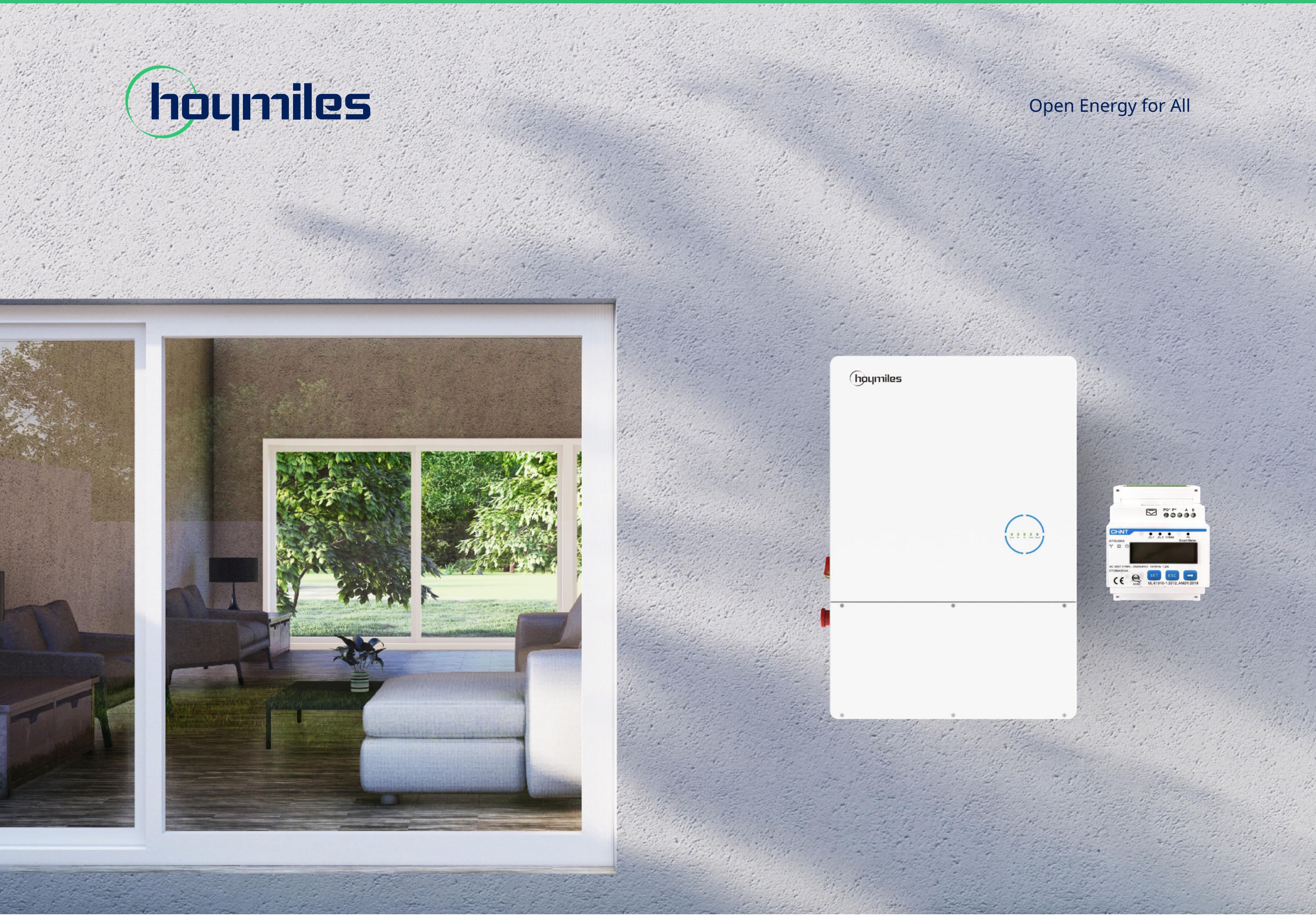
Open Energy for All



Split-phase Smart Meter

USER MANUAL

DTSU666 (CT-2 × 250 A)

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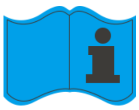
1 Safety Instruction

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 158℉ (-40℃-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

The 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 voltage, current, active power, reactive power, frequency, 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:

- CSA-C22.2# 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements;
- CSA-C22.2# 61010-2-030-2018 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 2-030: Particular Requirements for Equipment Having Testing or Measuring Circuits;
- UL 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements;
- UL 61010-2-030-2018 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 2-030: Particular Requirements for Equipment Having Testing or Measuring Circuits;
- ICES-003: Issue 7;
- FCC 47 CFR PART 15 SUBPART B;
- MODBUS-RTU protocol.

2.2 Product Naming Rule

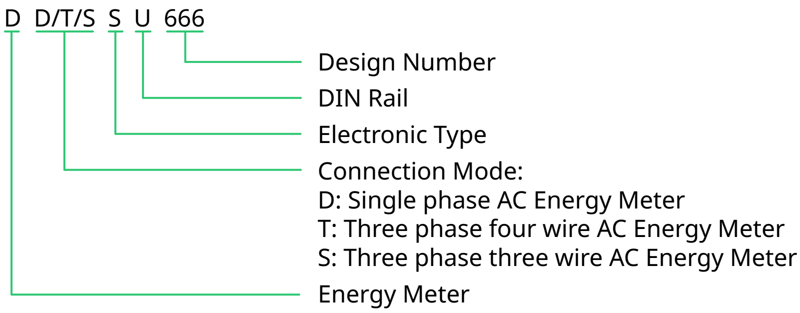


Figure 2-1 Product Naming Rule

Table 2-1 Model Specification

Model	Voltage	Current Specification	Impulse Constant	
			imp/kWh	imp/kvarh
DTSU666 (CT-2 × 250 A)	3 × 57.7 V/100 V - 3 × 240 V/415 V	250 A/50 mA	400	400

Note:

The current transformer is an external open type.

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:

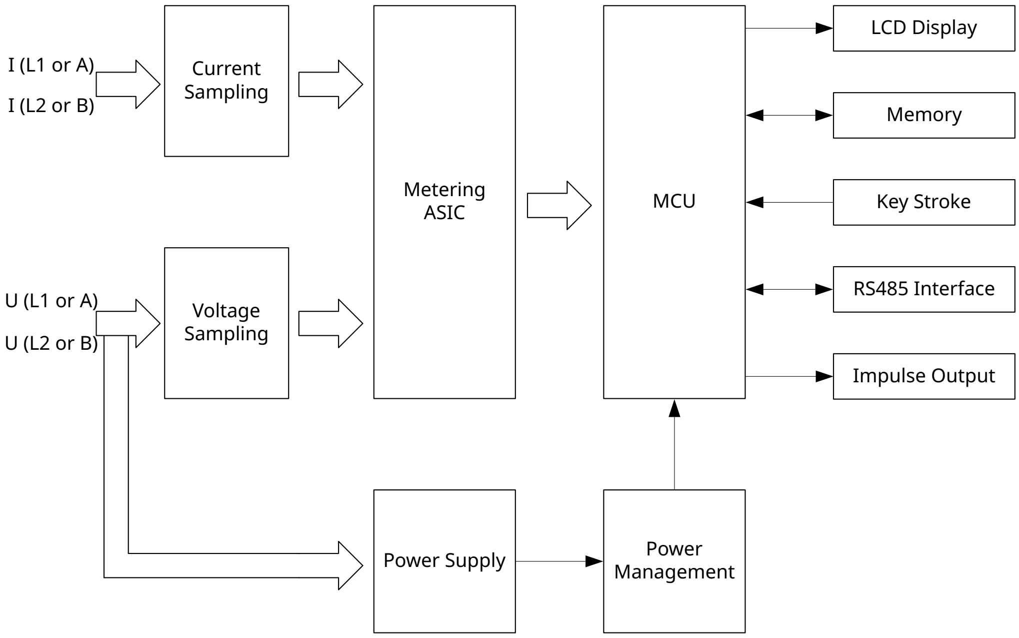


Figure 2-2 Working Principle Diagram

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, 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

The electricity meter is a double-circuit electric energy measurement, which can support a single-circuit three-phase power grid or a double-circuit three-phase power grid.

2.4.1 Measurement Function

The meter can measure the voltage and current of each phase, active power, reactive power, apparent power, power factor, grid frequency, and other operating parameters.

The calculation method of apparent power is “s= Urms*Irms”.

2.4.2 Metering Function

Each circuit has the metering function of forward and reverse active electric energy and four quadrant reactive electric energy.

2.4.3 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 9999999 kWh.

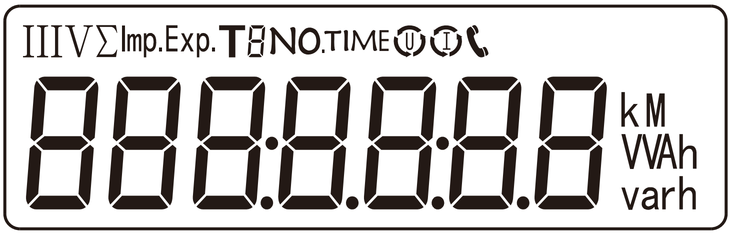
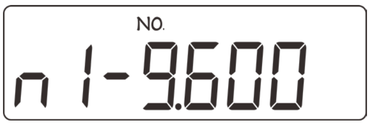
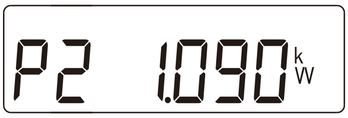


Figure 2-3 Liquid Crystal Display

Table 2-2 Display Interface

No.	Display Interface	Description
1		Positive active energy=10000.00 kWh
2		Reserve active energy=2345.67 kWh
3		Protocol: Modbus-RTU; address =001 Baud rate=9600 bps None parity, 1 stop bits
4		
5		L1 phase voltage=220.0 V
6		L2 phase voltage=220.0 V

7		L1 current=5.001 A
8		L2 current=5.001 A
9		Combined phase active power=3.291 kW
10		L1 active power=1.090 kW
11		L2 active power=1.090 kW
12		Combined phase power factor PFt=0.500
13		L1 phase power factor PF1=1.000
14		L2 phase power factor PF2=0.500

Note:

- The communication address of Modbus protocol is 1 decimal 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 Two stop bits, N1 means one-stop bits 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.

2.4.4 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.

2.4.5 Programming Function

2.4.5.1 Programming Parameter

Table 2-3 Programming Parameter

Parameter	Value Range	Description
Prot	1: 645 2: n.2 3: n.1 4: E.1 5: O.1	Settings for communication stop bit and parity bits: 1: Factory 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
Addr	1-247	Communication address
bAud	0: 1200 1: 2400 2: 4800 3: 9600	Communication baud rate: 0: 1200 bps; 1: 2400 bps; 2: 4800 bps; 3: 9600 bps;
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: P1 1: P2	Pulse output: 0: First active energy pulse; 1: Second active energy pulse
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

2.4.5.2 Programming Operation

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

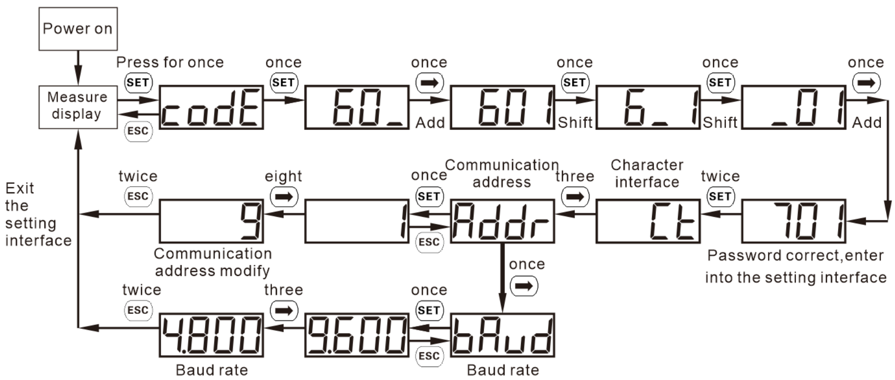


Figure 2-4 Setting examples for communication address and baud rate

When input digits, “ ” can be used as a cursor shift button; “ ” is “add” button, “ ” 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.

2.5 Product Dimensions

Table 2-6 Product Structure

Model	Modulus	Outline Size (W × H × D)	Installation Size (Din-rail)
DTSU666 (CT-2 × 250 A)	4	2.83 × 3.86 × 2.58 inch/72 × 98 × 65.5 mm	DIN35 standard din-rail

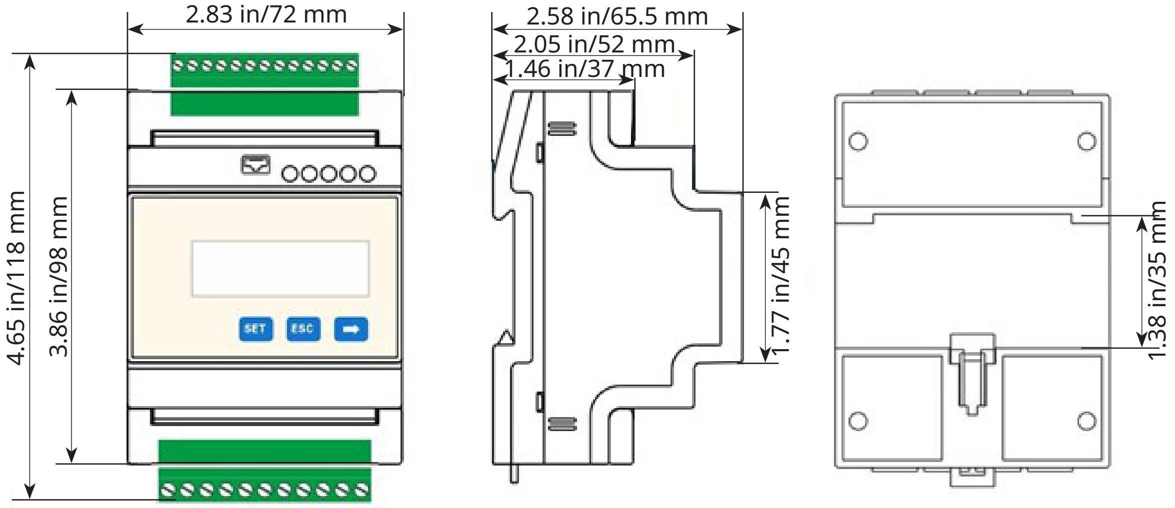


Figure 2-5 Product Dimensions

Note:

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

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.

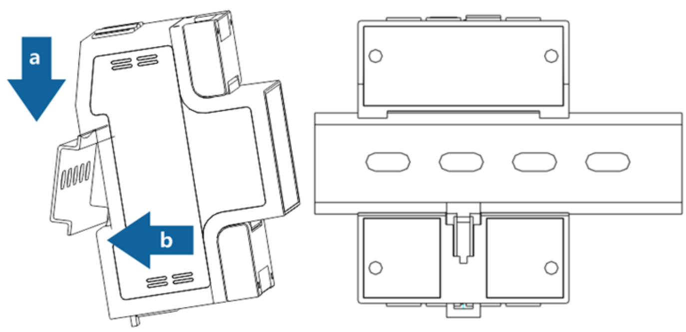
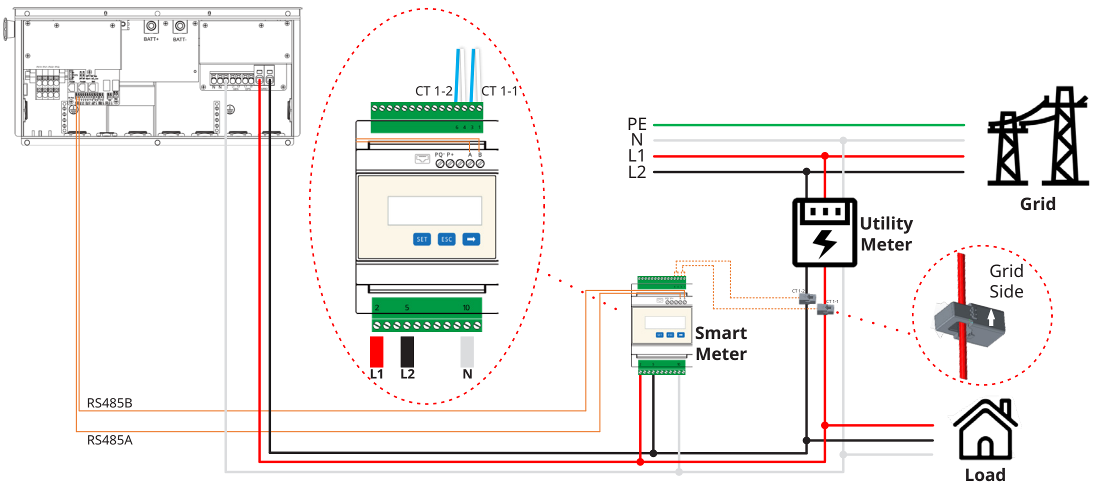


Figure 2-6 Meter Installation

Procedure	
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. • Clamp CT 1-1 and CT1-2 to L1/L2 cable, respectively connect the white and blue wire of CT 1-1 to terminals 1/3, and respectively connect the white and blue wire of CT 1-2 to terminals 4/6. The arrow on the surface of CT should point to the grid. • Connect grid L1/L2/N to meter's terminals 2/5/10. • Respectively connect the meter's terminals A and B to inverter METER_A and METER_B.



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.

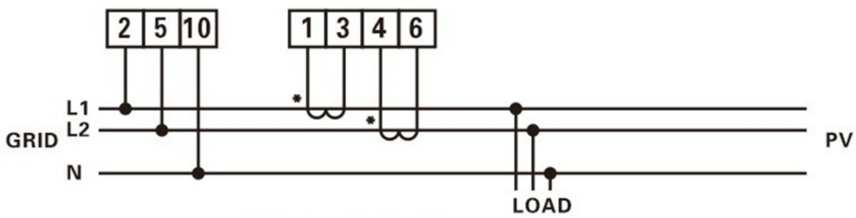


Figure 2-7 Type of Wiring 1P3W

Voltage signal (only for connection through current transformer):

2------L1 voltage input terminal

5------L2 voltage input terminal

10------N voltage input terminal

Current signal:

1------L1 current input terminal   3------L1 current output terminal

4------L2 current input terminal   6------L2 current output terminal

RS485 communication

A------RS485 terminal A   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	-13℉-158℉ (-25℃-70℃)
Relative humidity (annual average)	≤75%
Altitude	≤6562 ft (2000 m)
Atmospheric pressure	63 kPa-106 kPa

4.5 Performance Parameter

Technical Performance			Index
Input	Voltage	Rated value	Three phase four wire: 3 × 57.7 V/100 V-3 × 240 V/415 V, 50 Hz/60 Hz
		Class	Class B
		Consumption	≤1.5 W, 6VA
	Current	Rated value	250 A/50 mA
			*/85 mV-120 mV
		Class	Class B
	Energy	Class	Class B

Output	RS485 interface	Baud rate 1200/2400/4800/9600. Support Modbus-RTU
	Energy pulse	Provide (active/reactive electric energy) open circuit electrical signal pulse output of collector isolated by the optocoupler. An optical signal that provides active electrical energy.
Safe	Insulation resistance	Input and output terminals to case >100 MΩ
	Outage data retention time	≥10 years

4.6 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	

Note:

The meter is intended to be used indoors.

4.7 Technical Parameter

Model	DTSU666 (CT-2 × 250 A)
Power Supply	
Grid type	1P3W
Input voltage (phase voltage)	96 Vac - 138 Vac
Power consumption	≤1.5 W
Measuring Range	
Phase voltage	96 Vac - 138 Vac
Current	0 - 250 A
Measuring Accuracy	
$0.01\ I_n \le I < 0.05\ I_n$ (1)	±1.5%
$0.05\ I_n \le I \le I_n$ (1)	±1.0%
Communication	
Interface	RS485
Communication protocol	Modbus-RTU
Mechanical Data	
Wiring type	Via-CT
Ambient temperature range	-13℉ - 158℉ (-25℃ - 70℃)
Dimensions (W × H × D)	2.83 × 3.86 × 2.58 inch (72 × 98 × 65.5 mm)
Mounting type	DIN35 Rail
CT Data	
Thread	Single turn
Install	Buckle
Ambient temperature range	-13℉ - 158℉ (-25℃ - 70℃)
Dimensions (W × H × D)	1.73 × 3.07 × 1.3 inch (44 × 78 × 33 mm)
Cable length	19 ft (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.