MEASure:VOLTage:THD?	Query voltage total harmonic distortion.
:MEASure:CURRent:THD?	Query current total harmonic distortion.
:MEASure:VOLTage:HARMonic:ARRay?	Query voltage distortion of 1-50 times.
:MEASure:CURRent:HARMonic:ARRay?	Query current distortion of 1-50 times.
:MEASure:VOLTage:CF?	Query the measured value of voltage crest factor.
:MEASure:CURRent:CF?	Query the measured value of current crest factor.
:MEASure:VOLTage:HARMonic:RMS?	Query total RMS voltage of 1-50 times.
:MEASure:CURRent:HARMonic:RMS?	Query total RMS current of 1-50 times.
:MEASure:POWer:HARMonic:RMS?	Query total RMS active power of 1-50 times.
:SYSTem:ERRor?	Query error information.
:SYSTem:LEVel	Set the user's grade.
:LOCK	Set the lock key on the front panel.

1.3.2 Instruction Parse

UTE9802+ Instruction Parse

*IDN?

Function Query the instrument information.

Syntax *IDN?

Example *IDN?

-> UNI-T,UTE9802+,012345678,F1.02

Description The return format of instrument information is <manufacturer>,<model>,<serial number>,< firmware version>

*RST

Function Restore to the factory setting.

Syntax *RST

Example *RST

Description Except communication configuration parameter (instruction type, baud rate, address), other configuration parameter will restore to the factory setting.

*STB?

Function Query status byte register.

Syntax *STB?

Example *STB? -> 4

Description If returned value is 4, it represents the status byte register set to 00000100; It means the error queue is not empty, which also means an error has been generated.

*SAV

Function Save the current setting into nonvolatile memory for next time use.

Syntax *SAV

Example *SAV

:HOLD

Function Turn on/off hold mode.

Syntax :HOLD {<Boolean>}

:HOLD?

Example :HOLD OFF

:HOLD? -> 0

:MODE

Function Set the measurement mode of voltage/current.

Syntax :MODE {AC|ACDC|DC}

:MODE?

AC, ACDC = (RMS); DC

Example :MODE ACDC

:MODE? -> ACDC

:VOLTage:RANGe

Function Set the voltage range.

Syntax :VOLTage:RANGe {<Voltage>}

:VOLTage:RANGe?

<Voltage> = 75,150,300,600

Example :VOLTage:RANGe 150

:VOLTage:RANGe? -> 150

:VOLTage:AUTo

Function Turn on or off auto range of voltage.

Syntax :VOLTage:AUTo {<Boolean>}

:VOLTage:AUTo?

Example :VOLTage:AUTo 1

:VOLTage:AUTo? -> 1

:CURRent:RANGe

Function Set the current range.

Syntax :CURRent:RANGe {<Current>}

:CURRent:RANGe?

<Current> = 0.5, 2, 8, 20

Example :CURRent:RANGe 2

:CURRent:RANGe? -> 2

:CURRent:AUTo

Function Turn on or off auto range of current.

Syntax :CURRent:AUTo {<Boolean>}

:CURRent:AUTo?

Example :CURRent:AUTo 1

:CURRent:AUTo? -> 1

:RATe

Function Set update rate.

Syntax :RATe {<Time>}

:RATe?

<Time> = 0.1,0.25,0.5,1,2,5

Example :RATe 0.25

:RATe? -> 0.25

:AVERaging

Function Set the average switch and average count.

Syntax :AVERaging {<Average>}

:AVERaging?

<Average> = OFF,8,16,32,64

·OFF = Average is turned off

·8,16,32,64 = Average is turned on and it represents the average count.

Example :AVERaging 16

:AVERaging? -> 16

:MUTe

Function Turn on or off mute.

Syntax :MUTe {<Boolean>}

:MUTe?

Example :MUTe 1

:MUTe? ->1

:ALARm:FLAG?

Function Query the alarm state.

Syntax :ALARm:FLAG? {<Type>,<State>}

<Type> = CURRENT,POWER

CURRENT = current； POWER = power

<State> = DISABLE,WAITING， RUNNING， OK， LOW， HIGH

·DISABLE = the test is forbidden;

·WAITING = wait for connect to the load;

·RUNNING = testing;

·OK = the test is completed, the test result within the lower and upper limit;

·LOW = the test is completed, the test result is below the lower limit;

·HIGH = the test is completed, the test result is higher than theupper limit.

Example :ALARm:FLAG? CURRENT -> RUNNING

:ALARm:CURRent:HIGH

Function Set the upper limit of current alarm.

Syntax :ALARm:CURRent:HIGH {<NRf>}

:ALARm:CURRent:HIGH?

Example :ALARm:CURRent:HIGH 10.1

:ALARm:CURRent:HIGH? -> 10.1

:ALARm:CURRent:LOW

Function Set the lower limit of current alarm.

Syntax :ALARm:CURRent:LOW {<NRf>}

:ALARm:CURRent:LOW?

Example :ALARm:CURRent:LOW 1.1

:ALARm:CURRent:LOW? -> 1.1

:ALARm:POWer:HIGH

Function Set the upper limit of power alarm.

Syntax :ALARm:POWer:HIGH {<NRf>}

:ALARm:POWer:HIGH?

Example :ALARm:POWer:HIGH 1000.1

:ALARm:POWer:HIGH? -> 1000.1

:ALARm:POWer:LOW

Function Set the lower limit of power alarm.

Syntax :ALARm:POWer:LOW {<NRf>}

:ALARm:POWer:LOW?

Example :ALARm:POWer:LOW 10.1

:ALARm:POWer:LOW -> 10.1

:ALARm:TIMe

Function Set alarm delay.

Syntax :ALARm:TIMe {<NRf>}

:ALARm:TIMe?

Example :ALARm:TIMe 20.2

:ALARm:TIMe? -> 20.2

:UPDAte:COUNt?

Function Query the current update count.

Syntax :UPDAte:COUNt?

Example :UPDAte:COUNt? -> 763

Description Each time the data is updated, the number of updates will be increased by one. By detecting the difference in the number of updates before and after, it can determine whether the data update event occurs, so as to obtain the latest updated data.

:MEASure:FREQuency:VOLTage

Function Query the measured frequency of voltage.

Syntax :MEASure:FREQuency:VOLTage?

Example :MEASure:FREQuency:VOLTage? -> 50.00

:MEASure:VOLTage?

Function Query the currently measured value of voltage.

Syntax :MEASure:VOLTage?

Example :MEASure:VOLTage? -> 110.36

:MEASure:CURRent?

Function Query the currently measured value of current.

Syntax :MEASure:CURRent?

Example :MEASure:CURRent? -> 10.23

:MEASure:POWer:ACTive?

Function Query the currently measured value of power.

Syntax :MEASure:POWer:ACTive?

Example :MEASure:POWer:ACTive? -> 30.5

:MEASure:PFACtor?

Function Query the currently measured value of power factor.

Syntax :MEASure:PFACtor?

Example :MEASure:PFACtor? -> 0.519

:SYSTem:ERRor?

Function Query the last error code and information.

Syntax :SYSTem:ERRor?

Example :SYSTem:ERRor? -> -113,"Undefined header"

Description If there is no error, then it returns 0,"No error"

:LOCK

Function Set the lock key on the front panel.

Syntax :LOCK {<Boolean>}

:LOCK?

Example :LOCK 1

:LOCK? -> 1

UTE9806+ Instruction Parse

*IDN?

Function Query the instrument information.

Syntax *IDN?

Example *IDN?

-> UNI-T,UTE9806+,012345678,F1.02

Description The return format of instrument information is <manufacturer>, <model>, <serial number>, < firmware version>.

*RST

Function Restore to the factory setting.

Syntax *RST

Example *RST

Description Except communication configuration parameter (instruction type, baud rate, address), other configuration parameter will restore to the factory setting.

*STB?

Function Query status byte register.

Syntax *STB?

Example *STB? -> 4

Description If returned value is 4, it represents the status byte register set to 00000100; it means the error queue is not empty, which also means an error has been generated.

*SAV

Function Save the current setting into nonvolatile memory for next time use.
Syntax *SAV
Example *SAV

:HOLD

Function Turn on/off hold mode.
Syntax :HOLD {<Boolean>}
:HOLD?
Example :HOLD OFF
:HOLD? -> 0

:VOLTage:RANGe

Function Set the voltage range.
Syntax :VOLTage:RANGe {<Voltage>}
:VOLTage:RANGe?
<Voltage> = 60,600
Example :VOLTage:RANGe 60
:VOLTage:RANGe? -> 60

:VOLTage:AUTo

Function Turn on or off auto range of voltage.
Syntax :VOLTage:AUTo {<Boolean>}
:VOLTage:AUTo?
Example :VOLTage:AUTo 1
:VOLTage:AUTo? -> 1

:CURRent:RANGe

Function Set the current range.
Syntax :CURRent:RANGe {<Current>}
:CURRent:RANGe?
<Current> = 0.05, 0.1, 10

Example :CURRent:RANGe 0.05
:CURRent:RANGe? -> 0.05

:CURRent:AUTo

Function Turn on or off auto range of current.
Syntax :CURRent:AUTo {<Boolean>}
:CURRent:AUTo?
Example :CURRent:AUTo 1
:CURRent:AUTo? -> 1

:AVERaging

Function Set the average switch state and average count.
Syntax :AVERaging {<Average>}
:AVERaging?
<Average> = OFF, 8,16,32,64
·OFF = Average is turned off.
·8,16,32,64 = Average is turned on and it represents the average count.
Example :AVERaging 16
:AVERaging? -> 16

:MUTe

Function Turn on or off mute key.
Syntax :MUTe {<Boolean>}
:MUTe?
Example :MUTe 1
:MUTe? ->1

:ALARm:FLAG?

Function Query the alarm state.
Syntax :ALARm:FLAG? {<State>}
<State> = 0- not detecting, 1- PASS, 2- NG
Example :ALARm:FLAG?-> 0 # acquire the alarm state.

:ALARm:VOLTageFLAG?

Function Query the voltage alarm state.

Syntax :ALARm:VOLTageFLAG? {<State>}

<State> = 0- not detecting, 1- PASS, 2- NG

Example :ALARm:VOLTageFLAG?-> 0 # acquire the voltage alarm state.

:ALARm:SWItch:Total

Function Set the main switch of alarm.

Syntax :ALARm:SWItch:Total {<bool>}

:ALARm:SWItch:Total?

Example :ALARm:SWItch:Total ON

:ALARm:SWItch:Total? -> ON

Description If it need to read the main switch or other switch, change the third parameter Total.

:ALARm:ALARmpar:VOLTage:HIGH

Function Set the upper limit of voltage alarm.

Syntax :ALARm:ALARmpar:VOLTage:HIGH {<NR3>}

:ALARm:ALARmpar:VOLTage:HIGH?

Example :ALARm:ALARmpar:VOLTage:HIGH 250.5

:ALARm:ALARmpar:VOLTage:HIGH? -> 250.5

Description If it need to read the upper limit of voltage alarm or the upper limit of other parameter, change the third parameter **VOLTage**.

Example Set the upper limit of current alarm.

:ALARm:ALARmpar:CURRent:HIGH 1.065

:ALARm:ALARmpar:VOLTage:HIGH? -> 1.065

Set the upper limit of power.

:ALARm:ALARmpar**:**POWer:ACTive:HIGH 500

:ALARm:ALARmpar**:**POWer:ACTive:HIGH? -> 500

:ALARm:ALARmpar:VOLTage:LOW

Function Set the lower limit of voltage alarm.

Syntax :ALARm:ALARmpar:VOLTage:LOW {<NR3>}

:ALARm:ALARmpar:VOLTage:LOW?

Example :ALARm:ALARmpar:VOLTage:LOW 250.5

:ALARm:ALARmpar:VOLTage:LOW? -> 250.5

Description If it need to read the lower limit of voltage alarm or the lower limit of other parameter, change the third parameter **VOLTage**.

Example Set the lower limit of current alarm.
:ALARm:ALARmpar:CURRent:LOW 1.065
:ALARm:ALARmpar:VOLTage:LOW? -> 1.065

Set the lower limit of power.
:ALARm:ALARmpar:POWer:ACTive:LOW 500
:ALARm:ALARmpar:POWer:ACTive:LOW? -> 500

:ALARm:ALARmpar:DELy

Function Set the alarm delay.
Syntax :ALARm:ALARmpar:DELy {<NR1>}
:ALARm:ALARmpar:DELy?
Example :ALARm:ALARmpar:DELy 5
:ALARm:ALARmpar:DELy? -> 5

:ALARm:ALARmpar:BEEp

Function Set the alarm beeper times.
Syntax :ALARm:ALARmpar:BEEp{<NR1>}
:ALARm:ALARmpar:BEEp?
Example :ALARm:ALARmpar:BEEp 10
:ALARm:ALARmpar:BEEp? -> 10

:MEASure:FREQuency:VOLTage

Function Query the measuring frequency of voltage.
Syntax :MEASure:FREQuency:VOLTage?
Example :MEASure:FREQuency:VOLTage? -> 50.00

:MEASure:VOLTage?

Function Query the currently measured value of AC voltage.
Syntax :MEASure:VOLTage?
Example :MEASure:VOLTage? -> 110.36

:MEASure:VOLTage:PEAK+?

Function Query the currently measured value of voltage positive peak.
Syntax :MEASure:VOLTage:PEAK+?
Example :MEASure:VOLTage:PEAK+? -> 110.36

:MEASure:VOLTage:PEAK-?

Function Query the currently measured value of voltage negative peak.
Syntax :MEASure:VOLTage:PEAK-?
Example :MEASure:VOLTage:PEAK-? -> -110.36

:MEASure:CURRent?

Function Query the currently measured value of current.
Syntax :MEASure:CURRent?
Example :MEASure:CURRent? -> 10.23

:MEASure:CURRent:PEAK+?

Function Query the currently measured value of current positive peak.
Syntax :MEASure:CURRent:PEAK+?
Example :MEASure:CURRent:PEAK+? -> 14.53

:MEASure:CURRent:PEAK-?

Function Query the currently measured value of current negative peak.
Syntax :MEASure:CURRent:PEAK-?
Example :MEASure:CURRent:PEAK-? -> -14.53

:MEASure:POWer:ACTive?

Function Query the currently measured value of active power.
Syntax :MEASure:POWer:ACTive?
Example :MEASure:POWer:ACTive? -> 30.5

:MEASure:POWer:APParent?

Function Query the currently measured value of apparent power.
Syntax :MEASure:POWer:APParent?
Example :MEASure:POWer:APParent? -> 30.5

:MEASure:POWer:PFACtor?

Function Query the currently measured value of power factor.
Syntax :MEASure:PFACtor?
Example :MEASure:PFACtor? -> 0.519

:MEASure:POWer:PHAse?

Function Query the currently measured value of phase.
Syntax :MEASure:PHAse?
Example :MEASure:PHAse? -> 60.5

:SYSTem:ERRor?

Function Query the last error code and information.
Syntax :SYSTem:ERRor?
Example :SYSTem:ERRor? -> -113,"Undefined header"
Description If there is no error, then it returns 0,"No error"

:LOCK

Function Set the lock key state on the front panel.
Syntax :LOCK {<Boolean>}
:LOCK?
Example :LOCK 1
:LOCK? -> 1

UTE9811+ Instruction Parse

*IDN?

Function Query the instrument information.
Syntax *IDN?
Example *IDN?
-> UNI-T,UTE9811+,012345678,F1.02
Description The return format of instrument information is <manufacturer>,<model>,<serial number>,< firmware version>.

*RST

Function Restore to the factory setting.

Syntax *RST

Example *RST

Description Except communication configuration parameter (instruction type, baud rate, address), other configuration parameter will restore to the factory setting.

*STB?

Function Query status byte register.

Syntax *STB?

Example *STB? -> 4

Description If returned value is 4, it represents the status byte register set to 00000100; It means the error queue is not empty, which also means an error has been generated.

*SAV

Function Save the current setting into nonvolatile memory for next time use.

Syntax *SAV {<NR1>}

Example *SAV 0

:DISPlay:MODe

Function Set the current display interface.

Syntax :DISPlay:MODe {<Mode>}

:DISPlay:MODe?

Mode = RMS | CF | HARM_RMS | THD_VALUE | THD_PERCENT

·RMS = TRMS

·CF = Crest factor

·HARM_RMS = Total RMS harmonic

·THD_VALUE = Measured value of harmonic

·THD_PERCENT = Harmonic distortion factor

Example :DISPlay:MODe THD_VALUE

:DISPlay:MODe? -> THD_VALUE

:DISPlay:SELect

Function Select window 4 to display power factor or frequency.

Syntax :DISPlay:SELect {<Type>}

:DISPlay:SELect?

<Type> = PF | HZ

·PF = Display power factor

·HZ = Display measurement frequency

Example :DISPlay:SELect HZ

:DISPlay:SELect? -> HZ

:HOLD

Function Turn on/off hold mode.

Syntax :HOLD {<Boolean>}

:HOLD?

Example :HOLD OFF

:HOLD? -> 0

:VOLTage:RANGe

Function Set the voltage range.

Syntax :VOLTage:RANGe {<Voltage>}

:VOLTage:RANGe?

<Voltage> = 75,150,300,600

Example :VOLTage:RANGe 150

:VOLTage:RANGe? -> 150

Notes: This instruction can only be used when set the user's grade to High.

:VOLTage:AUTo

Function Turn on or off auto range of voltage.

Syntax :VOLTage:AUTo {<Boolean>}

:VOLTage:AUTo?

Example :VOLTage:AUTo 1

:VOLTage:AUTo? -> 1

Notes: This instruction can only be used when set the user's grade to High.

:CURRent:RANGe

Function Set the current range.

Syntax :CURRent:RANGe {<Current>}

:CURRent:RANGe?

<Current> = 0.2, 1, 4, 20

Example :CURRent:RANGe 1

:CURRent:RANGe? -> 1

Notes: This instruction can only be used when set the user's grade to High.

:CURRent:AUTo

Function Turn on or off auto range of current.

Syntax :CURRent:AUTo {<Boolean>}

:CURRent:AUTo?

Example :CURRent:AUTo 1

:CURRent:AUTo? -> 1

Notes: This instruction can only be used when set the user's grade to High.

:MANual:FREQuency

Function Set the input signal frequency of user defined.

Syntax :MANual:FREQuency {<NRf>}

:MANual:FREQuency?

<NRf> = 0 or 40~70;<NRf>= 0 represents this function (input signal frequency of user defined) is disabled.

Example :MANual:FREQuency 50.1

:MANual:FREQuency? -> 50.1

Notes: This instruction can only be used when set the user's grade to High.

:RATe

Function Set update rate.

Syntax :RATe {<Time>}

:RATe?

<Time> = 0.1,0.25,0.5,1,2,5

Example :RATe 0.25

:RATe? -> 0.25

:AVERaging

Function Set the average switch state and average count.

Syntax :AVERaging {<Average>}

:AVERaging?

<Average> = OFF,8,16,32,64

·OFF = Average is turned off

·8,16,32,64 = Average is turned on and it represents the average count.

Example :AVERaging 16

:AVERaging? -> 16

:MUTe

Function Turn on or off mute.

Syntax :MUTe {<Boolean>}

:MUTe?

Example :MUTe 1

:MUTe? ->1

:ALARm:FLAG?

Function Query the alarm state.

Syntax :ALARm:FLAG? {<Type>,<State>}

<Type> = CURRENT,POWER

CURRENT = current； POWER = power

<State> = DISABLE, WAITING, RUNNING, OK, LOW, HIGH

·DISABLE = the test is forbidden;

·WAITING = wait for connect to the load;

·RUNNING = testing;

·OK = the test is completed, the test result within the lower and upper limit;

·LOW = the test is completed, the test result is below the lower limit;

·HIGH = the test is completed, the test result is higher than theupper limit.

Example :ALARm:FLAG? CURRENT -> RUNNING

:ALARm:CURRent:HIGH

Function Set the upper limit of current alarm.

Syntax :ALARm:CURRent:HIGH {<NRf>}

:ALARm:CURRent:HIGH?

Example :ALARm:CURRent:HIGH 10.1

:ALARm:CURRent:HIGH? -> 10.1

:ALARm:CURRent:LOW

Function Set the lower limit of current alarm.

Syntax :ALARm:CURRent:LOW {<NRf>}

:ALARm:CURRent:LOW?

Example :ALARm:CURRent:LOW 1.1

:ALARm:CURRent:LOW? -> 1.1

:ALARm:POWer:HIGH

Function Set the upper limit of power alarm.

Syntax :ALARm:POWer:HIGH {<NRf>}

:ALARm:POWer:HIGH?

Example :ALARm:POWer:HIGH 1000.1

:ALARm:POWer:HIGH? -> 1000.1

:ALARm:POWer:LOW

Function Set the lower limit of power alarm.

Syntax :ALARm:POWer:LOW {<NRf>}

:ALARm:POWer:LOW?

Example :ALARm:POWer:LOW 10.1

:ALARm:POWer:LOW -> 10.1

:ALARm:TIMe

Function Set alarm delay.

Syntax :ALARm:TIMe {<NRf>}

:ALARm:TIMe?

Example :ALARm:TIMe 20.2

:ALARm:TIMe? -> 20.2

:UPDAte:COUNt?

Function Query the current update count.

Syntax :UPDAte:COUNt?

Example :UPDAte:COUNt? -> 763

Description Each time the data is updated, the number of updates will be increased by one. By detecting the difference in the number of updates before and after, it can determine whether the data update event occurs, so as to obtain the latest updated data.

:MEASure:DATa:TYPe

Function Set the type of measurement data

Syntax :MEASure:DATa:TYPe {<Type>}

:MEASure:DATa:TYPe?

Type = ACTUAL | LAST

·ACTUAL = Real-time measured data

·LAST = Recently update valid measured data

Example :MEASure:DATa:TYPe ACTUAL

:MEASure:DATa:TYPe -> ACTUAL

Description ·Set the type of measurement data to“ACTUAL”, query measurement data command (such as:MEASure:VOLTage?”) , the obtained value truly reflects the current measuring state of the instrument. The measured value is invalid when the instrument is in configuration measurement function or switching ranges, the obtained value is “NaN”.When the instrument exits configuration measurement function or switching ranges, the value obtained by the command is valid measurement data.

·Set the type of measurement data to“ LAST”, the value obtained by the query measurement data command is recently update valid measured data.

:MEASure:FREQuency[:VOLTage]?

Function Query the measured frequency of voltage.

Syntax :MEASure:FREQuency:VOLTage?

Example :MEASure:FREQuency:VOLTage? -> 50.00

:MEASure:VOLTage?

Function Query the currently measured value of voltage.

Syntax :MEASure:VOLTage?

Example :MEASure:VOLTage? -> 110.36

:MEASure:CURRent?

Function Query the currently measured value of current.

Syntax :MEASure:CURRent?

Example :MEASure:CURRent? -> 10.23

:MEASure:POWer[:ACTive]?

Function Query the currently measured value of power.

Syntax :MEASure:POWer:ACTive?

Example :MEASure:POWer:ACTive? -> 30.5

:MEASure:PFACtor?

Function Query the currently measured value of power factor.

Syntax :MEASure:PFACtor?

Example :MEASure:PFACtor? -> 0.519

:MEASure:VOLTage:THD?

Function Query voltage total harmonic distortion.

Syntax :MEASure:VOLTage:THD? {VALUE|PERCENT}

VALUE = Return the measured value of voltage total harmonic distortion, the unit is V.

PERCENT = Return voltage total distortion, the unit is %.

Example :MEASure:VOLTage:THD? VALUE -> 5.00

:MEASure:CURRent:THD?

Function Query current total harmonic distortion.

Syntax :MEASure:CURRent:THD? {VALUE|PERCENT}

VALUE = Return the measured value of current total harmonic distortion, the unit is A.

PERCENT = Return curent total distortion,the unit is %.

Example :MEASure:CURRent:THD? VALUE -> 1.000

:MEASure:VOLTage:HARMonic:ARRay?

Function Query voltage distortion of 1-50 times.

Syntax :MEASure:VOLTage:HARMonic:ARRay? {VALUE|PERCENT}

-> <Data1>,<Data2> … <Data50>

VALUE = Return the measured voltage distortion value of1-50 times, the unit is V.

PERCENT = Return voltage distortion of 1-50 times, the unit is %.

Example :MEASure:VOLTage:HARMonic:ARRay? VALUE

-> 10.00**,** 1.00 … 2.00

:MEASure:CURRent:HARMonic:ARRay?

Function Query current distortion of 1-50 times.

Syntax :MEASure:CURRent:HARMonic:ARRay? {VALUE|PERCENT}

-> <Data1>, <Data2> … <Data50>

VALUE = Return the measured current distortion value of1-50 times, the unit is A.

PERCENT = Return current distortion of 1-50 times, the unit is %.

Example :MEASure:CURRent:HARMonic:ARRay? VALUE

-> 5.012**,**1.031 … 0.101

:MEASure:VOLTage:CF?

Function Query the measured value of voltage crest factor.

Syntax :MEASure:VOLTage:CF?

Example :MEASure:VOLTage:CF? -> 1.420

:MEASure:CURRent:CF?

Function Query the measured value of current crest factor.

Syntax :MEASure:CURRent:CF?

Example :MEASure:CURRent:CF? -> 6.125

:MEASure:VOLTage:HARMonic:RMS?

Function Query total RMS voltage of 1-50 times.

Syntax :MEASure:VOLTage:HARMonic:RMS?

Example :MEASure:VOLTage:HARMonic:RMS? -> 110.23

:MEASure:CURRent:HARMonic:RMS?

Function Query total RMS current of 1-50 times.

Syntax :MEASure:CURRent:HARMonic:RMS?

Example :MEASure:CURRent:HARMonic:RMS? -> 1.236

:MEASure:POWer:HARMonic:RMS?

Function Query total RMS active power of 1-50 times.

Syntax :MEASure:POWer:HARMonic:RMS?

Example :MEASure:POWer:HARMonic:RMS? -> 120.23

:SYSTem:ERRor?

Function Query the last error code and information.

Syntax :SYSTem:ERRor?

Example :SYSTem:ERRor? -> -113,"Undefined header"

Description If there is no error, then it returns 0,"No error" .

:SYSTem:LEVel

Function Set the user's grade.

Syntax :SYSTem:LEVel {<LEVEL>,<NR1>}

:SYSTem:LEVel?

<LEVEL> = NORMAL | HIGH

<NR1> = Secret code

Example :SYSTem:LEVel HIGH,*****(secret code)

:SYSTem:LEVel? -> HIGH

:LOCK

Function Set the lock key on the front panel.

Syntax :LOCK {<Boolean>}

:LOCK?

Example :LOCK 1

:LOCK? -> 1

1.4 Acquire Newest Measurement Data

The measurement data will in breaks when in auto range or UTE9811+ is reconfigured, the acquired data is “nan” via“:MEASure:###:###?”. If user want to acquire the newest measurement data,it need to exit break state and then to acquire the data. By detecting the difference in the number of updates before and after, it can determine whether the data update event occurs, so as to obtain the latest updated data. The specific method as follows.

:UPDAte:COUNt? -> 101

:UPDAte:COUNt? -> 101

...

:UPDAte:COUNt? -> 102 # data update event occurs

:MEASure:VOLTage? -> 110.36

:MEASure:CURRent? -> 10.23

...

Chapter 2 Modbus Programming Manual

2.1 Modbus Introduction

Modbus is a widely used field bus protocol. Multiple slave machines can easily network with the host through Modbus, the host computer can be PC or PLC. Modbus has two varieties, which is Modbus-RTU and Modbus-ASC. UTE9802+ only supports Modbus-RTU.

2.2 Communication Interface and Setting

The detailed explanation can refer to “Chapter 6 Communication Setting” and “Chapter 8 Communication Interface”

of UTE9800+ User's Manual.

2.3 Communication Data Format

During communication, data is return by word (word- two bytes). In each returned word, MSB first, then LSB. If two bytes are continuously return (such as floating point number or long integer), MSB first, then LSB.

Data Format	Number of Register	Number of Byte	Description
Byte Data		1	
Integer Data	1	2	A return, MSB first, then LSB.
Long Integer Data	2	4	Return in two words, MSB first, then LSB.
Floating Point Data			

2.4 Interconversion of Word and Float

A register in Modbus protocol is 16 bits, that is a word. The previous section mentioned that floating-point take up two registers, i.e., two words. After receiving byte data, user needs to convert a word to a floating-point or a floating-point number to a word.

The following code is a good example for interconversion of word and float point.

```
/* C program for converting a floating point number to two words */
void FloatToWord(float Data,u16 *Word)
{
 union
 {
        float Data;
        unsigned char Byte[4];
 }FloatData;
 FloatData.Data=Data;
 Word[0]=(u16)FloatData.Byte[3]<<8|FloatData.Byte[2];
 Word[1]=(u16)FloatData.Byte[1]<<8|FloatData.Byte[0];
}
/* C program for converting two words to a floating point number */
float WordToFloat(const u16 *Word)
{
 union
 {
        float Data;
        unsigned char Byte[4];
 }FloatData;
 FloatData.Byte[3]=(Word[0]>>8)&0xFF;
 FloatData.Byte[2]=(Word[0])&0xFF;
 FloatData.Byte[1]=(Word[1]>>8)&0xFF;
```

```
FloatData.Byte[0]=(Word[1])&0xFF;
return FloatData.Data;
}
```

2.5 Modbus-RTU

2.5.1 Function code 03H， read multiple words

This command can read at leat one word. The following example issues a read command from the master station to slave station 1, reading two consecutive words that start from address 0096H (150) .

Command Message of Master Station

Slave address	01H
Function code	03H
Position of initial data	00H (MSB)
	96H (LSB)
Data number (calculating in word)	00H
	02H
CRC(Check Low)	24H (LSB)
CRC(Check High)	27H (MSB)

Respond Message of Slave Station (Normal)

Slave address	01H
Function code	03H
Data number (calculating in byte)	04H
Start data address 0096H	40H (MSB)
	DDH (LSB)
The second data address 0097H	1EH (MSB)
	B8H (LSB)
CRC(Check Low)	76H (LSB)
CRC(Check High)	1BH (MSB)

Respond Message of Slave Station (Abnormal)

Slave address	01H
Function code	83H
Error Code	02H
CRC(Check Low)	C0H (LSB)
CRC(Check High)	F1H (MSB)

2.5.2 Function code 10H, written multiple words

This command can write at least one word. The following example issues a write command from the master station to slave station 1, written data of two words 0003H and 0002H from the start address 0065H(101) . That is write 0003H into address 0065H, write 0002H into address 00066H. The slave replies to the master station when the write is completed.

Command Message of Master Station

Slave address	01H
Function code	10H
Position of initial data	00H
	65H
Data number (calculating in word)	00H (MSB)
	02H (LSB)
Data number (calculating in byte)	04H
The first data address	00H (MSB)
	03H (LSB)
The second data address	00H (MSB)
	02H (LSB)
CRC(Check Low)	44 (LSB)
CRC(Check High)	79 (MSB)

Respond Message of Slave Station (Normal)

Slave address	01H
Function code	10H
Position of initial data	00H (MSB)
	65H (LSB)
Data number (calculating in word)	00H (MSB)
	02H (LSB)
CRC(Check Low)	51H (LSB)
CRC(Check High)	D7H (MSB)

Respond Message of Slave Station (Abnormal)

Slave address	01H
Function code	90H
Error Code	02H
CRC(Check Low)	CDH (LSB)
CRC(Check High)	C1H (MSB)

2.5.3 Description of Error Code

Error code parsing for respond message of slave station (abnormal) as shown in the following table.

Error Code	Name	Description
01	Illegal function code	The slave machine does not support this function code.
02	Illegal data address	The starting data position or a combination of the starting data position and the number of transmitted data received from the machine is not allowed.
03	Illegal data value	Data received from the machine is not allowed.

2.6 Register List

2.6.1 UTE9802+ Register List

*Notes: R represents it can be read, that is support command 03H. W represents it can be wirtten, that is support command 10H.

Data Name	Data Format	Unit	Initial Address	Number of Register	Read/Write	Remarks
Product Information						
Product information	ASCII		0	50	R	"UNI-T,UTE9802+,012345678,F1.02"
Retain			50	50	R	
Parameter Setting						
Measurement mode	U16		100	1	R/W	0 (AC+DC), 1 (AC), 2 (DC)
Voltage range	U16		101	1	R/W	0 (Auto), 1 (75V), 2 (150V), 3 (300V), 4 (600V)
Current range	U16		102	1	R/W	0 (Auto), 1 (0.5A), U162 (2A), 3 (8A), 4 (20A)
Update cycle	U16		103	1	R/W	0 (0.1s), 1 (0.25s), 2 (0.5s), 3 (1s), 4 (2s), 5 (5s)
Average	U16		104	1	R/W	0 (the average is turned off), 1 (8 times), 2 (16 times), 3 (32 times), 4 (64 times)
Data hold	U16		105	1	R/W	0 (forbidden), 1 (enabled)
Display	U16		106	1	R/W	0 (display PF value), 1 (display frequency value)
Mute	U16		107	1	R/W	0 (forbidden), 1 (enabled)
Upper limit of current alarm	Float	A	108	2	R/W	0.000~40.000, When the upper limit and the lower limit is set to 0 at the same time, it represents the alarm is forbidden.
Lower limit of current alarm	Float	A	110	2	R/W	
Upper limit of power limit	Float	W	112	2	R/W	0.000~48000.0, When the upper limit and the lower limit is set to 0 at the same time, it represents the alarm is forbidden.
Lower limit of power limit	Float	W	114	2	R/W	
Alarm delay	Float	S	116	2	R/W	0.0~99.9
Measurement data type	U16		120	1	R/W	0: real-time measurement data 1: recently update TRMS data
Parament Configuration of Instrument						
Default setting	U16		140	1	W	0 (forbidden), 1 (set the parameter to

						the default value)
Save parameter	U16		141	1	W	0 (forbidden), 1 (save the parameter into system storage for next use)
Measurement Data						
Voltage value	Float	V	150	2	R	The numerical value is related to the measurement model.
Current value	Float	A	152	2	R	The numerical value is related to the measurement model.
Active power	Float	W	154	2	R	
Power factor	Float		156	2	R	
Frequency of voltage	Float	Hz	158	2	R	
Alarm state of current	U16		160	1	R	0(alarm forbidden), 1 (wait for connect to the load), 2 (testing), 3 (the result is normal), 4 (the result is low), 5 (the result is high)
Alarm state of power	U16		161	1	R	
Data update count	U16		162	1	R	The latest measurements are available when changes in this data are detected.

Expression of Special Data

- Floating point 9.91E+37 in measurement data, which represents invalid data, window displays "-----";
- Floating point 9.9E+37 in measurement data, which represents the data is overrange or overflow, window displays " --oL-" or "--oF-".

2.6.2 UTE9806+ Register List

*Notes: R represents it can be read, that is support command 03H. W represents it can be wirtten, that is support command 10H.

Data Name	Data Format	Unit	Initial Address	Number of Register	Read/Write	Remarks
Product Information						
Product model	ASCII		0000H	3	R	UTE9806+
Software version	ASCII		0006H	3	R	F1.02
Hardware version	ASCII		000CH	3	R	H1.02
Serial number	ASCII		0010H	5	R	012345678
Spare			0020H	32	R	
Parameter Setting						
Spare	ULong		0040H	2	R/W	Spare
...			...	n		Spare

Update cycle	ULong		004CH	2	R/W	0 (0.1s), 1 (0.25s), 2 (0.5s), 3 (1s), 4 (2s), 5 (5s)
Average switch	ULong		004EH	2	R/W	0 (the average is turned off), 1 (the average is turned on)
Spare			0050H	2		Spare
Average times	ULong		0052H	2	R/W	0 (8 times), 1 (16 times), 2 (32 times), 3 (64 times)
Spare			0050H	2		Spare
Spare			...	n		Spare
Voltage Range	ULong		0068H	2	R/W	0 (Auto), 1 (60V), 2 (600V)
Current Range	ULong		006AH	2	R/W	0 (Auto), 1 (0.05A), 2 (0.1A), 3 (10A)
Spare			006CH	2		Spare
Lock key	ULong		006EH	2	R/W	0 (forbidden), 1 (enabled)
Data Hold	ULong		0070H	2	R/W	0 (forbidden), 1 (enabled)
Mute Key	ULong		0072H	2	R/W	0 (forbidden), 1 (enabled)
Spare			...	n		Spare
Alarm switch	ULong		007EH	2	R/W	0 (OFF), 1 (ON)
Voltage alarm control	ULong		0080H	2	R/W	0 (OFF), 1 (ON)
Upper limit of voltage alarm	Float	V	0082H	2	R/W	0.000~9999
Lower limit of voltage alarm	Float	V	0084H	2	R/W	0.000~9999
Current alarm control	ULong		0086H	2	R/W	0 (OFF), 1 (ON)
Upper limit of current alarm	Float	A	0088H	2	R/W	0.000~9999
Lower limit of current alarm	Float	A	008AH	2	R/W	0.000~9999
Alarm control of active power	ULong		008CH	2	R/W	0 (OFF), 1 (ON)
Upper limit of active power	Float	W	008EH	2	R/W	0.000~9999
Lower limit of active power	Float	W	0090H	2	R/W	0.000~9999
Alarm control of apparent power	ULong		0092H	2	R/W	0 (OFF), 1 (ON)
Upper limit of apparent power	Float	VA	0094H	2	R/W	0.000~9999
Lower limit of apparent	Float	VA	0096H	2	R/W	0.000~9999

power						
Spare			0098H	2	R/W	
Spare			009AH	2	R/W	
Spare			009CH	2	R/W	
Alarm control of power factor	ULong		009EH	2	R/W	0 (OFF), 1 (ON)
Upper limit of power factor	Float		00A0H	2	R/W	0.000~9999
Lower limit of power factor	Float		00A2H	2	R/W	0.000~9999
Spare			...	n		Spare
Alarm delay times	ULong		00C8H	2	R/W	0~9999
Zero point alarm	ULong		00CAH	2	R/W	0 (OFF), 1 (ON)
Spare			...	2		Spare
Alarm indicator	ULong		00CEH	2	R/W	0 (OFF), 1 (ON)
Sound length of alarm	ULong		00D0H	2	R/W	0~9999 (0 represents no sound)
Measurement Data						
Voltage value	Float	V	0100H	2	R	AC voltage
Current value	Float	A	0102H	2	R	AC current
Active power	Float	W	0104H	2	R	
Apparent power	Float	W	0106H	2	R	
Power factor	Float	W	0108H	2	R	
Voltage frequency	Float	Hz	010AH	2	R	
Current frequency	Float	Hz	010CH	2	R	
Positive peak of voltage	Float	Hz	010EH	2	R	
Negative peak of voltage	Float	Hz	0110H	2	R	
Positive peak of current	Float	Hz	0112H	2	R	
Negative peak of current	Float	Hz	0114H	2	R	
Alarm state	ULong		0116H	2	R	0-not detecting, 1-pass, 2-NG

2.6.3 UTE9811+ Register List

*Notes:

1. R represents it can be read, that is support command 03H. W represents it can be wirtten, that is support command 10H.

2. “Voltage range”, “Current range”, “User’s defined input signal frequency” can only be used when set the user’s grade to High. The specific step can refer to section 7.5 User’s grade in UTE9800+ User’s Manaul.

Data Name	Data Format	Unit	Initial Address	Number of Register	Read/Write	Remarks
Product Information						
Product	ASCII		0	50	R	"UNI-T,UTE9811+ ,012345678,F1.02"

information						
Retain			50	50	R	
Parameter Setting						
Measurement mode	U16		100	1	R/W	0: normal TRMS (RMS) 1: harmonic distortion (THD%) 2: measured value of harmonic (THD) 3: crest factor (CF) 4: TRMS harmonic (HARM-RMS)
Voltage range*	U16		101	1	R/W	0(Auto), 1（75V）, 2（150V）, 3（300V）, 4（600V）
Current range*	U16		102	1	R/W	0（Auto）, 1（0.2A）, 2（1A）, 3（4A）,4（20A）
Update cycle	U16		103	1	R/W	0（0.1s）, 1（0.25s）, 2（0.5s）, 3（1s）, 4（2s）, 5（5s）
Average	U16		104	1	R/W	0（the average is turned off）, 1（8 times）, 2（16 times）, 3（32 times ）, 4（64 times）
Data hold	U16		105	1	R/W	0（forbidden）, 1（enabled）
Display	U16		106	1	R/W	0（display PF value）, 1（display frequency value）
Mute	U16		107	1	R/W	0（forbidden）, 1（enabled）
Upper limit of current alarm	Float	A	108	2	R/W	0.000~40.000, When the upper limit and the lower limit is set to 0 at the same time, it represents the alarm is forbidden.
Lower limit of current alarm	Float	A	110	2	R/W	
Upper limit of power limit	Float	W	112	2	R/W	0.000~48000.0, When the upper limit and the lower limit is set to 0 at the same time, it represents the alarm is forbidden.
Lower limit of power limit	Float	W	114	2	R/W	
Alarm delay	Float	S	116	2	R/W	0.0~99.9
User's defined input signal frequency	Float	Hz	118	2	R/W	0.0 or 40.0~70.0；0.0 represents this function is disabled.
Measurement data type	U16		120	1	R/W	0: real-time measurement data 1: recently update TRMS data
Parament Configuration of Instrument						
Default setting	U16		140	1	W	0（forbidden）, 1（set the parameter to the default value）
Save parameter	U16		141	1	W	0（forbidden）, 1（save the parameter into system storage for next use）
Measurement Data						
Voltage value	Float	V	150	2	R	The numerical value is related to the measurement model.

Current value	Float	A	152	2	R	The numerical value is related to the measurement model.
Active power	Float	W	154	2	R	
Power factor	Float		156	2	R	
Frequency of voltage	Float	Hz	158	2	R	
Alarm state of current	U16		160	1	R	0(alarm forbidden), 1（wait for connect to the load）, 2（testing）, 3（the result is normal）, 4（the result is low）, 5（ the result is high）
Alarm state of power	U16		161	1	R	
Data update count	U16		162	1	R	The latest measurements are available when changes in this data are detected.
Measurement Data of Crest Factor						
Voltage CF	Float		190	2	R	The ratio of voltage crest value and RMS voltage.
Current CF	Float		192	2	R	The ratio of current crest value and RMS current.
Measurement Data of Harmonic						
Total voltage distortion factor	Float	%	200	2	R	Total voltage distortion factor
Measured value of total voltage distortion factor	Float	V	202	2	R	Measured value of total voltage distortion factor
Total current distortion factor	Float	%	204	2	R	Total current distortion factor
Measured value of total current distortion factor	Float	A	206	2	R	Measured value of total current distortion factor
Voltage distortion factor of 1~50 times	Float	%	208	100	R	Voltage distortion factor of 1~50 times
Measured voltage value of 1~50 times	Float	V	308	100	R	Measured voltage value of 1~50 times
Current distortion factor of 1~50 times	Float	%	408	100	R	Current distortion factor of 1~50 times
Measured current value of 1~50 times	Float	A	508	100	R	Measured current value of 1~50 times
Total RMS voltage	Float	V	608	2	R	Total RMS voltage

Total RMS current	Float	A	610	2	R	Total RMS current
Total RMS active power	Float	W	612	2	R	Total RMS active power

Expression of Special Data

- Floating point 9.91E+37 in measurement data, which represents invalid data, window displays "-----";
- Floating point 9.9E+37 in measurement data, which represents the data is overrange or overflow, window displays " --oL-" or "--oF-".

Appendix 1 CRC Calculation

```
const unsigned char aucCRCHi[] = {
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
    0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
    0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40
};

const unsigned char aucCRCLo[] = {
    0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06, 0x07, 0xC7,
    0x05, 0xC5, 0xC4, 0x04, 0xCC, 0x0C, 0x0D, 0xCD, 0x0F, 0xCF, 0xCE, 0x0E,
    0x0A, 0xCA, 0xCB, 0x0B, 0xC9, 0x09, 0x08, 0xC8, 0xD8, 0x18, 0x19, 0xD9,
    0x1B, 0xDB, 0xDA, 0x1A, 0x1E, 0xDE, 0xDF, 0x1F, 0xDD, 0x1D, 0x1C, 0xDC,
    0x14, 0xD4, 0xD5, 0x15, 0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12, 0x13, 0xD3,
```

```
    0x11, 0xD1, 0xD0, 0x10, 0xF0, 0x30, 0x31, 0xF1, 0x33, 0xF3, 0xF2, 0x32,
    0x36, 0xF6, 0xF7, 0x37, 0xF5, 0x35, 0x34, 0xF4, 0x3C, 0xFC, 0xFD, 0x3D,
    0xFF, 0x3F, 0x3E, 0xFE, 0xFA, 0x3A, 0x3B, 0xFB, 0x39, 0xF9, 0xF8, 0x38,
    0x28, 0xE8, 0xE9, 0x29, 0xEB, 0x2B, 0x2A, 0xEA, 0xEE, 0x2E, 0x2F, 0xEF,
    0x2D, 0xED, 0xEC, 0x2C, 0xE4, 0x24, 0x25, 0xE5, 0x27, 0xE7, 0xE6, 0x26,
    0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0, 0xA0, 0x60, 0x61, 0xA1,
    0x63, 0xA3, 0xA2, 0x62, 0x66, 0xA6, 0xA7, 0x67, 0xA5, 0x65, 0x64, 0xA4,
    0x6C, 0xAC, 0xAD, 0x6D, 0xAF, 0x6F, 0x6E, 0xAE, 0xAA, 0x6A, 0x6B, 0xAB,
    0x69, 0xA9, 0xA8, 0x68, 0x78, 0xB8, 0xB9, 0x79, 0xBB, 0x7B, 0x7A, 0xBA,
    0xBE, 0x7E, 0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C, 0xB4, 0x74, 0x75, 0xB5,
    0x77, 0xB7, 0xB6, 0x76, 0x72, 0xB2, 0xB3, 0x73, 0xB1, 0x71, 0x70, 0xB0,
    0x50, 0x90, 0x91, 0x51, 0x93, 0x53, 0x52, 0x92, 0x96, 0x56, 0x57, 0x97,
    0x55, 0x95, 0x94, 0x54, 0x9C, 0x5C, 0x5D, 0x9D, 0x5F, 0x9F, 0x9E, 0x5E,
    0x5A, 0x9A, 0x9B, 0x5B, 0x99, 0x59, 0x58, 0x98, 0x88, 0x48, 0x49, 0x89,
    0x4B, 0x8B, 0x8A, 0x4A, 0x4E, 0x8E, 0x8F, 0x4F, 0x8D, 0x4D, 0x4C, 0x8C,
    0x44, 0x84, 0x85, 0x45, 0x87, 0x47, 0x46, 0x86, 0x82, 0x42, 0x43, 0x83,
    0x41, 0x81, 0x80, 0x40
};

unsigned short usMBCRC16( unsigned char    * pucFrame, unsigned short usLen )
{
    unsigned char    ucCRCHi = 0xFF;
    unsigned char    ucCRCLo = 0xFF;
    int                  iIndex;

    while( usLen-- )
    {
        iIndex = ucCRCLo ^ *( pucFrame++ );
        ucCRCLo = ( unsigned char)( ucCRCHi ^ aucCRCHi[iIndex] );
        ucCRCHi = aucCRCLo[iIndex];
    }
    return ( unsigned short )( ucCRCHi << 8 | ucCRCLo );
}

unsigned char SendBuf[30];
void main(void)
{
    unsigned short CRC;
    unsigned short SendLen;
    SendLen = 0;

    SendBuf[SendLen++] = 0x01;
    SendBuf[SendLen++] = 0x03;
    SendBuf[SendLen++] = 0x00;
```

```
        SendBuf[SendLen++] = 0x96;
        SendBuf[SendLen++] = 0x00;
        SendBuf[SendLen++] = 0x02;
        CRC = usMBCRC16(SendBuf,SendLen); /*Start to caclulating CRC */
        SendBuf[SendLen++] = CRC&0xFF;        /* CRC LSB */
        SendBuf[SendLen++] = (CRC>>8)&0xFF;    /* CRC MSB */
}
```