Open Energy for All

Three-phase Smart Meter

USER MANUAL

DTSU666 (CT-3 × 100 A)

CONTENTS

1 Safety Instruction

1.1 Safety Symbols

The following types of safety precautions and general information symbols used in this manual must be followed during the installation, operation, and maintenance.

Symbol	Usage
	Indicates a hazard with a high level of risk that, if not avoided, will result in death or serious injury.
	Indicates a hazard with a medium level of risk that, if not avoided, can result in death or serious injury.
	Indicates a hazard with a low level of risk that, if not avoided, can result in minor or moderate injury.
	Indicates a situation that, if not avoided, can result in property damage. NOTICE is used to address practices not related to personal injury.
	Caution! Failure to observe any warnings contained in this manual may result in injury.
	Danger to life due to high voltages! Only qualified personnel can open and maintain the inverter.
	Burn danger due to hot surface that may exceed 60℃.
	Refer to the operating instructions.
	Products shall not be disposed of as household waste.

1.2 Personnel Requirements

This document is only applicable to qualified personnel who have received professional training and possess the following skills:

- Knowledge of and compliance with this document and all safety instructions.
- Familiar with all safety specifications of the electrical system.
- Understanding of the composition and working principles of the grid-tied PV power system and local regulations.
- Proficiency in energy meter installation, operation, and maintenance.

Note:

- The qualified personnel must wear personal protective equipment (PPE) during all operations.
- The qualified personnel should comply with local laws and regulations during installation and operation. The safety instructions in this document are only supplements to laws and regulations.

1.3 Product-related Requirements

- When transporting and unpacking the products, please confirm they are not severely impacted.
- The package of the meter should use materials that can meet environmental requirements.
- The instrument and accessories shall be stored in dry and ventilated places, to avoid humidity and corrosive gas erosion. The storage environment temperature is -40℃ to 70℃, and the relative humidity should be no more than 75%.
- Transport and store the product based on transportation, basic environmental conditions, and testing methods for instruments and meters of JB/T9329-1999.

1.4 Disclaimer

Hoymiles shall not be liable for the following situations:

- Any damage caused by incorrect installation and operation.
- Any damage caused by improper transportation and storage.
- Any damage caused by unauthorized modifications to the product.
- Any installation, operation, and maintenance performed by unqualified personnel.
- Failure to comply with all safety and operation instructions described in this document.

1.5 Maintenance and Replacement

- Disconnect the power supply before any maintenance and repair operation.
- All maintenance and replacement operations must be performed by qualified personnel.
- It is recommended to carry out regular inspection and maintenance for safety reasons.
- If users find any quality problem within 18 months from the date of dispatch, Hoymiles is responsible for repairing or replacing it for free, on the condition that users operate the product according to the manual’s provision, and the seal is intact.

2 Product Introduction

2.1 Product Overview

Type DTSU666 three-phase smart meter (Din-rail) (hereinafter referred to as the “instrument”) adopts a large-scale integrated circuit and applies digital sampling technology. It is designed based on power monitoring and energy metering demands for electric power system, communication industry, construction industry, etc, as a new generation of intelligent instruments combining measurement and communication functions, mainly applied to the measurement and display for the electric parameters in the electric circuit including three voltage, three current, active power, reactive power, frequency, positive and negative energy, four quadrant energy, etc. Adopting the standard DIN35 mm din rail mounting and modular design, it is characterized by small volume, easy installation, and networking, widely applied to the internal energy monitoring and assessment for industrial and mining enterprises, hotels, schools, and large public buildings.

This type of energy meter conforms to the following standards:

- IEC 61010-1:2010《Safety requirements for electrical requirement for measurement, control, and laboratory use Part1: General requirements》;
- IEC 61326-1:2013《Electrical requirement for measurement, control, and laboratory use-EMC requirements Part1: General requirements》;
- MODUS-RTU protocol.

2.2 Product Naming Rule

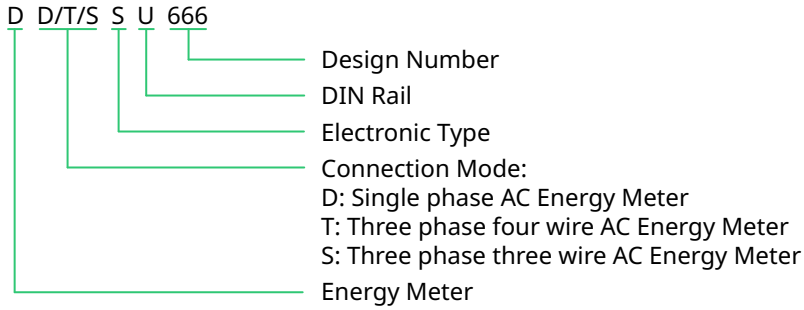


Figure 2-1 Product Naming Rule

Table 2-1 Model Specification

Model	Accuracy Grade	Referenced Voltage	Current Specification	Constant	Type
DTSU666 (CT-3 × 100 A)	Active Power 1	3 × 230 V/400 V	100 A/40 mA	400 imp/kWh	Transformer Access

2.3 Working Principle

2.3.1 Working Principle Diagram

The instrument is composed of a highly accurate metering integrated circuit (ASIC), management MCU, memory chip, RS485 communication module, etc.

The working principle block diagram of the instrument is shown in Figure 2-2:

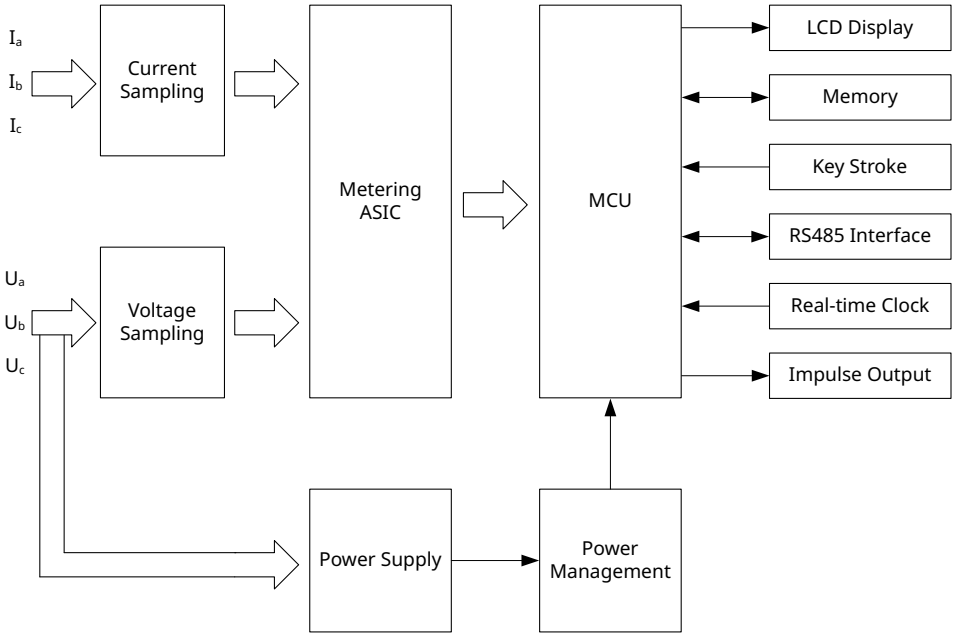


Figure 2-2 Working Principle Diagram

2.3.2 Metering Part Principle

The special metering integrated circuit (ASIC) integrated six loads in two orders ∑-△ a type of A/D conversion, please take the digital signal processing measured by the voltage circuit as well as all the power, energy, effective values, power factor, and frequency. This metering chip can measure the active power, reactive power, apparent power, active energy, reactive power, and apparent energy of each phase and combined phase, and at the same time, measure current, voltage effective values, power factor, phase angle, frequency, and other parameters, entirely satisfying the needs of the power meter. The chip provides an SPI interface, convenient for metering parameters as well as parameter calibration between the management MCU.

2.3.3 Data Processing Part Principle

Management MCU will timely read the electrical parameters such as current, voltage, power, etc. in the metering chips, judging the current quadrant based on the read data, and judging the current operated rate based on time and time rate, then adding the energy read from the metering chip to the corresponding quadrant energy and total energy based on the rate and quadrant, at the same time, calculating the corresponding combined energy based on the energy combination mode, and then store and backup the energy.

2.4 Main Function

2.4.1 Display function

From the displayed interface, the electrical parameter and energy data are all primary side data (that is, the multiplied by current and voltage ratios). The energy measuring value will be displayed in seven bits, with the display range from 0.00 kWh to 999999.9 kWh.

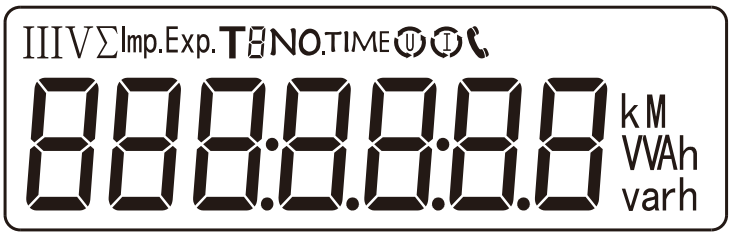


Figure 2-3 Liquid Crystal Display

Table 2-2 Display Interface

No.	Display Interface	Description
1		Combined active energy=10000.00 kWh
2		Positive active energy=10000.00 kWh
3		Reserve active energy=2345.67 kWh
4		Protocol: Modbus-RTU; address =001 Baud rate=9600 bps None parity, 1 stop bits
5		
6		Phase A voltage=220.0 V
7		Phase B voltage=220.1 V
8		Phase C voltage=220.2 V

9		Phase A current=5.000 A
10		Phase B current=5.001 A
11		Phase C current=5.002 A
12		Combined phase active power=3.291 kW
13		Phase A active power=1.090 kW
14		Phase B active power=1.101 kW
15		Phase C active power=1.100 kW
16		Combined phase power factor PFt=0.500
17		Phase A power factor PFa=1.000
18		Phase B power factor PFb=0.500
19		Phase C power factorPFc=0.500

Note:

Combined active energy=Positive active energy + Reserve active energy

The communication address of Modbus protocol is 1 terminal data (1-247), and the factory default baud rate is 9600 bps, N.8.1; E1 means even check 1 stop bit, O1 means odd check 1 stop bit, and N1 means one stop bit without check.

The above interface is used to show the meaning of the display content. Due to the different functions of the instrument, the display symbols will increase or decrease.

2.4.2 Programming Function

2.4.2.1 Programming Parameter

Table 2-3 Programming Parameter

Parameter	Value Range	Description
CT	1-9999	Current ratio, used for setting the input loop current ratio: When the current is connected to the line via the transformer, Ct=the rated current of the primary loop / the rated current of the secondary circuit; When the current is directly connected to the line, Ct shall be set as 1.
PT	0.1-999.9	Voltage ratio, used for setting the voltage ratio of the input loop; When the voltage is connected to the line via the transformer, Pt= the rated voltage of the primary loop / the rated voltage of the secondary circuit; When the voltage is directly connected to the line, Pt shall be set as 1.0.
Prot	1-5	Settings for communication stop bit and parity bits: 1: 645 mode; 2: None parity, 2 stop bits, n.2; 3. None parity, 1 stop bit, n.1; 4: Even parity, 1 stop bit, E.1; 5: Odd parity, 1 stop bit, O.1
bAud	0: 1200 1: 2400 2: 4800 3: 9600 4: 19200	Communication baud rate: 0: 1200 bps; 1: 2400 bps; 2: 4800 bps; 3: 9600 bps; 4: 19200 bps (customization)
Addr	1-247	Communication address
nET	0: n.34 1: n.33	Option for wiring mode: 0: n.34 represents three-phase four wire; 1: n.33 represents three-phase three wire.
PLuS	0: P 1: Q 2: S	Pulse output: 0: active energy pulse; 1: reactive energy pulse; 2: others
dISP	0-30	Display in turns (second) 0: Timely display; 1-30: Time interval of actual display
bLCd	0-30	Backlight lighting time control (minutes) 0: Normally light; 1-30: Backlight lighting time without button operation

2.4.2.2 Programming Operation

Button description: The “SET” button represents “confirmation” or “cursor shift” (when input digits); the “ESC” button represents “exit”; the “→” (“ ➡ ”) button represents “add”. The input code is (default 701).

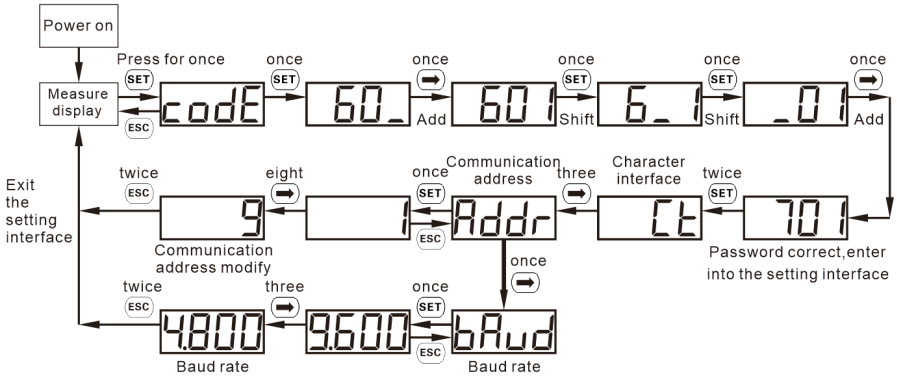


Figure 2-4 Setting examples for communication address and baud rate

When input digits, "SET" can be used as a cursor shift button; "➡" is "add" button, "ESC" means exiting the programming operation interface or switching to the character interface from the digit modification interface; adding from the beginning after setting the digit to the maximum value.

Note:

The communication address can also be set through the S-Miles App. Open the S-Miles App, tap "Toolkit → Meter Location", and enter the serial number of the smart meter, the communication address will be automatically set to 002. If two meters are required for an AC-coupled system, the address of the grid side meter should be set to 002, and the address of the PV side meter should be set to 001.

2.4.3 Communication Function

It has an RS485 communication interface, and the baud rate can be changed between 1200 bps, 2400 bps, 4800 bps, and 9600 bps.

The factory default communication parameter is Modbus-RTU protocol; the baud rate is 9600 bps, with the calibration bit and stop bit to be n.1, and the instrument address is 1.

2.4.4 Energy Measurement Function

The horizontal axis of the measurement plane represents the current vector I (fixed on the horizontal axis), and the instantaneous voltage vector is used to represent the current power transmission. Compared with the current vector I, it has phase angleφ. The counter-clockwise direction φangle is positive.

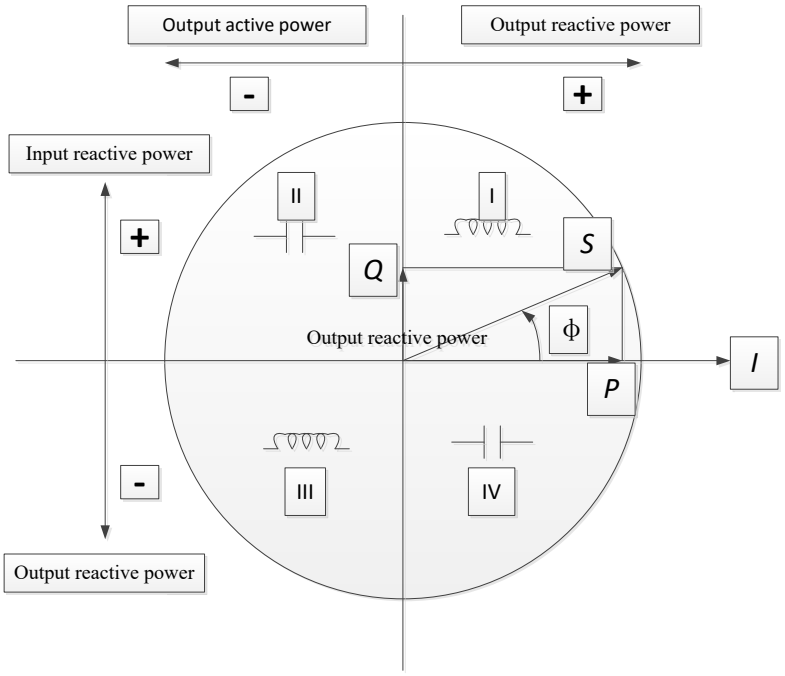


Figure 2-5 Measurement schematic diagram for energy four quadrants

Note:

1. The measurement method for the combined active energy depends on the contents of character words of the active combined mode.

Table 2-4 Character words of active combined mode

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	Reserved	Reserved	Reserved	Reverse active (0 no less, 1 less)	Reverse active (0 not added, 1 added)	Positive active (0 no less, 1 less)	Positive active (0 not added, 1 added)

Example:

when the content of the active combination mode is 05,

combined active energy=positive active energy +reverse active energy

factory default value: combined active energy=positive energy

2. The combined reactive energy of four quadrants can be respectively measured and the reactive energy can be set as the sum of arbitrarily four-quadrant energy, with its measurement mode depending on the contents of character words 1 and 2 of the reactive combination mode.

Table 2-5 Character words of the combined reactive combination mode

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
IV quadrant (0 no less, 1 less)	IV quadrant (0 not added, 1 added)	III quadrant (0 no less, 1 less)	III quadrant (0 not added, 1 added)	II quadrant (0 no less, 1 less)	II quadrant (0 not added, 1 added)	I quadrant (0 no less, 1 less)	I quadrant (0 not added, 1 added)

0 bit: I quadrant reactive; 0-Not counted into combined reactive; 1-Counted into combined reactive;
First bit: I quadrant reactive; 0-Not counted into combined reactive; 1-Minus the quadrant reactive;
Second bit: II quadrant reactive; 0-Not counted into combined reactive; 1-Counted into combined reactive
Third bit: II quadrant reactive; 0-Not counted into combined reactive; 1-Minus the quadrant reactive;
Fourth bit: III quadrant reactive; 0-Not counted into combined reactive; 1-Counted into combined reactive
Fifth bit: III quadrant reactive; 0-Not counted into combined reactive; 1-Minus the quadrant reactive;
Sixth bit: IV quadrant reactive; 0-Not counted into combined reactive; 1-Counted into combined reactive
Seventh bit: IV quadrant reactive; 0-Not counted into combined reactive; 1-Minus the quadrant reactive;
For example: when the content of the reactive combination mode is A5;
Combined reactive energy = I quadrant reactive + II quadrant reactive - III quadrant reactive - IV quadrant reactive
Factory default value: combined reactive 1 energy=I + IV, combined reactive 2 energy=II + III.

2.5 Product Dimensions

Table 2-6 Product Structure

Model	Modulus	Outline Size (W × H × D)	Installation Size (Din-rail)
DTSU666 (CT-3 × 100 A)	4	72 × 100 × 65 mm	DIN35 standard din-rail

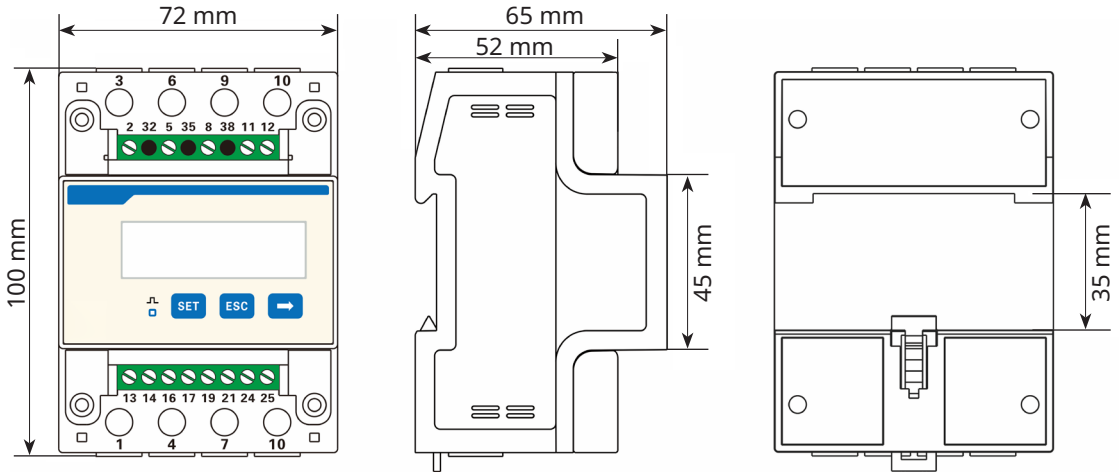


Figure 2-6 Product Dimensions

Note:

- The undeclared tolerance is ±1 mm.
- The above information only indicates the product size, and the shape of different specifications is slightly different.

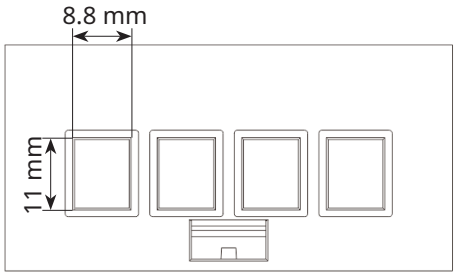


Figure 2-7 Current cable terminal (conductor cross-sectional area ≤16 mm^2)

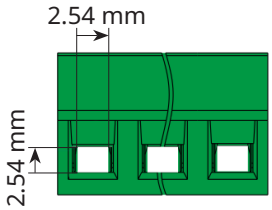


Figure 2-8 RS485 cable terminal (conductor cross-sectional area: 0.25 mm^2-1 mm^2)

2.6 Product Installation

DANGER	• Before connecting the cables, ensure that the smart meter is not damaged in any way. Otherwise, electric shocks or fires may occur.
NOTICE	• Before installation, please check whether the model and specifications of the products on the box are in line with the material, if not, please contact the supplier. • Check whether the packing case of the product is damaged, if damaged, please contact the supplier. • When unpacking the carton, if the shell has obvious signs caused by severe impact or falling, please contact the supplier as soon as possible. • After the instrument is removed from the packing box, it should be placed in a flat and safe place, facing up, not overlaying for more than five layers; if the inner package or shell has been damaged, please do not install the product.

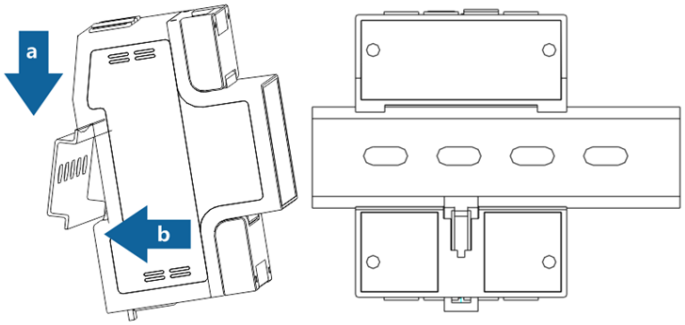
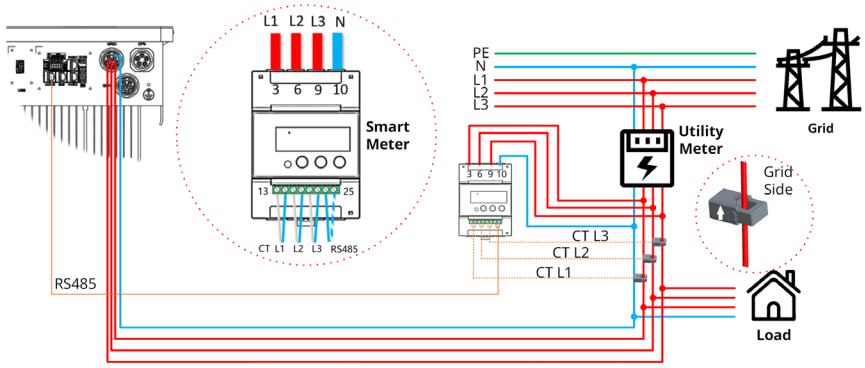
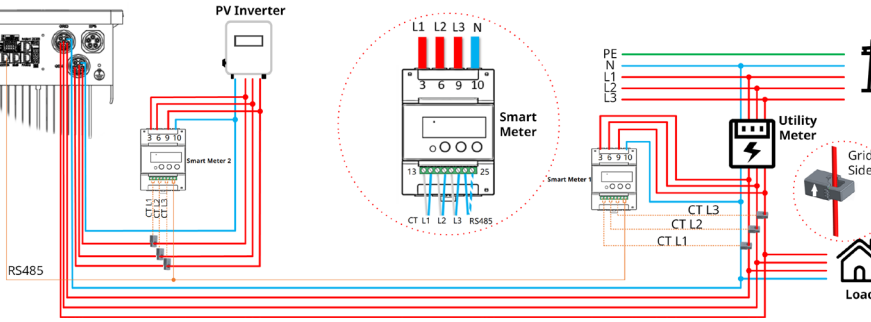


Figure 2-9 Meter Installation

Procedure (DC-coupled System)	
Steps	• Clamp the meter to the guide rail directly, and install the meter and the rail in or near the distribution box, right after the utility meter. • Connect grid L1/L2/L3/N to meter's terminals 3/6/9/10. • Clamp three CTs to L1/L2/L3 and respectively connect wirings to terminals 13/14, 16/17, and 19/21. The arrow on the surface of CT should point to the grid. • Connect the communication cable between the inverter and the smart meter.



Procedure (AC-coupled System)	
Steps	• The smart meter 1 is connected to the grid port, and the smart meter 2 is connected to the GEN port. The connection method is the same as that described above.



Note:

- When installing, clip the end of the card slot into the guide rail.
- When disassembling, use a screwdriver to press the card to remove the instrument.

2.7 Typical Wiring

DANGER	• High voltage may cause an electric shock, which will result in serious injury, death, or serious property damage. Please strictly comply with the safety instructions in this document and other relevant documents.

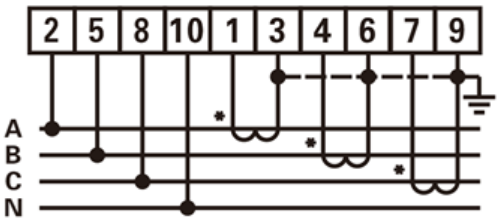


Figure 2-10 Type of Wiring 3P4W

Figure 2-11 RS485

Voltage signal

3------UA (Phase A voltage input terminal) 6------UB (Phase B voltage input terminal)
9------UC (Phase C voltage input terminal) 10------UN (Phase N voltage input terminal)

Current signal

13------IA* (Phase A current input terminal) 14------IA (Phase A current output terminal)
16------IB* (Phase B current input terminal) 17------IB (Phase B current output terminal)
19------IC* (Phase C current input terminal) 21------IC (Phase C current output terminal)

RS485 communication

24------A (RS485 terminal A) 25------B (RS485 Terminal B)

3 Troubleshooting

Fault Phenomenon	Factor Analysis	Elimination Method
No display after the instrument is powered on	• Incorrect wiring mode. • Abnormal voltage supplied for the instrument.	• If the wiring mode is incorrect, please reconnect based on the correct wiring mode (see the wiring diagram). • If the supplied voltage is abnormal, please supply the voltage on the instrument specification. • If the fault still exists, please contact the local supplier.
Abnormal RS485 communication	• The RS485 communication cable is disconnected, short-circuited, or reversely connected. • The address, baud rate, data bit and parity bit of the instrument are not in accordance with the host computer. • The end of the RS485 communication cable has not been matched with resistance. (when the distance is over 100 meters.) • Not matched with the communication protocol order of the host computer.	• If there is any problem with the communication cable, please reconnect or change the cable. • Set the address, baud rate, data bit, and parity bit to be the same as the host computer through buttons; for button settings, please see "parameter setting". • If the communication distance is over 100 meters, and the communication parameter settings are the same as the host computer, but cannot communicate, please lower the baud rate or add a resistance of 120Ω at the start terminal and ending terminal.
Inaccurate energy metering	• Incorrect wiring, please check whether the phase sequence corresponding to the voltage and current is correct. • Check whether the high-end and low-end of the current transformer inlet are reversely connected. • The power of Pa, Pb, and Pc will be abnormal if there is any negative value.	• If the wiring mode is incorrect, please reconnect based on the correct wiring mode (see the wiring diagram). • If the fault still exists, please contact the local supplier.

4 Technical Specification

4.1 Limit of error caused by the current augment

Table 4-1 The limit value of the active percentage error of meters on balanced load

Type	Current Value	Power Factor	Percent Error Limits for Various Classes of Meter		
			Class C	Class B	Class A
Connection through current transformers	0.01 $I_n \le I < 0.05\ I_n$	1	±1.0	±1.5	±2.0
	0.05 $I_n \le I \le I_{max}$	1	±0.5	±1.0	±1.2
	0.02 $I_n \le I < 0.1\ I_n$	0.5L, 0.8C	±1.0	±1.5	±2.0
	0.1 $I_n \le I \le I_{max}$	0.5L, 0.8C	±1.0	±1.0	±1.2
Direct connection	0.05 $I_b \le I < 0.1\ I_b$	1	-	±1.5	±2.0
	0.1 $I_b \le I \le I_{max}$	1	-	±1.0	±1.2
	0.01 $I_b \le I < 0.2\ I_b$	0.5L, 0.8C	-	±1.5	±2.0
	0.2 $I_b \le I \le I_{max}$	0.5L, 0.8C	-	±1.0	±1.2

Note:

I_n: secondary rated current of the current transformer; I_b: calibrated current of the meter

L: inductive; C: capacitive

Table 4-2 The limit value of the reactive percentage error of meters on balanced load

Current Value		sinφ (inductive or capacitive)	Percentage Error Limits for Various Classes of Meter
Direction connection	Connection through current transformers		Class A
0.05 $I_b \le I < 0.1\ I_b$	0.02 $I_n \le I < 0.05\ I_n$	1	±2.5
0.1 $I_b \le I \le I_{max}$	0.05 $I_n \le I \le I_{max}$	1	±2.0
0.1 $I_b \le I < 0.2\ I_b$	0.05 $I_n \le I < 0.1\ I_n$	0.5	±2.5
0.2 $I_b \le I \le I_{max}$	0.1 $I_n \le I \le I_{max}$	0.5	±2.0
0.2 $I_b \le I \le I_{max}$	0.1 $I_n \le I \le I_{max}$	0.25	±2.5

Table 4-3 The limit value of the reactive percentage error of meters on balanced load

Current Value		Power Factor	Percentage Error Limits for Various Classes of Meter		
Direction connection	Connection through current transformers		Class C	Class B	Class A
0.1 $I_b \le I \le I_{max}$	0.05 $I_n \le I \le I_{max}$	1	±0.6	±2.0	±3.0
0.2 $I_b \le I \le I_{max}$	0.1 $I_n \le I \le I_{max}$	0.5L	±1.0	±2.0	±3.0

Table 4-4 The limit value of the reactive percentage error of meters on imbalanced load

Current Value		Power Factor	Percentage Error Limits for Various Classes of Meter
Direction connection	Connection through current transformers		Class A
0.1 $I_b \le I \le I_{max}$	0.05 $I_n \le I \le I_{max}$	1	±3.0
0.2 $I_b \le I \le I_{max}$	0.1 $I_n \le I \le I_{max}$	0.5	±3.0

4.2 Start

Under the power factor of 1.0 and started current, the instrument can be started and continuously measured (for the multiple-phase instrument, it will bring a balanced load). If the instrument is designed based on measurement for dual directional energy, it is applicable for each direction of energy.

Table 4-5 Start Current

Type	Class of Meter			Power Factor
	Class C	Class B	Class A	
Direct connection	-	0.004 I_b	0.005 I_b	1
Connection through current transformers	0.001 I_b	0.002 I_b	0.003 I_b	1

4.3 Defluction

When the voltage is applied with no current flowing in the current circuit, the test output of the meter shall not produce more than one pulse. When testing, the current circuit shall be disconnected, and the applied voltage of the voltage circuit shall be 115% of the referenced voltage.

4.4 Environmental Parameter

Limited working temperature range	-25℃-70℃
Relative humidity (annual average)	≤75%
Altitude	≤4000 m
Atmospheric pressure	63 kPa-106 kPa

4.5 Electrical Parameter

Specified operating voltage range	0.9 U_n-1.1 U_n	
Extended operating voltage range	0.8 U_n-1.15 U_n	
Limiting operating voltage range	0 U_n-1.15 U_n	
Voltage line power consumption	≤1.5 W/6 VA	
Current line power consumption	I_b<10 A	≤0.2 VA
	I_b≥10 A	≤0.4 VA
Data storage time after power interruption	≥10 years	

4.6 Technical Parameter

Model	DTSU666 (CT-3 × 100 A)
Power Supply	
Grid type	3P4W
Input voltage (phase voltage)	154 Vac - 253 Vac
Power consumption	≤1.5 W
Measuring Range	
Phase voltage	154 Vac - 253 Vac
Current	0 - 100 A
Measuring Accuracy	
0.01 In ≤ I < 0.05 In(1)	±1.5 %
0.05 In ≤ I ≤ In(1)	±1.0 %
Communication	
Interface	RS485
Communication protocol	Modbus-RTU
Mechanical Data	
Wiring type	Via-CT
Ambient temperature range	-25℃ - 70℃
Dimensions (W × H × D)	72 × 100 × 65 mm
Mounting type	DIN35 Rail
CT Data	
Thread	Single turn
Install	Buckle
Ambient temperature range	-25℃ - 70℃
Dimensions (W × H × D)	44 × 77 × 33 mm
Cable length	6 m

(1) Secondary rated current of the current transformer.

Floor 6-10, Building 5, 99 Housheng Road, Gongshu District,
Hangzhou 310015
P. R. China
+86 571 2805 6101

General inquiry: info@hoymiles.com
Technical support: service@hoymiles.com

Visit https://www.hoymiles.com/ for more informations.