

# UNI-T®

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## Datasheet

### UTE300 Series Digital Power Meter

## Key Specifications

- ◆ AC and DC voltage :  
UTE310 and UTE310G: 15V, 30V, 60, 150V, 300V, 600V  
UTE310H and UTE310HG: 15V, 30V, 60, 150V, 300V, 600V, 1000V
- ◆ AC and DC current :  
UTE310 and UTE310G: 5mA, 10 mA, 20 mA, 50 mA, 100 mA, 200 mA, 500 mA, 1A, 2A, 5A, 10A, 20A  
UTE310H and UTE310HG: 1A, 2A, 5A, 10A, 20A, 50A
- ◆ AC and DC power :  
UTE310 and UTE310G: 75mW ~ 1200W  
UTE310H and UTE310HG: 15W ~ 50000W
- ◆ Frequency Measurement: 0.1Hz ~ 300kHz
- ◆ Integration power: 0 ~ 10000 hours
- ◆ Four operations: A+B, A-B, AxB, A/B, A/B<sup>2</sup>, A<sup>2</sup>/B
- ◆ Harmonic Measurement: 1 ~ 50th
- ◆ Wave display: Voltage, current
- ◆ External sensor: Current
- ◆ DAC output: U, I, P, S, Q, LAMBda, PHI, FU, FI, UPK, IPK, WH, WHP, WHM, AH, AHP, AHM, MATH

## User-friendly and easy-to-use Design

Graphical user interface, simple and convenient operation; help system for access information easily; USB data storage; multi-data display at one screen; USB for file management; USB online upgrade for maintenance and update the system of product.

## Application

- ◆ Research & Education
- ◆ High speed measurement at manufacturing
- ◆ Laboratory and R&D measurements
- ◆ Lighting appliances
- ◆ Power tools
- ◆ Home appliances
- ◆ EV and electric heating appliances manufacturing and more.

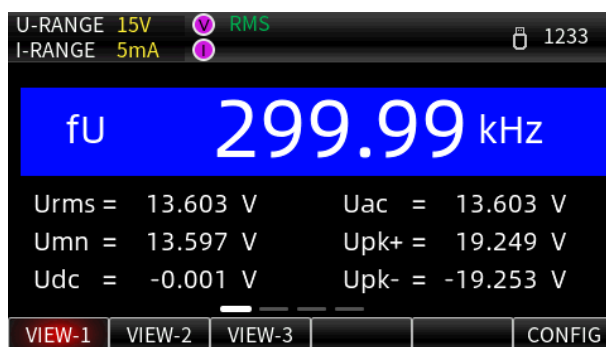
## Main Features

- ◆ 4.3" TFT-LCD display resolution 480\*272
- ◆ Measuring range of voltage and current RMS:  
UTE310 and UTE310G: 75mV ~ 600V / 25uA ~ 20A  
UTE310H and UTE310HG: 75mV ~ 1000V / 10mA ~ 50A
- ◆ Maximum resolution of voltage and current: 1mV/0.1uA
- ◆ Basic accuracy of voltage, current and power: 0.1%
- ◆ Maximum resolution of power: 0.001mW
- ◆ Measuring bandwidth: 0.1Hz~300 kHz

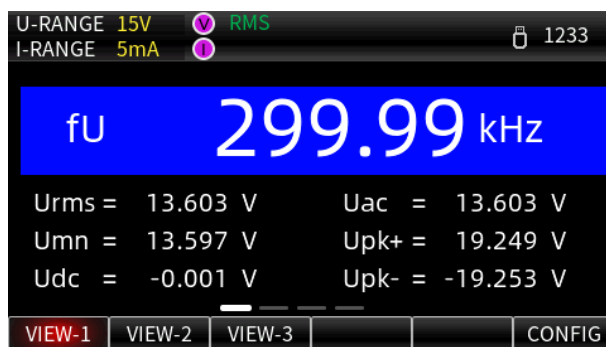
- ◆ Sampling rate: 1MHz
- ◆ Multiple interfaces: USB, RS-232, GP-IB, LAN
- ◆ Communication protocol: Modbus and SCPI
- ◆ Voltage and current waveform display, harmonic graphic display, D/A output for measurement recording, comparator function, current sensor input, USB data storage

## Features

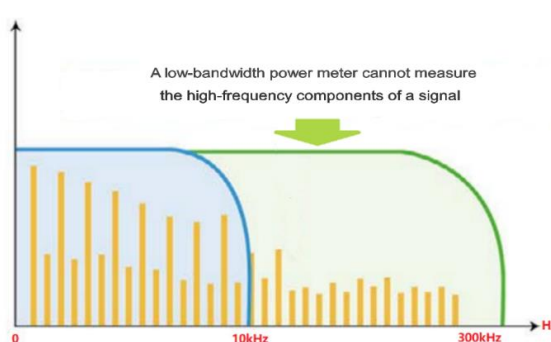
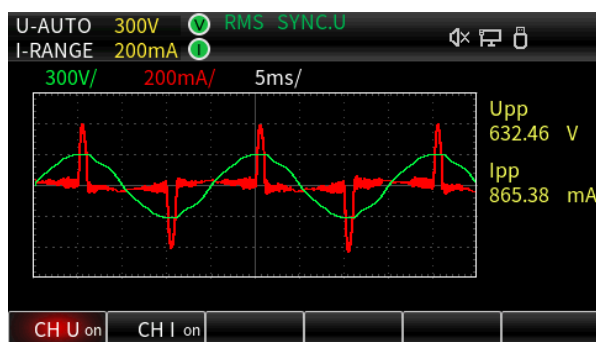
4.3" TFT, multi-parameter displays at one screen



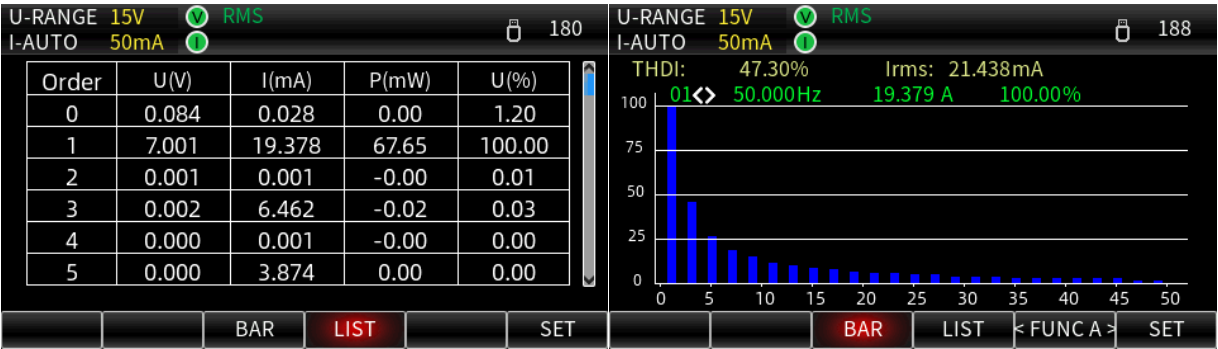
300 kHz analog bandwidth for capturing higher frequency signal



Sampling rate 1MHz for accurately measuring transient signal



50<sup>th</sup> harmonic supports IEC61000-4-7



Multi-channel communication port



UTE310/UTE310G



UTE310H/UTE310HG

## Technical Index

f: Frequency (When f appears in the error calculation formula, the unit is kHz) **Rate**: Data update interval

CF: Crest factor **rdg.**: Reading **FS.**: Reading **λ /PF**: Power Factor **∅**: Phase Difference

| Model                            | UTE310、UTE310G                                                                           |                      | UTE310H、UTE310HG                                               |                      |
|----------------------------------|------------------------------------------------------------------------------------------|----------------------|----------------------------------------------------------------|----------------------|
| Bandwidth                        | DC,0.1Hz ~ 300kHz                                                                        |                      | DC,0.1Hz ~ 300kHz                                              |                      |
| Sampling Rate                    | 1MHz                                                                                     |                      | 1MHz                                                           |                      |
| Voltage Range                    | CF=3                                                                                     | CF=6/6A              | CF=3                                                           | CF=6/6A              |
|                                  | 15V                                                                                      | 7.5V                 | 15V                                                            | 7.5V                 |
|                                  | 30V                                                                                      | 15V                  | 30V                                                            | 15V                  |
|                                  | 60V                                                                                      | 30V                  | 60V                                                            | 30V                  |
|                                  | 150V                                                                                     | 75V                  | 150V                                                           | 75V                  |
|                                  | 300V                                                                                     | 150V                 | 300V                                                           | 150V                 |
|                                  | 600V                                                                                     | 300V                 | 600V                                                           | 300V                 |
|                                  | /                                                                                        | /                    | 1000                                                           | 500                  |
| Voltage Resolution               | 0.001V/0.01V                                                                             | 0.0001V/0.001V/0.01V | 0.001V/0.01V/0.1V                                              | 0.0001V/0.001V/0.01V |
| Voltage Accuracy                 | DC,0.1Hz ~ 45Hz:±(0.1% rdg.+ 0.2% F.S.)                                                  |                      | DC,0.1Hz ~ 45Hz:±(0.1% rdg.+ 0.2% F.S.)                        |                      |
|                                  | 45Hz ~ 66Hz:±(0.1% rdg.+ 0.05% F.S.)                                                     |                      | 45Hz ~ 66Hz:±(0.1% rdg.+ 0.05% F.S.)                           |                      |
|                                  | 66Hz ~ 1kHz:±(0.1% rdg.+ 0.2% F.S.)                                                      |                      | 66Hz ~ 1kHz:±(0.1% rdg.+ 0.2% F.S.)                            |                      |
|                                  | 1kHz ~ 10kHz:±(0.07 * f)% rdg.+ 0.3% F.S.)                                               |                      | 1kHz ~ 10kHz:±(0.07 * f)% rdg.+ 0.3% F.S.)                     |                      |
|                                  | 10kHz ~ 100kHz:<br>±(0.5% rdg.+ 0.5% F.S.)±[0.04*(f-10)]% rdg.                           |                      | 10kHz ~ 100kHz:<br>±(0.5% rdg.+ 0.5% F.S.)±[0.04*(f-10)]% rdg. |                      |
|                                  | For 110% to 130% of the rated range, add 50% of the reading error to the above accuracy. |                      |                                                                |                      |
|                                  | Current Range                                                                            | CF=3                 | CF=6/6A                                                        |                      |
| 5mA                              |                                                                                          | 2.5mA                |                                                                |                      |
| 10mA                             |                                                                                          | 5mA                  |                                                                |                      |
| 20mA                             |                                                                                          | 10mA                 |                                                                |                      |
| 50mA                             |                                                                                          | 25mA                 |                                                                |                      |
| Current Range                    | 100mA                                                                                    | 50mA                 |                                                                |                      |
|                                  | 200mA                                                                                    | 100mA                |                                                                |                      |
|                                  | 500mA                                                                                    | 250mA                |                                                                |                      |
|                                  | 1A                                                                                       | 0.5A                 | 1A                                                             | 0.5A                 |
|                                  | 2A                                                                                       | 1A                   | 2A                                                             | 1A                   |
|                                  | 5A                                                                                       | 2.5A                 | 5A                                                             | 2.5A                 |
|                                  | 10A                                                                                      | 5A                   | 10A                                                            | 5A                   |
|                                  | 20A                                                                                      | 10A                  | 20A                                                            | 10A                  |
|                                  |                                                                                          |                      | 50A                                                            | 25A                  |
| Current Resolution               | 0.0001mA/0.001mA/0.01mA/0.1mA/1mA                                                        |                      | 0.1mA/1mA                                                      | 0.01mA/0.1mA/1mA     |
| Accuracy of Direct Current Input | DC: ±(0.1% rdg.+ 0.2% F.S.)                                                              |                      | DC: ±(0.2% rdg.+ 0.2% F.S.)                                    |                      |
|                                  | 0.1Hz ~ 45Hz:±(0.1% rdg.+ 0.2% F.S.)                                                     |                      | 0.1Hz ~ 45Hz:±(0.1% rdg.+ 0.2% F.S.)                           |                      |
|                                  | 45Hz ~ 66Hz:±(0.1% rdg.+ 0.05% F.S.)                                                     |                      | 45Hz ~ 66Hz:±(0.1% rdg.+ 0.05% F.S.)                           |                      |
|                                  | 66Hz ~ 1kHz:±(0.1% rdg.+ 0.2% F.S.)                                                      |                      | 66Hz ~ 1kHz:±(0.1% rdg.+ 0.2% F.S.)                            |                      |
|                                  | 1kHz ~ 10kHz:±(0.07 * f)% rdg.+ 0.3% F.S.)                                               |                      | 1kHz ~ 10kHz:±(0.13 * f)% rdg.+ 0.3% F.S.)                     |                      |
|                                  | 10kHz ~ 20kHz:<br>±(0.5% rdg.+ 0.5% F.S.)±[0.04*(f-10)]% rdg.                            |                      | 10kHz ~ 20kHz:<br>±(0.13 * f)% rdg.+ 0.5% F.S.)                |                      |
|                                  |                                                                                          |                      |                                                                |                      |

| Model                                                          | UTE310、UTE310G                                                                           |                                                 | UTE310H、UTE310HG                                               |                             |
|----------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------------|----------------------------------------------------------------|-----------------------------|
| Accuracy of Direct Current Input                               | 20kHz ~ 100kHz:<br>±(0.5% rdg.+ 0.5% F.S.)±{0.04*(f-10)}% rdg.                           |                                                 |                                                                |                             |
|                                                                | For 110% to 130% of the rated range, add 50% of the reading error to the above accuracy. |                                                 |                                                                |                             |
| Current Sensor Ext1 Channel Range                              | CF=3                                                                                     | CF=6/6A                                         | CF=3                                                           | CF=6/6A                     |
|                                                                | 2.5V                                                                                     | 1.25V                                           | 2.5V                                                           | 1.25V                       |
|                                                                | 5V                                                                                       | 2.5V                                            | 5V                                                             | 2.5V                        |
|                                                                | 10V                                                                                      | 5V                                              | 10V                                                            | 5V                          |
| Current Sensor Ext2 Channel Range                              | 50mV                                                                                     | 25mV                                            | 50mV                                                           | 25mV                        |
|                                                                | 100mV                                                                                    | 50mV                                            | 100mV                                                          | 50mV                        |
|                                                                | 200mV                                                                                    | 100mV                                           | 200mV                                                          | 100mV                       |
|                                                                | 500mV                                                                                    | 250mV                                           | 500mV                                                          | 250mV                       |
|                                                                | 1V                                                                                       | 0.5V                                            | 1V                                                             | 0.5V                        |
|                                                                | 2V                                                                                       | 1V                                              | 2V                                                             | 1V                          |
| Accuracy of External Sensor Current Input                      | DC,0.1Hz ~ 45Hz:±(0.1% rdg.+ 0.2% F.S.)                                                  |                                                 | DC,0.1Hz ~ 45Hz:±(0.1% rdg.+ 0.2% F.S.)                        |                             |
|                                                                | 45Hz ~ 66Hz:±(0.1% rdg.+ 0.05% F.S.)                                                     |                                                 | 45Hz ~ 66Hz:±(0.1% rdg.+ 0.05% F.S.)                           |                             |
|                                                                | 66Hz ~ 1kHz:±(0.1% rdg.+ 0.2% F.S.)                                                      |                                                 | 66Hz ~ 1kHz:±(0.1% rdg.+ 0.2% F.S.)                            |                             |
|                                                                | 1kHz ~ 10kHz:±(0.07 * f)% rdg.+ 0.3% F.S.)                                               |                                                 | 1kHz ~ 10kHz:±(0.07 * f)% rdg.+ 0.3% F.S.)                     |                             |
|                                                                | 10kHz ~ 100kHz:<br>±(0.5% rdg.+ 0.5% F.S.)±{0.04*(f-10)}% rdg.                           |                                                 | 10kHz ~ 100kHz:<br>±(0.5% rdg.+ 0.5% F.S.)±{0.04*(f-10)}% rdg. |                             |
|                                                                | Active Power Accuracy for Direct Current Input (PF=1)                                    | DC:±(0.1% rdg.+ 0.2% F.S.)                      |                                                                | DC: ±(0.3% rdg.+ 0.2% F.S.) |
| 0.1Hz ~ 45Hz:±(0.3% rdg.+ 0.2% F.S.)                           |                                                                                          | 0.1Hz ~ 45Hz:±(0.3% rdg.+ 0.2% F.S.)            |                                                                |                             |
| 45Hz ~ 66Hz:±(0.1% rdg.+ 0.05% F.S.)                           |                                                                                          | 45Hz ~ 66Hz:±(0.1% rdg.+ 0.05% F.S.)            |                                                                |                             |
| 66Hz ~ 1kHz:±(0.2% rdg.+ 0.2% F.S.)                            |                                                                                          | 66Hz ~ 1kHz:±(0.2% rdg.+ 0.2% F.S.)             |                                                                |                             |
| 1kHz ~ 10kHz:<br>±(0.1% rdg.+ 0.3% F.S.)±{0.067*(f-1)}% rdg.   |                                                                                          | 1kHz ~ 10kHz:<br>±(0.13 * f)% rdg.+ 0.3% F.S.)  |                                                                |                             |
| 10kHz ~ 20kHz:<br>±(0.5% rdg.+ 0.5% F.S.)±{0.09*(f-10)}% rdg.  |                                                                                          | 10kHz ~ 20kHz:<br>±(0.13 * f)% rdg.+ 0.2% F.S.) |                                                                |                             |
| 20kHz ~ 100kHz:<br>±(0.5% rdg.+ 0.5% F.S.)±{0.09*(f-10)}% rdg. |                                                                                          |                                                 |                                                                |                             |
|                                                                |                                                                                          |                                                 |                                                                |                             |
| Active Power Accuracy for External Sensor Current Input (PF=1) | DC:±(0.1% rdg.+ 0.2% F.S.)                                                               |                                                 | DC:±(0.1% rdg.+ 0.2% F.S.)                                     |                             |
|                                                                | 0.1Hz ~ 45Hz:±(0.3% rdg.+ 0.2% F.S.)                                                     |                                                 | 0.1Hz ~ 45Hz:±(0.3% rdg.+ 0.2% F.S.)                           |                             |
|                                                                | 45Hz ~ 66Hz:±(0.1% rdg.+ 0.05% F.S.)                                                     |                                                 | 45Hz ~ 66Hz:±(0.1% rdg.+ 0.05% F.S.)                           |                             |
|                                                                | 66Hz ~ 1kHz:±(0.2% rdg.+ 0.2% F.S.)                                                      |                                                 | 66Hz ~ 1kHz:±(0.2% rdg.+ 0.2% F.S.)                            |                             |
|                                                                | 1kHz ~ 10kHz:<br>±(0.1% rdg.+ 0.3% F.S.)±{0.067*(f-1)}% rdg.                             |                                                 | 1kHz ~ 10kHz:<br>±(0.1% rdg.+ 0.3% F.S.)±{0.067*(f-1)}% rdg.   |                             |
|                                                                | 10kHz ~ 100kHz:<br>±(0.5% rdg.+ 0.5% F.S.)±{0.09*(f-10)}% rdg.                           |                                                 | 10kHz ~ 100kHz:<br>±(0.5% rdg.+ 0.5% F.S.)±{0.09*(f-10)}% rdg. |                             |
|                                                                |                                                                                          |                                                 |                                                                |                             |
| Frequency Measurement Range                                    | Data update time                                                                         | Frequency range                                 | Data update time                                               | Frequency range             |
|                                                                | 0.1 S                                                                                    | 20Hz≤f≤300kHz                                   | 0.1 S                                                          | 20Hz≤f≤300kHz               |
|                                                                | 0.25 S                                                                                   | 10Hz≤f≤300kHz                                   | 0.25 S                                                         | 10Hz≤f≤300kHz               |
|                                                                | 0.5 S                                                                                    | 5.0Hz≤f≤300kHz                                  | 0.5 S                                                          | 5.0Hz≤f≤300kHz              |
|                                                                | 1 S                                                                                      | 2.0Hz≤f≤300kHz                                  | 1 S                                                            | 2.0Hz≤f≤300kHz              |
|                                                                | 2 S                                                                                      | 1.0Hz≤f≤300kHz                                  | 2 S                                                            | 1.0Hz≤f≤300kHz              |
|                                                                | 5 S                                                                                      | 0.5Hz≤f≤300kHz                                  | 5 S                                                            | 0.5Hz≤f≤300kHz              |

| Model                               | UTE310、UTE310G                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                          | UTE310H、UTE310HG |                                          |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|------------------|------------------------------------------|
| Frequency Measurement Range         | 10 S                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | $0.2\text{Hz} \leq f \leq 300\text{kHz}$ | 10 S             | $0.2\text{Hz} \leq f \leq 300\text{kHz}$ |
|                                     | 20 S                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | $0.1\text{Hz} \leq f \leq 300\text{kHz}$ | 20 S             | $0.1\text{Hz} \leq f \leq 300\text{kHz}$ |
|                                     | Auto                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | $0.1\text{Hz} \leq f \leq 300\text{kHz}$ | Auto             | $0.1\text{Hz} \leq f \leq 300\text{kHz}$ |
|                                     | Note: When using direct current input with UTE310H and UTE310HG, the maximum measurement range is 20kHz.                                                                                                                                                                                                                                                                                                                                                                |                                          |                  |                                          |
| Power Range                         | 75mW ~ 12000W                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          | 15W ~ 50KW       |                                          |
| Influence of Power Factor           | When $\lambda = 0$ :<br>$45\text{Hz} \leq f \leq 66\text{Hz}$ : $\pm 0.2\%$ of S<br>When f reaches up to 100kHz: $\pm[0.2 + 0.2 \times f]\%$ of this is a reference value. The unit of f is kHz<br>When $0 < \lambda < 1$ :<br>$(\text{Power Reading}) \times [(\text{Power Reading Error } \%) + (\text{Power Range Error } \%) \times (\frac{\text{Power Range}}{\text{Apparent Power Display Value}})] + [\tan \phi \times (\text{Influence When } \lambda = 0) \%]$ |                                          |                  |                                          |
| Accuracy of Apparent Power S        | Voltage Accuracy + Current Accuracy                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                          |                  |                                          |
| Accuracy of Reactive Power Q        | $\text{Apparent Power Accuracy} + (\sqrt{(1.0004 - \lambda^2)} - \sqrt{(1 - \lambda^2)}) \times 100\%$ of the Range                                                                                                                                                                                                                                                                                                                                                     |                                          |                  |                                          |
| Accuracy of Power Factor $\lambda$  | $\pm[(\lambda - \frac{\lambda}{1.0002}) +  \cos \phi - \cos[\phi + \sin^{-1}(\text{Influence of Power Factor when } \lambda = 0) \% / 100] ] \pm 1\text{digit}$<br>The voltage and current are at the rated range, and $\phi$ is the phase difference between the voltage and current                                                                                                                                                                                   |                                          |                  |                                          |
| Accuracy of Phase Difference $\phi$ | $\pm[ \phi - \cos^{-1}(\frac{\lambda}{1.0002})  + \sin^{-1}\{(\text{Influence on Power Factor } \% \text{ when } \lambda = 0) / 100\}]$                                                                                                                                                                                                                                                                                                                                 |                                          |                  |                                          |
| When the line filter is turned on   | f < 45Hz: Increase by 1% of the reading<br>45Hz ≤ f < 66Hz: Increase by 0.3% of the reading                                                                                                                                                                                                                                                                                                                                                                             |                                          |                  |                                          |
| Temperature Coefficient             | Within the range of 5°C to 18°C or 28°C to 40°C, add ±0.03%/°C of the reading.                                                                                                                                                                                                                                                                                                                                                                                          |                                          |                  |                                          |
| Waveform Display                    | Display Voltage and Current Waveforms                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                          |                  |                                          |
| Line Filtering                      | Standard Configuration                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                          |                  |                                          |
| Frequency Filtering                 | Standard Configuration                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                          |                  |                                          |
| Harmonic Measurement                | Capable of measuring up to the 50th harmonic.                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |                  |                                          |
| Integration Function                | Capable of performing average active power integration and current integration                                                                                                                                                                                                                                                                                                                                                                                          |                                          |                  |                                          |
| Mathematical Operations             | Standard Configuration                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                          |                  |                                          |
| D/A Output and Control              | Standard configuration includes 4-channel D/A conversion output                                                                                                                                                                                                                                                                                                                                                                                                         |                                          |                  |                                          |
| Communication Interface             | LAN, USB, RS-232 (optional GPIB, with GPIB the model is UTE310G or UTE310HG)                                                                                                                                                                                                                                                                                                                                                                                            |                                          |                  |                                          |

**Effect of temperature changing after the zero level compensation or range is changed**

DC Voltage: Add 0.02% of the range per °C to the DC voltage accuracy.

DC Current: Add the following values to the DC current accuracy:

UTE310 and UTE310G: (range of 5mA/10mA/20mA/50mA/100mA/200mA): 5  $\mu$ A/°C

UTE310 and UTE310G: (range of 0.5A/1A/2A/5A/10A/20A): 500  $\mu$ A/°C

EX1: 1 mV/°C

EX2: 50  $\mu$ V/°C

DC power: In DC power accuracy, consider the impact of voltage and current.

**The accuracy of wave display, Upk and Ipk**

Increase the following values to the above accuracy (the reference value):

Valid input range is  $\pm$  within the range of 300% (Crest factor=6 or 6A,  $\pm$  within the range of 600%).

Voltage input:  $1.5 \times \text{range} \sqrt{(15/\text{range})\%}$

Direct current input range:

UTE310 and UTE310G: (range of 5mA/10mA/20mA/50mA/100mA/200mA):  $3 \times \text{range} \sqrt{(0.005/\text{range})\%}$

UTE310 and UTE310G: (range of 0.5A/1A/2A/5A/10A/20A):  $3 \times \text{range} \sqrt{(0.5/\text{range})\%}$

UTE310H and UTE310HG: Direct current input:  $3 \times \text{range} \sqrt{(1/\text{range})\%}$

External current sensor input range:

EX1:  $3 \times \text{range} \sqrt{(2.5/\text{range})\%}$

EX2:  $3 \times \sqrt{(2.5/\text{range})\%}$

**Effect of self-heating due to voltage input**

AC Voltage Accuracy: Add  $0.0000001 \times U^2\%$  of the reading to the AC voltage accuracy..

DC Voltage Accuracy: Add  $0.0000001 \times U^2\%$  of the reading +  $0.0000001 \times U^2\%$  of the range to the DC voltage accuracy, where U is the voltage reading (V)

AC Power Accuracy: Add  $0.0000001 \times U^2\%$  of the reading to the AC power accuracy.

DC Power Accuracy: Add  $0.0000001 \times U^2\%$  of the reading +  $0.0000001 \times U^2\%$  of the range to the DC power accuracy.

U is the voltage reading (V). Even after the voltage input decreases, the effect of self-heating will continue until the temperature of the input resistor drops.

**Effect of self-heating due to current input****UTE310 and UTE310G:**

AC Current Accuracy: Add  $0.00013 \times I^2\%$  of the reading to the AC current accuracy.

DC Current Accuracy: Add  $0.00013 \times I^2\%$  of the reading +  $0.004 \times I^2\text{mA}$  to the DC current accuracy for the 0.5A/1A/2A/5A/10A/20A range.

DC Current Accuracy: Add  $0.00013 \times I^2\%$  of the reading +  $0.00004 \times I^2\text{mA}$  to the DC current accuracy for the 5mA/10mA/20mA/50mA/100mA/200mA range.

AC Power Accuracy: Add  $0.00013 \times I^2\%$  of the reading to the AC power accuracy.

DC Power Accuracy: Add  $0.00013 \times I^2\%$  of the reading +  $0.004 \times I^2\text{mA}$  to the DC power accuracy for the 0.5A/1A/2A/5A/10A/20A range.

DC Power Accuracy: Add  $0.00013 \times I^2\%$  of the reading +  $0.00004 \times I^2\text{mA}$  to the DC power accuracy for the 5mA/10mA/20mA/50mA/100mA/200mA range.

I is the current reading (A). Even after the current input decreases, the effect of self-heating will continue until the temperature of the shunt resistor drops.

#### UTE310H and UTE310HG:

AC Current Accuracy: Add  $0.00006 \times I^2\%$  of the reading to the AC current accuracy.

DC Current Accuracy: Add  $0.00006 \times I^2\%$  of the reading +  $0.001 \times I^2\text{mA}$  to the DC current accuracy.

AC Power Accuracy: Add  $0.00006 \times I^2\%$  of the reading to the AC power accuracy.

DC Power Accuracy: Add  $0.00006 \times I^2\%$  of the reading +  $0.001 \times I^2\text{mA}$  to the DC power accuracy.

I is the current reading (A). Even after the current input decreases, the effect of self-heating will continue until the temperature of the shunt resistor drops.

#### The accuracy changing due to the data update interval

When the data update rate is 0.1 seconds, add 0.05% of the reading to the accuracy in the 0.5Hz to 1kHz range.

The accuracy guarantee range for frequency, voltage, and current (direct input) is as follows:

In the 0.1Hz to 10Hz range, all accuracy values are for reference only.

For DC, 10-45Hz, and 400Hz-30kHz ranges, if the current exceeds 20A, the current accuracy is for reference only.

When the frequency exceeds 30kHz to 100kHz, the maximum current input is 6A (Applies only to UTE310 and UTE310G).

| Item            | Specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Crest factor    | 3 or 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Wire Method     | Single phase 2-wire system (1P2W)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Range Switching | Manual or Auto                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Automatic Range | <p>Range Increasing</p> <p>The range increases when any of the following conditions are met.</p> <ul style="list-style-type: none"> <li>● Crest factor=3<br/>Urms or Irms exceeds 130% of the current set range.<br/>The Upk and Ipk values of the input signal exceed 300% of the current set range.</li> <li>● Crest factor=6<br/>Urms or Irms exceeds 130% of the current set range.<br/>The Upk and Ipk values of the input signal exceed 600% of the current set range.</li> <li>● Crest factor=6A<br/>Urms or Irms exceeds 260% of the current set range.<br/>The Upk and Ipk values of the input signal exceed 600% of the current set range.</li> </ul> |

| Item                               | Specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Automatic Range                    | <p>Range Decreasing</p> <p>The range decreases when any of the following conditions are met.</p> <ul style="list-style-type: none"> <li>● Crest factor=3<br/>Urms or Irms is less than or equal to 30% of the measuring range<br/>Urms or Irms is less than or equal to 125% of the lower range.<br/>The Upk and Ipk values of the input signal are less than 300% of the current set range.</li> <li>● Crest factor=6<br/>Urms or Irms is less than or equal to 30% of the measuring range<br/>Urms or Irms is less than or equal to 125% of the lower range.<br/>The Upk and Ipk values of the input signal are less than 600% of the current set range.</li> </ul> |
| Display Mode Switching             | RMS (TRMS of voltage and current), VOLTAGE MEAN (rectified average value calibrated to RMS voltage), DC (simple average of voltage and current)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Measurement synchronization Source | The entire interval of the signal's voltage, current, or data update interval can be selected as the synchronization source for the measurement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| line Filter                        | OFF or ON (cut-off frequency 500Hz)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Peak Measurement                   | <p>The instantaneous voltage, instantaneous current, or instantaneous power obtained from the sampling</p> <p>Measure the peak (maximum, minimum) value of voltage, current, or power.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Zero Level Compensation            | Remove the offset from internal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

| Item                                                               | Specification                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lead and lag phase detection (Phase angle Phi: +(lead) and -(lag)) | <p>The overrun and hysteresis of the input voltage and current can be detected correctly under the following condition.</p> <ul style="list-style-type: none"> <li>● Sine waveform</li> <li>● When the measured value is greater than or equal to 50% of the measuring range (greater than or equal to 100% at peak factor=6)</li> <li>● Frequency: 20Hz ~ 2kHz</li> <li>● Phase difference: <math>\pm(5^{\circ} \sim 175^{\circ})</math></li> </ul> |
| Ratio                                                              | <p>When inputting the output of external sensor VT and CT to the instrument, the sensor conversion ratios: VT ratio, CT ratio and power coefficient should be set.</p> <ul style="list-style-type: none"> <li>● Valid digits: Automatically set according to the effective number of digits for voltage and current ranges.</li> <li>● Setting range: 0.001 ~ 9999</li> </ul>                                                                        |
| Average                                                            | <p>Choose from the following two methods:</p> <ul style="list-style-type: none"> <li>● Exponential Mean,</li> <li>● Moving Average</li> </ul> <p>Choose the decay constant for exponential averaging or the moving average constant from 8, 16, 32, and 64</p>                                                                                                                                                                                       |
| Crest factor                                                       | Calculate the peak factor (peak /RMS value) of the voltage and current.                                                                                                                                                                                                                                                                                                                                                                              |
| Four Operations                                                    | There are a total of 6 types of operations (A+B, A-B, A×B, A/B, A <sup>2</sup> /B, A/B <sup>2</sup> )                                                                                                                                                                                                                                                                                                                                                |

| Item                                | Specification                                                      |
|-------------------------------------|--------------------------------------------------------------------|
| Average Active Power at Integration | Calculating the average active power during the integration period |

## integral

| Item                                     | Specification                                                                                                                                                                                                                                                                                                         |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mode                                     | Manual integration, Normal integration, Repeat integration                                                                                                                                                                                                                                                            |
| Timer                                    | Automatic stopping the integration by setting the timer<br>Setting range: 0 hour 00 minute 00 second ~ 10000 hours 00 minutes 00 seconds (for 0 min 00 sec 00 sec, it is automatically set to manual integration mode)                                                                                                |
| Timer Overflow                           | WP: 999999MWh/-99999MWh<br>q: 999999MAh/-99999MAh<br>When the integration time reaches the maximum integration time of 10000 hours, or when the integration value reaches the maximum displayable integration value (999999 or -99999), the integration time and value are maintained and the integration is stopped. |
| Accuracy                                 | $\pm(\text{Power accuracy (or current accuracy)} + 0.1\% \text{ of reading})$ (fixed range)<br>Note: In the automatic range, no measurement is performed when the range is changed. The first measured value after the range change and the period of non-measurement will be added.                                  |
| Range Setting                            | Automatic range, fixed range<br>The range switching see the measurement section of voltage, current and active power for details                                                                                                                                                                                      |
| Effective Frequency Range of Integration | Active power: DC ~ 45kHz<br>Current: when the measurement mode is RMS, DC, the lower frequency ~ 45kHz determined by data update interval.<br>When the measurement mode is VOLTAGE MEAN, DC, the lower frequency ~ 45kHz determined by data update interval.                                                          |
| Timer Accuracy                           | $\pm 0.02\%$                                                                                                                                                                                                                                                                                                          |
| Remote Control                           | Use external sensor signal to start, stop or rest the integration                                                                                                                                                                                                                                                     |

## Harmonic measurement

| Item            | Specification                                                                                                                                                                                                                                                                                                                    |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mode            | PLL synchronization                                                                                                                                                                                                                                                                                                              |
| Frequency Range | Fundamental frequency of PLL source is within the range of 10Hz~1.2kHz.                                                                                                                                                                                                                                                          |
| PLL Source      | Select the voltage or current of each input unit<br>Input level<br>When the Crest factor=3, larger than or equal to 50% of the rated range<br>When the Crest factor=6, larger than or equal to 100% of the rated range<br>When the fundamental frequency is less than or equal to 200Hz, the frequency filter must be turned on. |
| FFT Data Length | 1024/512                                                                                                                                                                                                                                                                                                                         |
| Window          | Rectangle                                                                                                                                                                                                                                                                                                                        |

**Harmonic Measurement Mode: use the fixed count 1024 to perform FFT calculation**

| Fundamental Frequency                                                                                                       | Sampling Rate   |
|-----------------------------------------------------------------------------------------------------------------------------|-----------------|
| $10\text{Hz} \leq \text{fundamental frequency} < 75\text{Hz}$                                                               | $f \times 1024$ |
| $75\text{Hz} \leq \text{fundamental frequency} < 150\text{Hz}$                                                              | $f \times 512$  |
| $150\text{Hz} \leq \text{fundamental frequency} < 300\text{Hz}$                                                             | $f \times 256$  |
| $300\text{Hz} \leq \text{fundamental frequency} < 600\text{Hz}$                                                             | $f \times 128$  |
| $600\text{Hz} \leq \text{fundamental frequency} \leq 1200\text{Hz}$                                                         | $f \times 64$   |
| f in the formula is the basic frequency of the input signal.<br>* The upper limit of the number of analyses can be reduced. |                 |

IEC harmonic measurement mode (measured according to IEC61000-4-7:2002 standard) : 200ms time window is used for FFT calculation, and the maximum number of THD calculation is 40

| Signal System | Sampling Rate  |
|---------------|----------------|
| 50 Hz         | $f \times 512$ |
| 60 Hz         | $f \times 512$ |

The power accuracy when the line filter is turned off. indicator  $\pm(\% \text{ reading} + \% \text{ range})$

| Item                                     | Specification     |
|------------------------------------------|-------------------|
| Frequency                                | Voltage           |
| $10\text{ Hz} \leq f < 45\text{ Hz}$     | $0.15\% + 0.35\%$ |
| $45\text{ Hz} \leq f \leq 440\text{ Hz}$ | $0.15\% + 0.35\%$ |
| $440\text{ Hz} < f \leq 1\text{ kHz}$    | $0.20\% + 0.35\%$ |
| $1\text{ kHz} < f \leq 2.5\text{ kHz}$   | $0.80\% + 0.45\%$ |
| $2.5\text{ kHz} < f \leq 5\text{ kHz}$   | $3.05\% + 0.45\%$ |

- \* When the crest factor=3
- \* When  $\lambda(\text{crest factor})=1$
- \* The power over 1.2 kHz is the reference value.
- \* For direct current range, increase 10  $\mu\text{A}$  to the current accuracy, increase  $(10\text{ } \mu\text{A} / \text{direct current range}) \times 100\%$  of range to the power accuracy
- \* For external current sensor, increase 100  $\mu\text{A}$  to the current accuracy, increase  $(10\text{ } \mu\text{A} / 100\text{ } \mu\text{V} / \text{the rated range of external current sensor}) 100\%$  of range to the power accuracy
- \* For harmonic input, increase the  $n^{\text{th}}$  harmonic reading of  $(\{n/(m+1)\}/50)\%$  on the  $(n+m)$  and  $(n-m)$  harmonics of voltage and current, and  $(\{n/(m+1)\}/25)\%$  on the  $(n+m)$  and  $(n-m)$  harmonics of power;
- \* Increases its reading of  $(n/500)$  on the  $n^{\text{th}}$  harmonic of voltage and current, and increase its reading of  $(n/250)\%$  on power.
- \*The accuracy at the crest factor=6, the accuracy is same as the crest factor =3 with double range.
- \* The accuracy guarantee ranges for frequency, voltage and current are the same as those for common measurements.

If the amplitude of the high-frequency component is large, it may appear to have an effect of about 1% on a particular harmonic, which depends on the size of its frequency component; therefore, if the frequency component is small relative to the rated range, it will not cause a problem.

## External current sensor input

| Crest factor | Measuring Range                                         |
|--------------|---------------------------------------------------------|
| 3            | EX1:2.5V/5V/10V<br>EX2:50mV/100mV/200mV/500mV/1V/2V/    |
| 6            | EX1:1.25V/2.5V/5V<br>EX2:25mV/50mV/100mV/250mV/0.5V/1V/ |

## D/A output

| Item                      | Specification                                                                                                                                      |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Output Voltage            | $\pm 5V$ full scale (maximum approximate $\pm 7.5V$ ), relative to each rated value                                                                |
| Output Parameter          | Setting channel: U、I、P、S、Q、LAMBda、PHI、FU、FI、UPK、IPK、WH、WHP、WHM、AH、AHP、AHM、MATH                                                                     |
| Accuracy                  | $\pm$ (each parameter accuracy + 0.2% of full scale (FS)) (FS=5V)                                                                                  |
| D/A Conversion Resolution | 16 bits                                                                                                                                            |
| Minimum Load              | 100k                                                                                                                                               |
| Update Interval           | Same as data update interval<br>*When the data update interval is set to AUTO, it is almost the same as the signal interval. But at 100ms or more. |
| Temperature Coefficient   | $\pm$ full scale of 0.05%/°C                                                                                                                       |

## Waveform display

| Item                     | Specification                                                                                                        |
|--------------------------|----------------------------------------------------------------------------------------------------------------------|
| Number of Display Grid   | 300                                                                                                                  |
| Display Format           | p-p packed data                                                                                                      |
| Sampling Rate            | About 1MS/s                                                                                                          |
| Time Axis                | 500us/div, 1ms/div, 2ms/div, 5ms/div, 10ms/div, 20ms/div, 50ms/div, 100ms/div, 200ms/div, 500ms/div, 1s/div, 2s/div. |
| Vertical Axis            | Voltage waveform display: (voltage range /3)/div<br>Current waveform display: (current range /3)/div                 |
| Turn on/off Wave Display | Turn on/off the waveform display of each voltage or current                                                          |

## USB Interface

| Item                                       | Specification                                                                                                                                                     |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Port Number                                | 1                                                                                                                                                                 |
| Port Type                                  | B type interface (socket)                                                                                                                                         |
| Specification of Electrical and Mechanical | USB Rev. 2.0                                                                                                                                                      |
| Transmission Mode                          | HS (high speed; 480Mbps) and FS (full speed; 12Mbps)                                                                                                              |
| Protocol                                   | User-defined protocol                                                                                                                                             |
| PC Requirements                            | Equipped with USB port, running English or Chinese version of Windows7 (32-bit/64-bit)<br>Windows Vista (32-bit) or<br>Windows XP (32-bit, SP2 or update version) |

## Serial Interface (RS-232)

| Item                        | Specification                                                       |
|-----------------------------|---------------------------------------------------------------------|
| Port Type                   | D-Sub 9-pin (plug)                                                  |
| Specification of Electrical | EIA-574(EIA-232(RS-232)9                                            |
| Baud Rate                   | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 11520 (default 115200) |

## Ethernet Interface

| Item                                       | Specification                   |
|--------------------------------------------|---------------------------------|
| Port Number                                | 1                               |
| Port Type                                  | RJ-45                           |
| Specification of Electrical and Mechanical | IEEE802.3                       |
| Transmission System                        | Ethernet (100BASE-TX, 10BASE-T) |
| Transmission Rate                          | Maximum 100Mbps                 |
| Communication Rate                         | TCP/IP                          |
| Support Services                           | DHCP, remote control            |

## General characteristics

|                                    |                                                                                                                                                                                                          |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rated power voltage                | 110VAC/220VAC                                                                                                                                                                                            |
| Preheat Time                       | ≥ 30 minutes                                                                                                                                                                                             |
| Operating Environment              | Full accuracy 5°C ~40°C, 20% R.H.~80%R.H., non-condensation                                                                                                                                              |
| Storage Temperature                | -25°C ~60°C, 20% R.H.~80%R.H., non-condensation                                                                                                                                                          |
| Altitude                           | 2000 meters                                                                                                                                                                                              |
| Calibration Period                 | 12 months                                                                                                                                                                                                |
| Rated Power Frequency              | 50/60Hz                                                                                                                                                                                                  |
| Allowable Range of Power Frequency | 48Hz ~ 63Hz                                                                                                                                                                                              |
| Maximum Power Consumption          | 50VA                                                                                                                                                                                                     |
| Weight                             | 4.3kg (gross weight), 2.6kg (net weight)                                                                                                                                                                 |
| Safety Standard                    | Applicable standard: IEC 61010-1-2012, EN 61010-2-030<br>EMC: EN 61326-1 Class A, EN 61000-3-2, EN 61000-3-3 The communication output line and a shield line<br>Safety degree: II<br>Pollution degree: 2 |

## Packing List

- ◆ Power cable 1 piece
- ◆ Safety test lead 1 pair (1 red and 1 black)
- ◆ Y type terminal 4 pieces
- ◆ Alligator clip 2 pieces
- ◆ Protective cover (with "Warning" engraved insert) 1 piece
- ◆ Product Calibration Certificate 1 piece
- ◆ Warranty card and certificate of conformity 1 piece
- ◆ Download guide of User's manual 1 piece