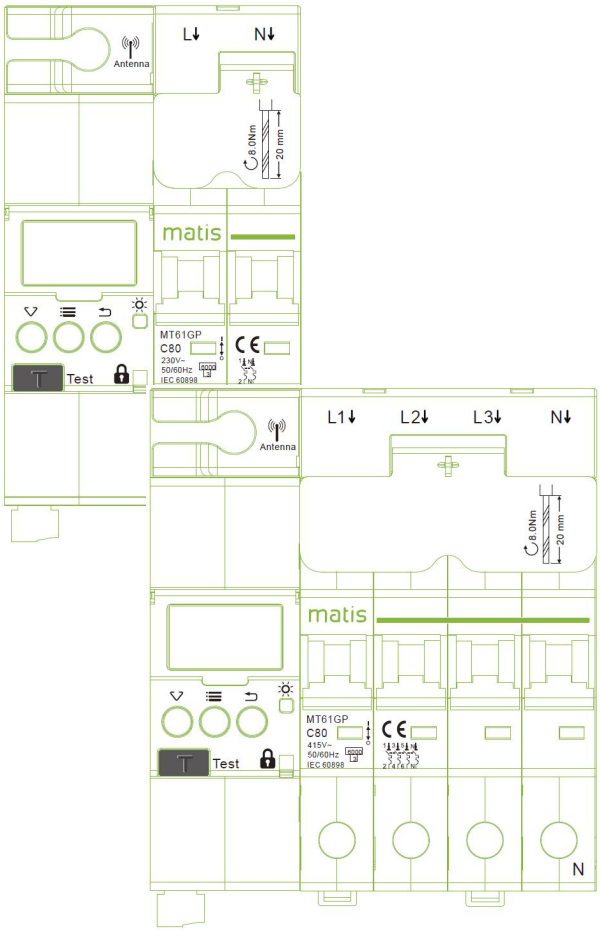
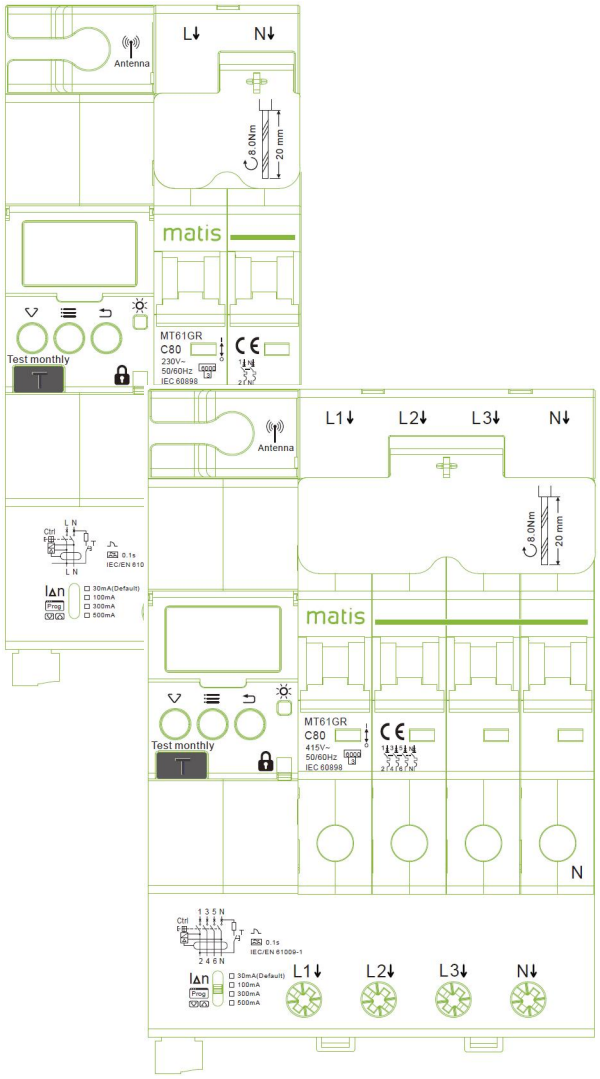
MT61GP(GR) Smart Metering Breaker

User Manual

08/2024





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Background

Distributed power generation in the form of solar photovoltaic has formed a major trend in various countries. There are comprehensive power distribution requirements for **bidirectional measurement & metering**, voltage loss protection, and leakage protection on the power supply side. On the load side, there are basic electrical parameters measurement, metering electrical parameters, demand, multi-tariff metering, and comprehensive electrical protection. Integrators and energy operation managers, in order to better optimize and manage devices, require devices with remote control and automatic reclosing operation logic. To meet the needs of different customers and different scenarios, the MT61GP (GR) product hardware and firmware are upgraded.

Smart metering breakers can be used in different scenarios of small new energy distributed power supply and load management needs, mainly with the following characteristics:

1. Flexible installation. Single-phase and three-phase, guide rail installation.

2. Comprehensive functions. Full power measurement, metering, multi-tariff, demand; remote control, timing control, automatic reclosing and other control logics, applicable to a wide range of scenarios, fully meeting the power distribution needs of source and load ends.

3. Standardized protocol. Communication through Modbus facilitates quick and accurate access of device to the monitoring platform.

1 Overview

1.1 Function Overview

MT61GP (GR) smart metering breakers provide monitoring of single-phase or three-phase basic measurements (current, voltage, power, power factor, frequency), energy metering, control, reclosing, etc.

Models:

- MT61GP-RS N/2P C16~80A
- MT61GP-RS N/4P C16~80A
- MT61GR-RS N/2P C16~80A
- MT61GR-RS N/4P C16~80A

Main functions of the device:

- Electrical parameter monitoring, such as I, In, U, V, PQS, E, PF, Hz
- Measurement of active and reactive energy
- Power/current demand, peak demand
- Alarms with timestamps
- Maximum/minimum values for many parameters
- Pulse output
- Management of up to 4 tariffs
- Modbus communication

1.2 Main Features

Features	**MT61GP-RS N/2P**	**MT61GP-RS N/4P**	**MT61GR-RS N/2P**	**MT61GR-RS N/4P**
Direct measurement (max. 80 A)	■	■	■	■
Measurement display	■	■	■	■
Measurement of basic electrical parameters; (I, In, V,	■	■	■	■

PQS, PF, Hz);				
Measurement of active and reactive energy	■	■	■	■
Active energy measurement accuracy class (total and partial kWh)	1%	1%	1%	1%
Four-quadrant energy measurement	■	■	■	■
Multi-tariff (built-in clock)	4	4	4	4
Present value of current and power demand	■	■	■	■
Peak value of current and power demand	■	■	■	■
Maximum/minimum instantaneous value	■	■	■	■
Control: Remote opening and closing control, reclosing control	■	■	■	■
Alarm & protection: overcurrent (phase), overload (phase);	■	■	■	■
Line voltage over/under voltage, phase voltage over/under voltage;	■	■	■	■
Leakage protection (electronically selectable leakage			■	■

action value)				
Control: Programmable digital input	1*ON 1*OFF Default	1*ON 1*OFF Default	1*ON 1*OFF Default	1*ON 1*OFF Default
Communication control	Modbus	Modbus	Modbus	Modbus
Pulse output	600imp/kWh	600imp/kWh	600imp/kWh	600imp/kWh
Width (18 mm module in DIN rail mounting)	4P	6P	4P	6P

@2024-09-30 Modified

2 Functions

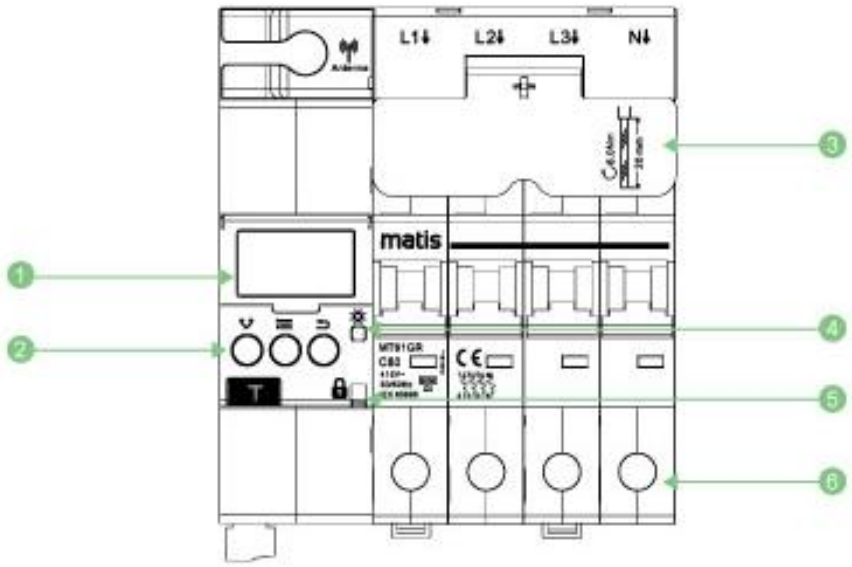
Smart metering breakers monitor energy consumption by application, zone or feeder in a distribution cabinet. They can be used to monitor feeders in main switchboards or to monitor mains power supply inside switchboards. It is used in scenarios such as small distributed power incoming lines, home main power supply, AC charging pile main power supply, communication base station main power supply, etc.

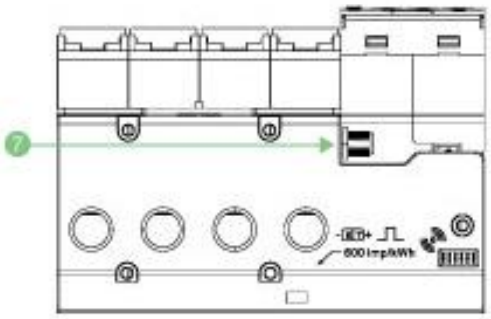
2.1 Introduction to Functions and Advantages

Functions	**Advantages**
The maximum current of the feeder can be measured directly: 80A built-in current transformer (CT)	Save installation time and space inside the distribution cabinet No wiring to manage Simple distribution network
Metering & circuit breaker combination	Can be used in single-phase or three-phase systems, no need to install circuit breakers
Remote control	Via RS485 or IO
Automatic reclosing	Multifunctional reclosing list to meet the needs of different reclosing scenarios
Leakage module	Electronic selection of leakage protection action value

3 Description

3.1 MT61GP Smart Metering Breaker



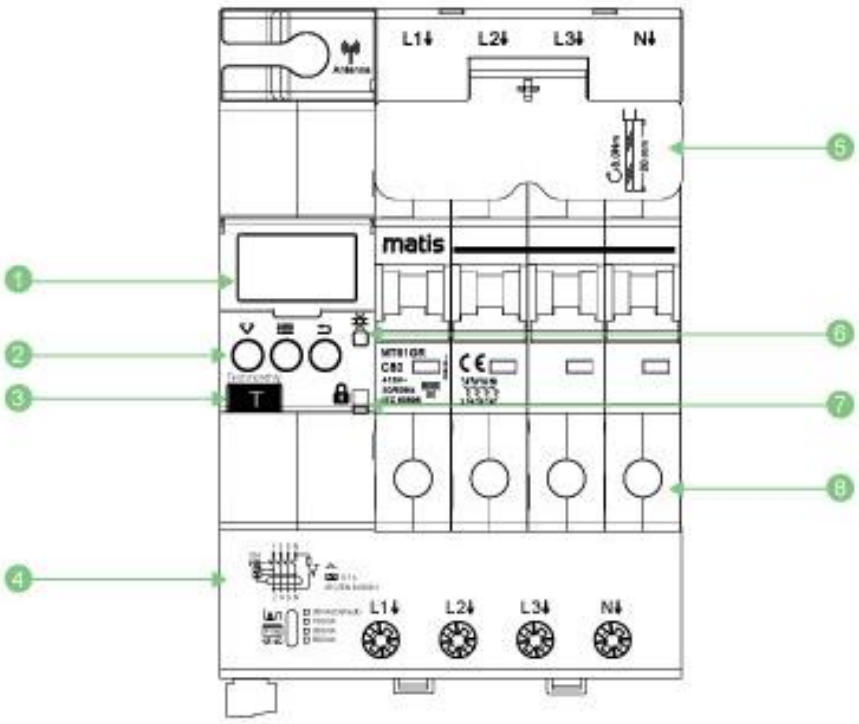


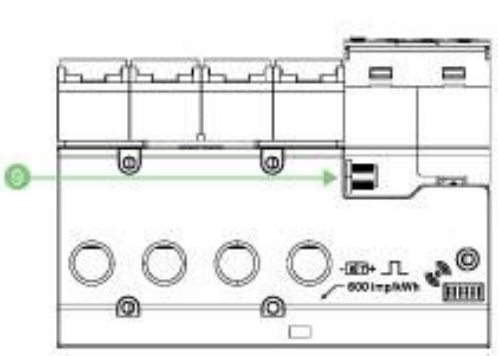
①Display screen ②Menu/Move/Back ③Wiring cover

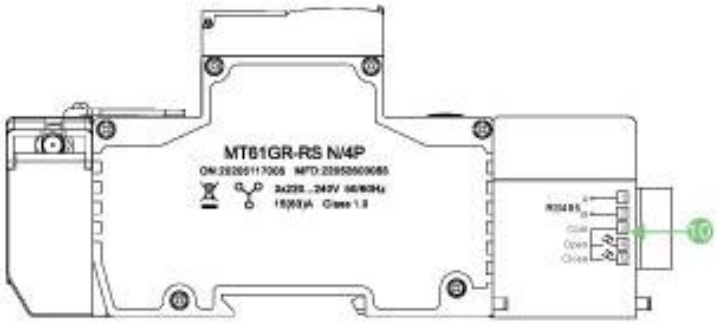
④Communication indicator ⑤Padlock mechanism ⑥Circuit breaker

⑦Antenna ⑧Terminal

3.2 MT61GR Smart Metering Breaker







①Display screen ②Menu/Move/Back ③Leakage test button

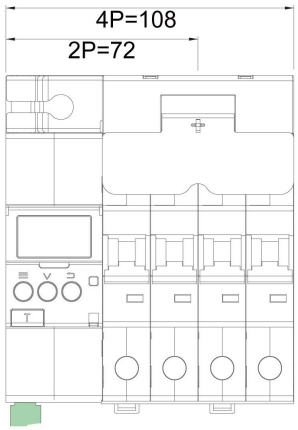
④Leakage module ⑤Wiring cover ⑥Communication indicator

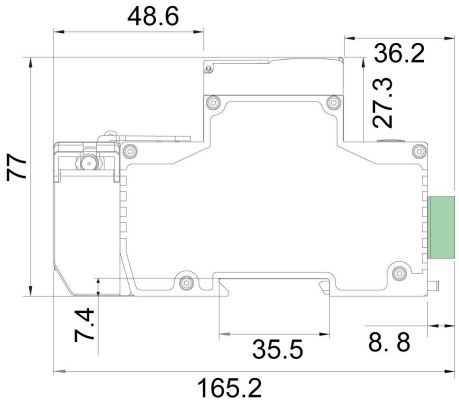
⑦Padlock mechanism ⑧Circuit breaker ⑨Antenna

⑩Terminal

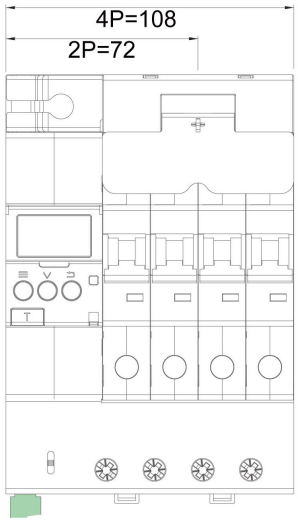
4 Hardware and Installation

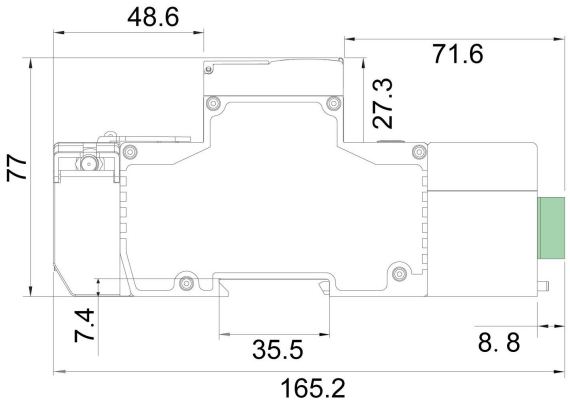
4.1 MT61GP Dimensions (mm)





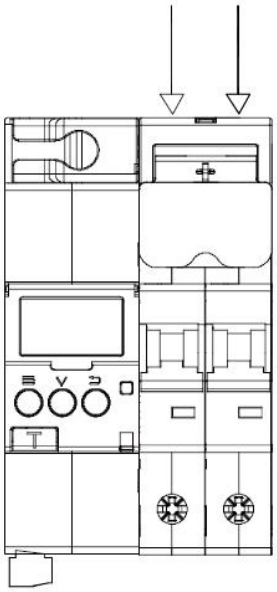
4.2 MT61GR Dimensions (mm)



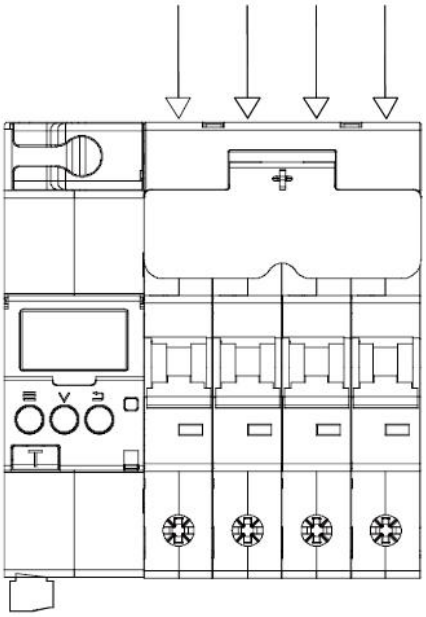


5 Wiring

5.1 MT61GP Wiring Diagram



1PH2W L-N



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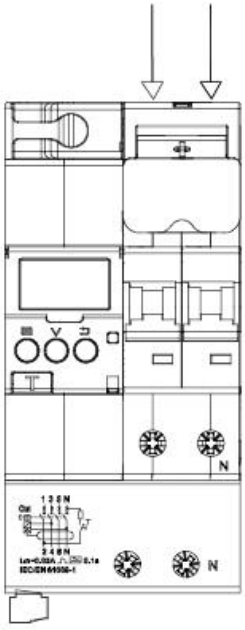
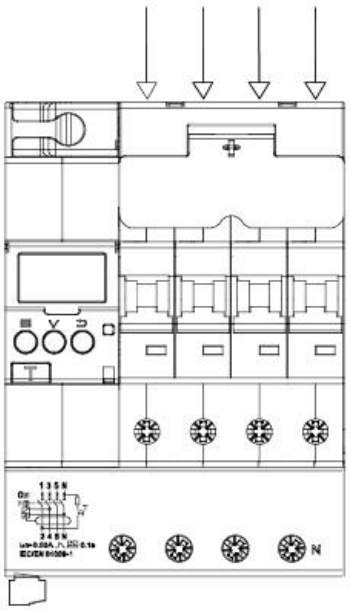
5.2 MT61GR Wiring Diagram

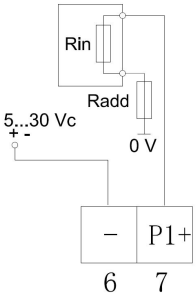


1PH2W L-N

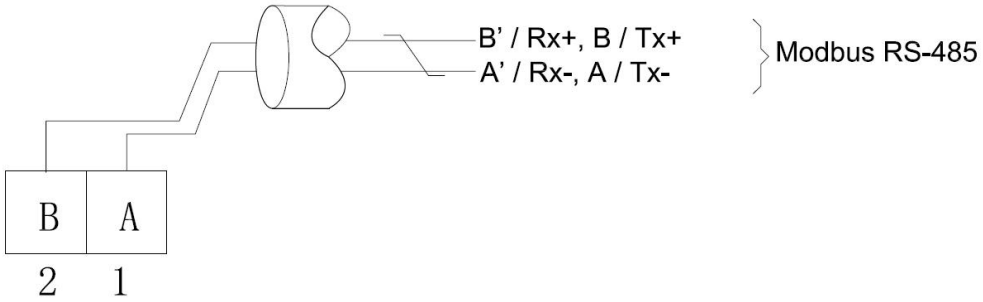


3PH4W

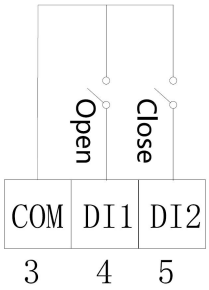
5.3 Pulse Output Wiring Diagram



5.4 Modbus Communication Wiring Diagram



5.5 IO Port Wiring Diagram



6 Communication LED Indicator

The communication LED indicates the communication status between the smart metering breaker and the main device as follows.

Indicator Status	Description
LED red indicator flashes	Communication with the device has been established.
	NOTE: The LED will also flash if an online error occurs.

LED green indicator is always on	There is no active communication between the master and slave devices

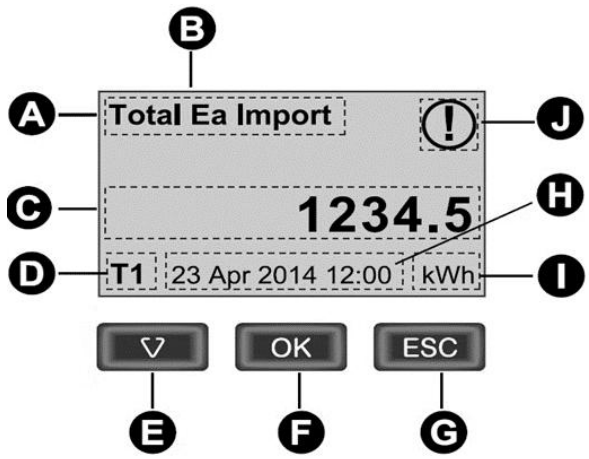
7 Data Display and Settings

The smart metering breaker's front panel with LED, graphic display and menu buttons allow you to access the information required to operate and modify parameter settings.

Parameters can also be displayed, configured and reset via the front panel.

It has a multi-tariff function that allows you to configure different tariffs.

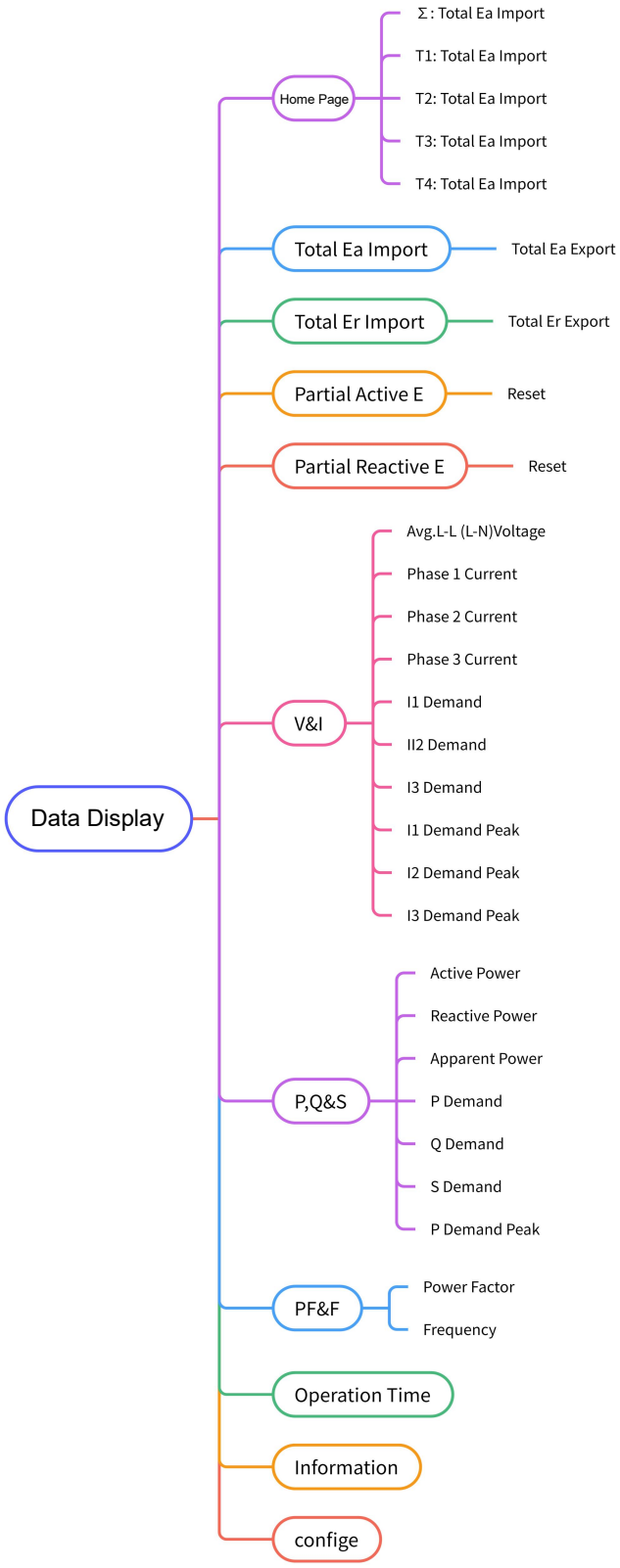
7.1 Data Home Page Display



A	Measurement
B	Ea / Er = active/reactive energy
C	Value
D	Effective tariff (if applicable)
E	Scrollable screen
F	View additional screens related to the measurement category (if available)
G	Return to previous screen
H	Date and time (if applicable)
I	Unit
J	Icon indicating that the date/time has not been set

The main screen only displays Total Ea Import. But there are 5 interfaces: General \T1\T2\T3\T4 interface. Press the down key to display them in turn;

7.2 Data Display



7.3 Demand Reading

Features	Description
Demand value	

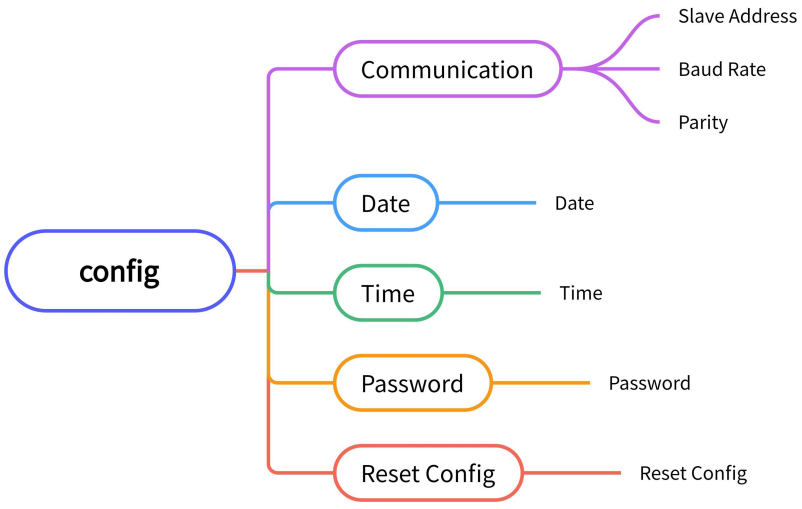
Current	Per phase and average value
Active power, reactive power, apparent power	Total value
Peak demand	
Current	Per phase and average value
Active power, reactive power, apparent power	Total value

7.4 Multi-tariff Function

Stored in 4 different registers according to different tariffs: T1, T2, T3 and T4

8 Measurement & Metering Parameter Configuration

8.1 Configuration Mode Menu Tree



8.2 Device Configuration

Function	Factory settings
Rated frequency	50 Hz
Multi-tariff	Enable
Demand	Mode: sliding block; interval: 15 minutes
Power demand	Enable
Digital input	
Pulse output	400 pulses/kWh

Communication	Baud rate=9600; address=1
Password	0000
Alarm	Disable

8.2.1 Configuration Mode

1. Go to the main menu and find the "config" menu.
2. Enter your password when prompted. The configuration menu appears.

8.2.2 Modify Parameters

There are two ways to modify parameters, depending on the type of parameter:

1. Modify the numerical value digit by digit on the screen.
2. Modify via modbus.

Note: Before modifying any parameters, make sure you are familiar with the device's HMI functionality and navigation structure in configuration mode.

8.2.3 Partial Energy Reset

Clears all active and reactive energy accumulated since the last reset. This operation does not reset the total accumulated active and reactive energy.

Part of the energy can be reset in the menu or reset via modbus.

8.2.4 Peak Demand Reset

The maximum demand value for the current month is automatically updated before 00:00 every month. And record the time when the maximum demand occurs.

8.2.5 Maximum and Minimum Values

Record the maximum and minimum values for the month.

9 Protection: Over/Under-voltage, Phase Loss, Power Failure, Leakage Protection

9.1 Over/under Voltage and Phase Loss Configuration

Over/Under Voltage Protection Settings			
Item	Voltage	Time	Execute
Overvoltage value L1	≥275v Setting value (265~350V)	5s	☐ Alarm ☐ Open (default) ☐ Lock
Overvoltage recovery value	≤1.1Ue 255V	30s (default) 20~60s can be set	
Undervoltage value L1	≤160v setting value (100~200V)	3s	☐ Alarm ☐ Open (default) ☐ Lock
Undervoltage recovery value	≥0.85Ue 195V	30s (default) 20~60s can be set	

Phase Loss Protection Settings			
Item	Voltage	Time	Execute
Phase loss voltage value	≤30v Setting value (100~200V)	3s	☐ Alarm ☐ Open (default) ☐ Lock

Phase loss voltage recovery value	≥0.85Ue 195V	30s (default) 20~60s can be set	

9.2 Device Configuration

Leakage alarm is required and can be associated; Leakage opening is optional and device defaults to leakage opening.

Leakage Protection		
Item	Leakage value	Execute
Leakage value 1	30mA	☐ Alarm ☐ Open
Leakage value 2	100mA	
Leakage value 3	300mA	
Leakage value 4	500mA	

9.3 Configuration Mode

1. Go to the main menu and find the “config” menu.
2. Enter your password when prompted. The configuration menu appears.

10 Automatic Reclosing and Configuration

When tripping is caused by leakage or current fault (overload, short circuit), automatic reclosing can be performed according to a certain time.

Automatic reclosing parameters can be configured in the screen menu, and reclosing list parameters can be selected. (Currently, the reclosing list parameters can only be selected through modbus. After subsequent firmware upgrades, the configuration can be selected on the screen)

10.1 SRM: Configuration of Current Fault Reclosing Times

After the current fault (overload, short circuit) tripping, the switch will be closed after the "RT" time, but manual closing is not limited by time. If the fault current is eliminated within "CT" time after closing, the closing is successful and the circuit breaker operates

normally; If the fault current is not eliminated, the circuit breaker will re-adjust and perform automatic reclosing according to the number of reclosing "NR" in the selected mode "RM". After reclosing fails, manual unlocking or closing is required.

Press the xxxx keys to move between the different available sequences (RM). (Currently selected via modbus list)

Each sequence determines the maximum number of reclosings (NR), reclosing time (RT) and reset time (CT).

RM	NR	RT	CT
RM0	Circuit breaker disables auto-reclosing		
RM1	2	1min	15min
RM2	2	1min	15min
RM3	2	90s	15min
RM4	2	90s	15min
RM5	2	3min	15min
RM6	2	30s	30min
RM7	2	30s	30min

Default value: RM5

10.2 SRD: Configuration of Leakage Reclosing Times

When the residual current exceeds the operating current value and the circuit breaker trips, it will close after the "RT" time, but manual closing is not limited by time. If the fault current is eliminated within "CT" time after closing, the closing is successful and the circuit breaker operates normally; If the fault current is not eliminated, the circuit breaker will be adjusted according to the number of reclosing "NR" in the selected mode "RD" and perform automatic reclosing. After reclosing fails, manual unlocking or closing is required.

Press the xxxx keys to move between the different available sequences (RD). (Currently selected via modbus list)

Each sequence determines the maximum number of reclosings (NR), reclosing time (RT) and reset time (CT).

RD	NR	RT	CT
RD0	Leakage disables automatic reclosing		
RD1	3	2,4 and 8min.	15min
RD2	6	2,4 and 8 min.therest	15min
RD3	6	10,20,30,60,130 and 600s.	15 min.
RD4	7	30s,1,2,3,4,8 and16min.	15min
RD5	7	2,4,8,16 and 32min.therest	15min
RD6	8	30s,1,2,3,4,5,6, and 7min.	15min
RD7	8	2,4 and 6min.therest	15min
RD8	10	90s.	15 min.
RD9	10	1min.	15min
RD10	10	3min.	15min
RD11	30	20s,40s and 5min.therest	15min

Default value: RD1

11 Input and Output Functions

11.1 Digital Input

The meter can accept 2 digital inputs, namely DI1 and DI2.

Digital input has 5 operating modes:

- General input status: for simple on/off digital input. The digital input can be the OF or SD signal of the circuit breaker, or the status of external devices, etc.

- Control the opening and closing operations: used to control the opening and closing operations of the circuit breaker. The detection signal can be used for both short and long signals.

- DI1: Open

- DI2: Close

12 Modbus List

See modbus list for details.

13 Electrical Characteristics

13.1 Power System Input

Characteristics	Value
Measuring voltage	230V L-N ±20%; 400V L-L ±20%;
Measuring current	10(63A); 20(80A);
Frequency	50/60Hz±10%

13.2 Measurement & Metering Parameters

Measurement Accuracy	Value
Voltage measurement	0.50%
Current measurement	0.50%
Active power measurement	1.00%
Reactive power measurement	2.00%
Active energy measurement	1.00%
Reactive energy measurement	2.00%

Metering Characteristics	Value
Energy	Forward and reverse active and reactive energy, apparent energy; Partial energy (can be cleared)

Energy pulse	600 imp/kwh
Tariff	4 tariffs
Demand	Demand and maximum demand
The most value	Maximum and minimum values

13.3 Protection: Over/Under Voltage, Phase Loss, Power Outage

Characteristics	Value
Overvoltage fault action	Overvoltage value: 275V (default/settable)
	Overvoltage recovery value: 255V (default/settable)
Undervoltage fault action	Undervoltage value: 160V (default/settable)
	Undervoltage recovery value: 195V (default/settable)
Output to correlate	Outputs to correlate: 0 = not correlated; 1 = correlated Bit0 = Alarm Bit1 = Open Bit2 = Lock

Characteristics	Value
Phase loss action value:	20V (default/settable)
Output to correlate	Outputs to correlate: 0 = not correlated; 1 = correlated Bit0 = Alarm Bit1 = Open Bit2 = Lock

13.4 Protection: Overload (Overcurrent), Leakage Protection

Characteristics	Value
Overcurrent/overload_fault action	Adjust according to actual needs
Output to correlate	Outputs to correlate: 0 = not correlated; 1 = correlated Bit0 = Alarm Bit1 = Open

	Bit2 = Lock

Leakage protection	Value
Sensitivity IΔn	30 mA - 0.1 A - 0.3A - 0.5 A (programmable)
Execution actions	Alarm and trip optional

13.5 Input & Output

	Characteristics	Value
Pulse output	Number of pulses/kWh	600
Digital input	ON / OFF or customized	Passive output

13.6 Mechanical Characteristics

Characteristics	Value
IP protection grade	IP40
Active energy display range	999999.99 kwh
Communication LED	LED flashes red
Impulse coefficient	500 imp/k(W/VAR)h
Weight	MT61GP 2P 478g、MT61GP 4P 805g MT61GR 2P 617g、MT61GR 4P 1008g

13.7 Environmental Characteristics

Characteristics	Value
Operating temperature	-15 ~55 ℃
Storage temperature	-25 ~70 ℃
Relative humidity	Relative humidity 5 … 95% without condensation
Altitude	Below 2000 meters above sea level

13.8 Modbus Communication

Characteristics	Effective value	Default value
Baud rate	9600	9600
	19200	
	38400	
Data bits	8	8
Check mode	Odd	No check
	Even	
	No check	
Stop bit	1	1
Address	1–247	1

14 Typical Applications @2024-10-14 adjusted

The following table describes functions, advantages, and main applications.

Functions	**Advantages**	**Applications**
Total energy and partial energy counters;	Energy consumption monitoring	Billing management Application metering
Partial energy reset	Separately metering	Mobile device metering, apartment rental energy metering
Pulse output	Collect pulses from the meter using a PLC or any basic acquisition system	Remotely monitor power consumption Can be integrated into other systems
Four tariffs are managed via an internal clock	Divide energy consumption into peak and off-peak hours, weekdays and weekends, or different sources of electricity (for example, from the grid or renewable energy generation)	Energy demand management Bill management Analyze power consumption behavior
Measure basic electrical parameters; (I, In, V, PQS, PF, Hz);	Instantaneous measurements help monitor load status	Monitor real-time energy consumption status of feeders or any distribution cabinets
Modbus communication	Using Modbus protocol	Modbus protocol for data transmission
Bidirectional metering	By identifying input/output active/reactive energy, it is possible to monitor the flow of energy in both directions: energy consumed by the	Ideal for facilities with backup generators or green power sources (such as solar panels or energy storage)

	grid and energy generated in the opposite direction	
Measure active energy	Bidirectional measurement of forward consumption and reverse generation	In a power system with new energy, energy consumption can be managed, new energy power sources can be invested rationally, and energy costs can be reduced.
Measure reactive energy	Bidirectional measurement of forward consumption and reverse generation	Monitor reactive power consumption and release for reactive energy monitoring, manage reactive energy consumption and avoid reactive energy fines
Digital input	Programming can be used to: • Control circuit breaker opening and closing • Monitor external status	Monitor: • Control device opening and closing operations • Intrusion (e.g. meter cabinet door opened) or device status
Current, power demand present value, peak value	Device comes with demands	Can make segmented demand forecasts to provide better demand forecasts for energy management;
Control: remote opening and closing control, reclosing control	The device can realize remote control and reclosing control	• Remote control scenarios • Automatic reclosing in unattended scenarios
Alarm & Protection	Overcurrent (phase), overload (phase); Line voltage over/under voltage, phase voltage over/under voltage;	Protect line electricity safety
Super capacitor	Save data during power outage	Data storage can be performed during power outage

14.1 Application of Smart Metering Breaker in Distributed New Energy Scenarios @2024-10-14 added

With the access of new energy, especially distributed photovoltaics, the smart distribution network will face many new challenges: The distributed energy resources connected to the medium and low-voltage distribution network will change the power flow characteristics of the traditional distribution system. Designed distributed photovoltaics require the system to be equipped with new protection schemes, voltage control strategies, and measurement, metering and monitoring to meet the problems caused by bidirectional power flow;

14.1.1 Voltage Monitoring

1. After distributed photovoltaics are connected to the power grid, due to the fluctuation of transmission power and the characteristics of distributed loads, the voltage at each load node of the transmission line is high or low, causing the voltage deviation to exceed the technical indicators for safe operation.
2. After the intervention of large-scale distributed photovoltaics, there is a problem of static voltage offset in local nodes of the distribution network. Under the static operating status of the power grid, the voltage theoretically decreases gradually along the direction of the power flow of the transmission line.
3. **Product application:** The smart metering breaker has built-in voltage monitoring, which can set the voltage protection threshold. If the voltage deviation exceeds the technical indicators for safe operation, a warning or opening operation can be performed. After the voltage deviation returns to the safe operation index, automatic reset processing is performed.

14.1.2 Frequency Monitoring

1. The frequency of distributed new energy grid connection operates within a certain safe range. If the frequency exceeds the limit, it needs to be disconnected within the specified time. It ensures the safe operation of large network systems.
2. **Product application**: The smart metering breaker has built-in frequency monitoring and can set the protection threshold.
   a) If the frequency deviation of the large network exceeds the technical indicators for safe operation, warning or opening operations can be performed. After the frequency deviation returns to the safe operation index, it will perform automatic reset processing or respond to the closing command.
   b) It can respond to the instructions of the grid-connected inverter. When the inverter frequency deviation exceeds the technical indicators for safe operation, it can give instructions to the smart metering breaker to perform the opening operation. After the frequency deviation returns to the safe operation index, automatic reset

processing is performed, or the switch is closed in response to the command. After the frequency deviation returns to the safe operation index, it can respond to the inverter closing command.

14.1.3 Phase Monitoring

The grid-connected phase of distributed new energy must be synchronized with the power grid, otherwise it will cause phase errors in electric energy, causing oscillation and damage to the power grid.

Product application: The smart metering breaker has built-in phase monitoring, which can provide a reference for distributed grid connection.

14.1.4 Phase Sequence Monitoring

The phase sequence of distributed new energy grid connection must be consistent with the grid phase.

Product application: The smart metering breaker has built-in phase sequence monitoring, which can provide a reference for distributed grid connection.

14.1.5 Measurement & Metering

1. Monitoring of basic electrical parameters such as I, In, U, V, PQS, E, PF, Hz
2. Bidirectional measurement of active and reactive energy
3. Power/current demand, peak demand

14.1.6 Power Factor Monitoring

1. Distributed photovoltaics basically require a power factor of 0.95 (lead-lag). However, in actual sites, the reactive power adjustment capability and overload capability of the inverter itself are not fully utilized, and the power factor often fails to meet the standard.
2. **Product application**: Smart metering breaker can monitor power factor. If the power factor deviates from the set value, it can choose to alarm;

14.1.7 Demand

1. Power/current demand, peak demand

14.1.8 Short-circuit Current Trip (Advanced Version)

1. Distributed new energy, (for example, the short-circuit current of photovoltaic inverters is only 25% greater than the rated current), cannot provide higher short-circuit current. When a circuit breaker failure occurs on a transmission line, the fault on the line cannot be detected and the protection cannot respond due to the insufficient short-circuit current capability of the PV inverter. Especially in traditional three-stage protection, instantaneous current quick-break protection may not be recognized.
2. **Product application**: The smart metering breaker can detect short circuits through synchronous collection of protection points, current magnitude and voltage. Built-in tripping, timely response protection.

14.1.9 Power Quality Protection (Advanced Version)

1. The output of distributed photovoltaics is determined by light, and grid-connected photovoltaic inverters are controlled by power electronic components that can be quickly shut down. This may cause voltage fluctuations and flickers in local distribution lines. If dynamic changes in load are added, it will cause more serious consequences.
2. The impact of harmonics generated by distributed photovoltaics on the power grid and loads. In the worst case, poor power quality will cause damage and interference to nearby power generation systems, sensitive electrical equipment, and signal transmission.
3. **Product application**: The smart metering breaker can be set to monitor harmonics. When harmonics deviate from the set value, alarm or trip can be selected;