

# User Manual

Data Concentrator Unit

**Model No.:** AJ102C

**Version:** 1.0

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## Revision History

Version	Date	Changes	Checked by	Approved by
1.0	2024.09.07	Initial version.	Junxiao,rongjiehe,aoboyan	
1.1	2024.09.26	Update Event	aoboyan	longyang

## Warning Statement

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference
- (2) this device must accept any interference received, including interference that may cause undesired operation

**Note:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

### RF exposure

This equipment complies with CE radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.

### CE mark



Hereby, Shenzhen Kaifa Technology(Chengdu) Co.,Ltd. declare that Data Concentrate Unit with model AJ102C supports WIFI , 2G and 4G functions. It is in conformity with the relevant union harmonization legislation: Radio Equipment Directive: 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address: website preparation in progress.

2.4G WiFi: 20dBm

GPRS900: 32.02dBm

GPRS1800: 30.46dBm

LTE Band3: 24.4dBm

LTE Band8: 24.7dBm

LTE Band28: 24.0dBm

LTE Band40: 24.5dBm

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## Overview

The data concentrator unit (DCU) can provide automatic data collection and remote control of smart electricity meters in AMI system. As a part of AMI solution, the DCU is used for managing meter, monitoring meter work status, collecting and storing meter data, transferring the data to central system, and transfer the message/command from the central system to meters, and vice versa.

## 1 Abbreviation

AMI	Advance Metering Infrastructure
DCU	Data Concentrator Unit
HES	Head End System
MDMS	Meter Data Management System
RF	Radio Frequency
WAN	Wide Area Network
LAN	Local Area Network
RTC	Real Time Clock
HLS	High Level Security
LLS	Low Level Security
SNTP	Simple Network Time Protocol
LED	Light-Emitting Diode
CSQ	Carrier Squelch
SIM	Subscriber Identity Module
APN	Access Point Name
PDP	Program Decision Package
DHCP	Dynamic Host Configuration Protocol
IMEI	International Mobile Equipment Identity
PAP	Password Authentication Protocol
CHAP	Challenge Handshake Authentication Protocol
IMSI	International Mobile Subscriber Identity
FDD	Frequency Division Duplexing
CAT	LTEUE-Category
RADIUS	Remote Authentication Dial In User Service
MAC	Media Access Control
FCC	Federal Communications Commission
CENELEC	Comite Europeen de Normalisation Electrotechnique (European Electro technical Standardization Committee)
AES	Advanced Encryption Standard
GCM	Galois/Counter Mode
FIFO	First In First Out
HTTP	Hyper Text Transfer Protocol
FTP	File Transfer Protocol
SNMP	Simple Network Management Protocol
GUI	Graphical User Interface
HDLC	High - level Data Link Control
PAN	Personal Area Network
DDR	Double Data Rate
MPU	Microprocessor Unit

## 2 Main Technical Features

### 2.1 Technical Features

Technical features	Description
Nominal voltage (Un)	3×230V/400V
Specified operating voltage range	0.8Un ~ 1.2Un
Extended operating voltage range	0.6Un* ~ 1.2Un
Frequency	60 Hz (± 2%)
Minimum capacity*	450 smart meters
Minimum effective commissioning meter number*	1 smart meter
Power consumption	Static power consumption: active ≤ 10W, apparent ≤ 25VA With communication: active ≤ 15W, apparent ≤ 30VA
Communication protocol	DLMS/COSEM/web service
Display	Refer to LED indicators chapter for the communication status indication
Tamper protection	Terminal cover removal detection Main cover removal detection
Communication interfaces	<b>WAN:</b> One plug and play GSM/GPRS/LTE module support DLMS/COSEM with TCP/UDP profile. One 10/100M Ethernet port with RJ-45 connector. <b>LAN:</b> One Lora RF port, which is embedded in the main board. The basic parameter as follows: Frequency: 915MHz~918MHz TX power: ≤22dBm <b>Local:</b> One optical port for local communication: Infrared, 9600bps One RS-485 port for local communication, 9600bps One RS-232 port for local communication, 9600bps One Wi-Fi for local communication, USB port: one USB2.0.
RTC	IEC 62054-21 (≤+/- 0.5 sec/ day, 230Vac, 23°C)
Insulation protection	Protection Class: Class II AC Voltage: 4kV (50Hz for 60s) Impulse Voltage: 10kV (1.2/50us)
Electrostatic discharge	Contact discharge 8kV Air discharge 15kV

Technical features	Description
Operating temperature range	-10°C~ +85°C
Temperature range for storage and transport	-25°C~ +85°C
Relative Humidity	Up to 95% non-condensing
Life time	15 years
Failure rate	<=0.5% per year

Table 1 - Description of technical features

\*0.6Un~1.2Un DCU works normally, when voltage less than 0.6Un DCU cannot work.

\*Minimum capacity, one DCU at least can communicates with 450 meters

\*Minimum effective commissioning meter number, there is no minimum limitation for effective commissioning, even 1 meter under a DCU, it still can get an effective commissioning

## 3 Mechanical

### 3.1 Overview

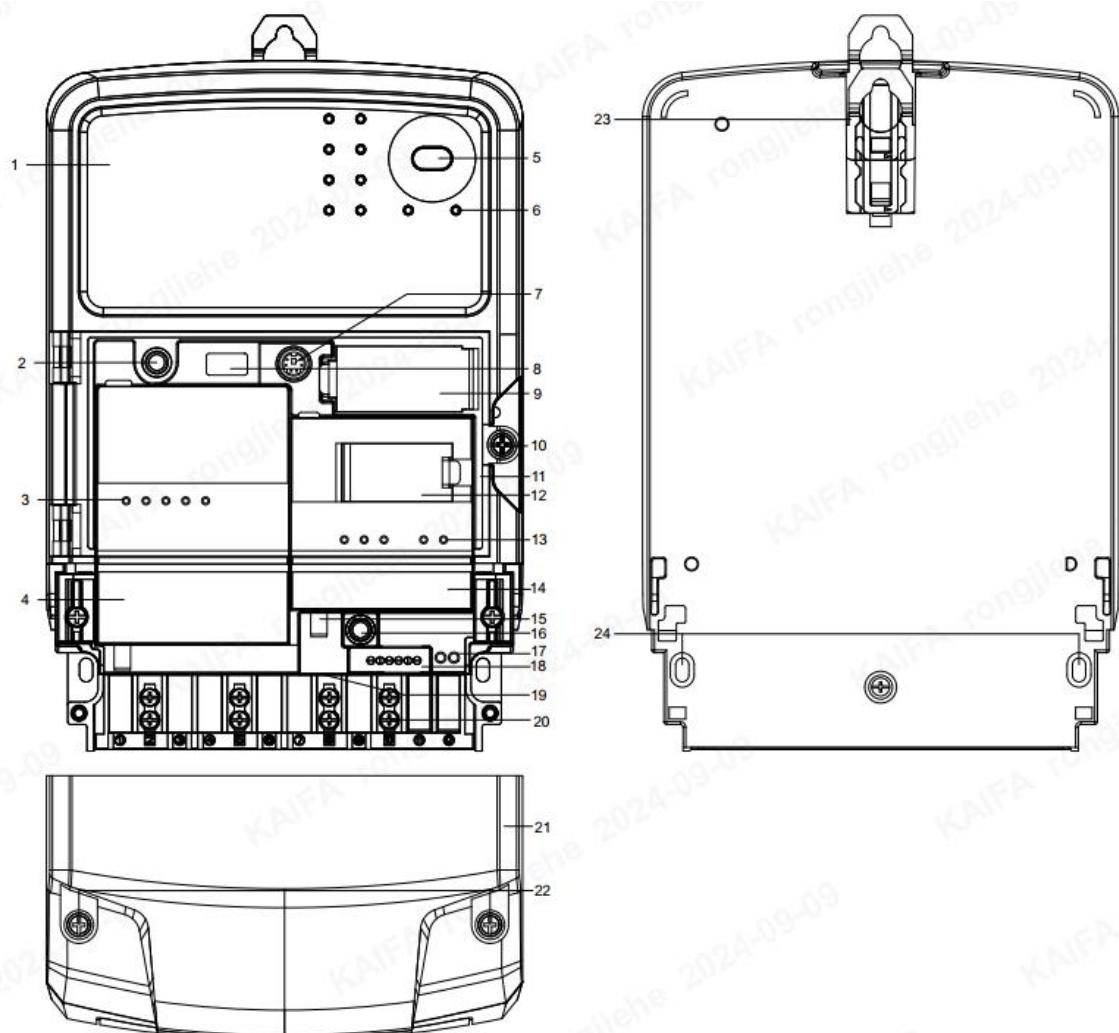


Figure - 1 General view of DCU

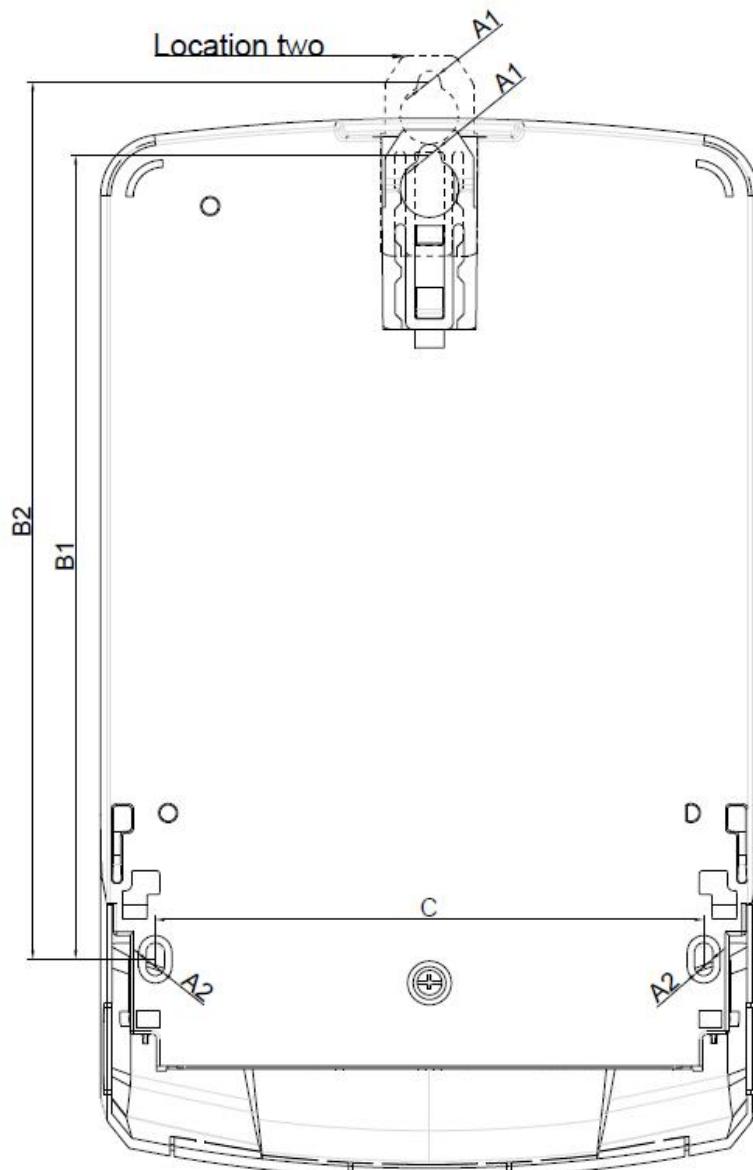
1. Main cover	13. LED indicators of 4G/2G module
2. Module cover detector(reserved)	14. 4G module
3. LED indicators of RF module	15. Antenna port (SMA)
4. RF module	16. Terminal cover detector
5. Optical port	17. 5V Auxiliary power
6. LED indicators	18. Digital input and RS-485 port
7. RS-232 port	19. Ethernet port
8. USB interface	20. Main terminals
9. External battery slot	21. Terminal cover
10. Module cover seal screw	22. Terminal cover seal screws
11. Module cover	23. Device hook
12. SIM card slot	24. Device fixing holes

## 3.2 Mechanical Features

The DCU supports IP51 indoor use. It should be installed with DCU protection box.

### 3.2.1 Mounting

The DCU uses three-point (A base triangle) mounting. The mounting holes accommodates 5.0 mm mounting screws. Two lower mounting holes are on both sides of the DCU bottom part.



No.	Dimension
A1	$\emptyset 6 \pm 0.5$
A2	$\emptyset 5 \pm 0.3$
B1	$200 \pm 2$
B2	$240 \pm 2$
C	$150 \pm 2$

Figure - 2 Mounting point of DCU

### 3.2.2 DCU Cover

The DCU cover is made of UV-resistance, high impact-resistance and self-extinguishing polycarbonate (PC+10%GF). It is sealed in such a way that the internal parts of the DCU are accessible only after breaking the seals.

The color of the cover is grey. The material can pass a glow wire test at  $650^\circ\text{C} \pm 10^\circ\text{C}$  and duration of application is  $30 \pm 1\text{s}$ .

### 3.2.3 Terminals and Terminal Block

The terminals are made of brass with tin plated ( $\geq 5$  micron) and provide eight stainless steel M4 current screws in each terminal which are better protected against corrosion. The stainless screws can pass 72 hours salt spray test according to IEC 60068. The screw is at least 3 threads in the terminals. The screw head type is Philips & slotted head.

The current terminal diameter size is 5.5mm. The type of wires can be solid cores, composite cores or stranded wires. The terminal block is suitable for cable sleeves, see the figure as below:

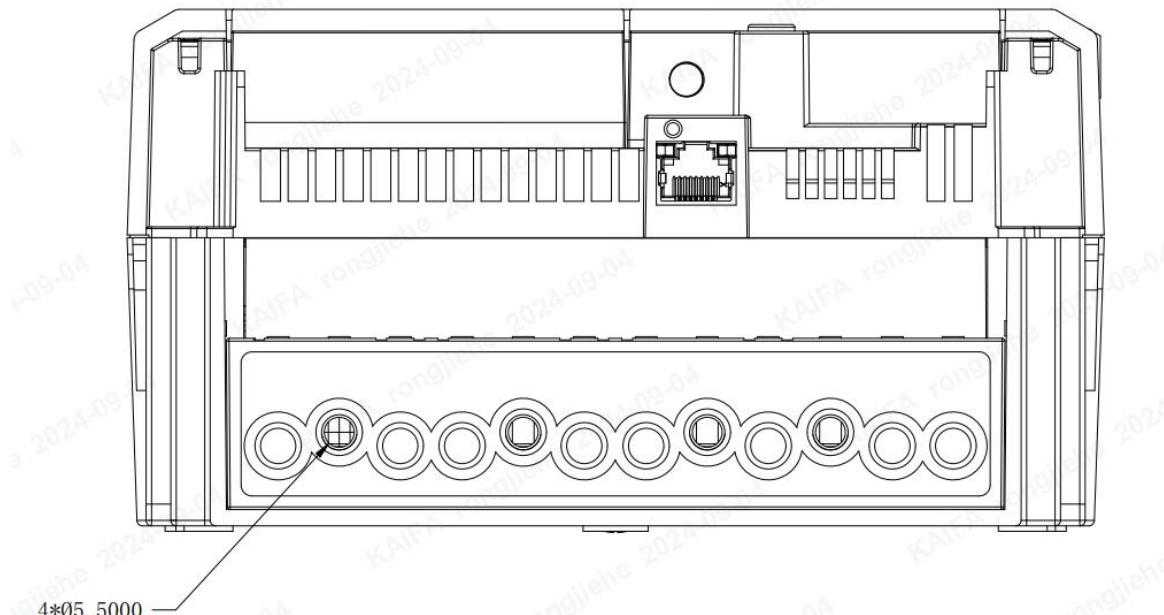


Figure - 3 Dimensions of DCU terminals

The terminal:

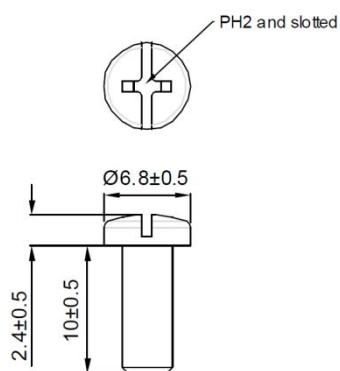


Figure - 4 Dimensions of terminal

The terminal block is made of UV-resistance, high impact-resistance and self-extinguishing polycarbonate (PC+20%GF), the color of the terminal block is grey, and the material can pass a glow wire test at  $960^{\circ}\text{C} \pm 10^{\circ}\text{C}$  and duration of application is  $30\pm 1$ s.

**Note:** To insure the reliable connection, the recommended install torque is  $1.2\pm 0.1\text{Nm}$ .

### 3.2.4 Terminal Cover

The terminal cover is made of UV-resistance, high impact-resistance and self-extinguishing polycarbonate(PC+10%GF) and suitable for cables incoming and outgoing vertically from the bottom, and have provision for security sealing.

The connection diagram of the DCUs is shown on the terminal cover.

The color of the terminal cover is grey. The material can pass a glow wire test at  $650^{\circ}\text{C} \pm 10^{\circ}\text{C}$  and duration of application is  $30\pm 1\text{s}$ .

### 3.2.5 External Battery Slot

The DCU supports an external 4 pins battery socket slot for 4.8V NIMH battery. DCU has internal battery as default for RTC, the 4.8V NIMH battery will be used as a backup power supply to power the system and it will be provided by default,

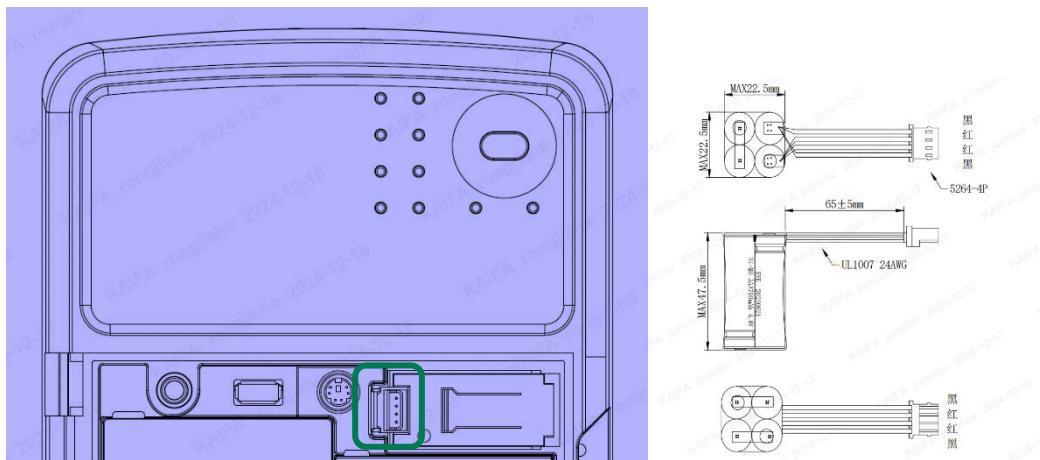
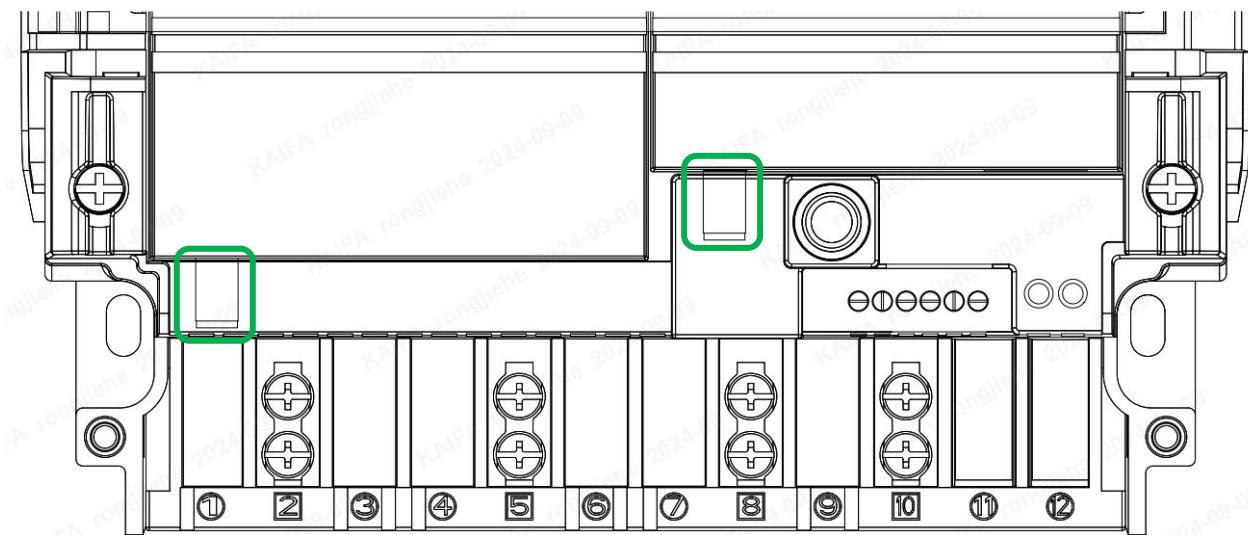


Figure - 5 Battery installation

### 3.2.6 Antenna

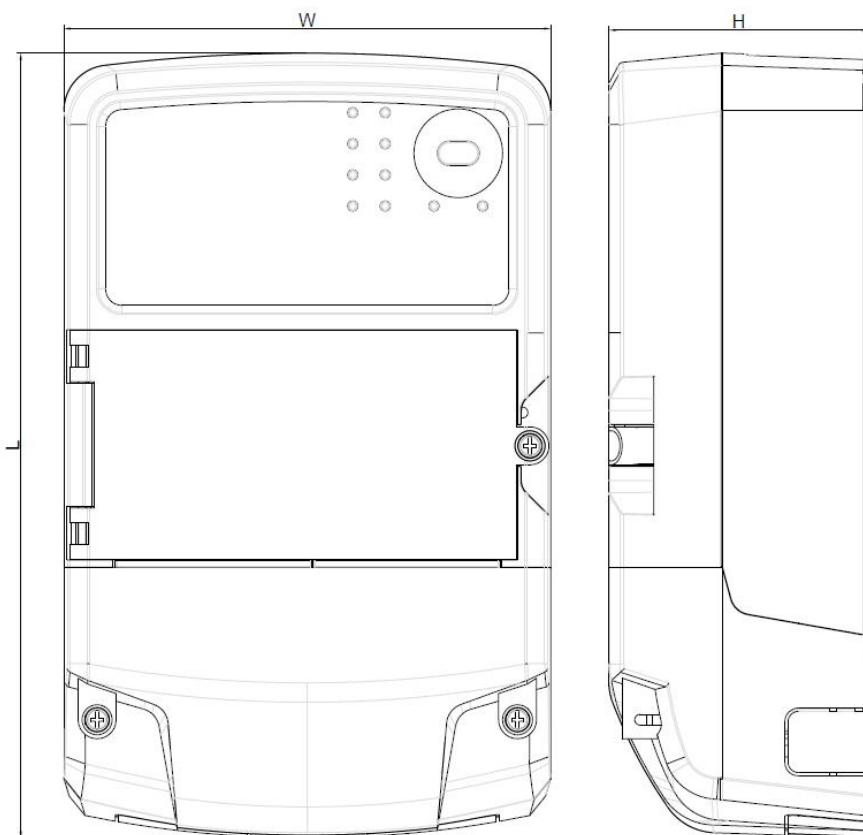
The 4G and LoRa module have a SMA antenna port, to support SMA antenna installation.

Figure - 6 Antenna



## 3.3 Dimensions and Weight

The DCU dimension (L×W×H) is  $290\text{mm} \times 180\text{mm} \times 96\text{mm}$  ( $\pm 2\text{mm}$ ), the weight is about 1.6Kg.



No.	Dimension
L	290±2
W	180±2
H	96±2

Figure - 7 Dimensions of DCU

### 3.4 Nameplate

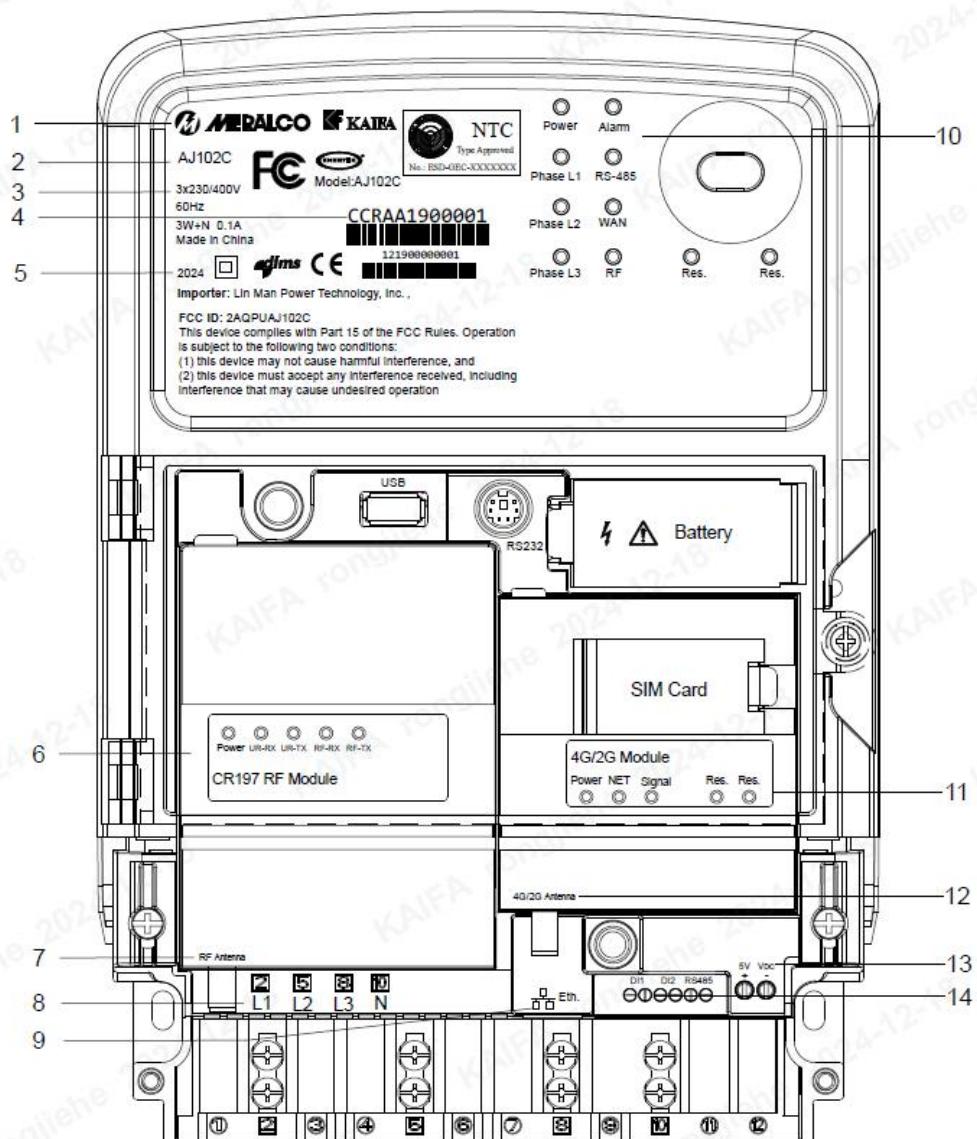


Figure - 8 Marking of DCU

1. Manufacturer mark
2. Type designation
3. Rated voltage, rated frequency
4. Serial number
5. Year of manufacture
6. LED indicators of RF module
7. Antenna of RF module
8. Terminal code and wire diagram
9. Ethernet port mark
10. LED indicators of DCU
11. LED indicators of 4G/2G module
12. Antenna of 4G/2G module
13. 5V Auxiliary power
14. Digital input and RS-485 port

### 3.4.1 DCU Serial Number

1. Each DCU has two permanent, clear and unique serial number. The serial numbers are respectively KAIFA Meter No and MERALCO Company No. the serial number is permanently print on the DCU cover in two types, numbers and barcode.
2. The DCU's unique serial number is also recorded in the non-volatile memory of DCU as a permanent value, which can be read out via optical port, or remote command.
3. The barcode and the internal memory's serial number consist of 12 digits.

Example:

KAIFA Meter No. is 121900000001. MERALCO Company No. is CCRAA1900001.

### 3.5 Wiring Diagram

A wiring diagram is laser marked on the DCU terminal block area.

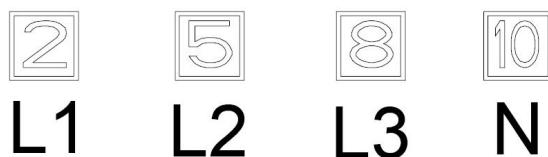


Figure - 9 Wiring diagram

### 3.6 Sealing of DCU

The DCU has seven security seals:

- One seal for module cover
- Two seals for the DCU main cover

The above three type seals will be fixed in factory.

- Two seals are for terminal cover

The terminal cover seal will be fixed after DCU installation.

It is impossible to touch the DCU electrical part unless physically and transparently destroy the main cover seals and the DCU enclosure.

The seal wire should use steel wire which diameter less than 1.5mm.

Below picture shows the sealing positions of the DCU.

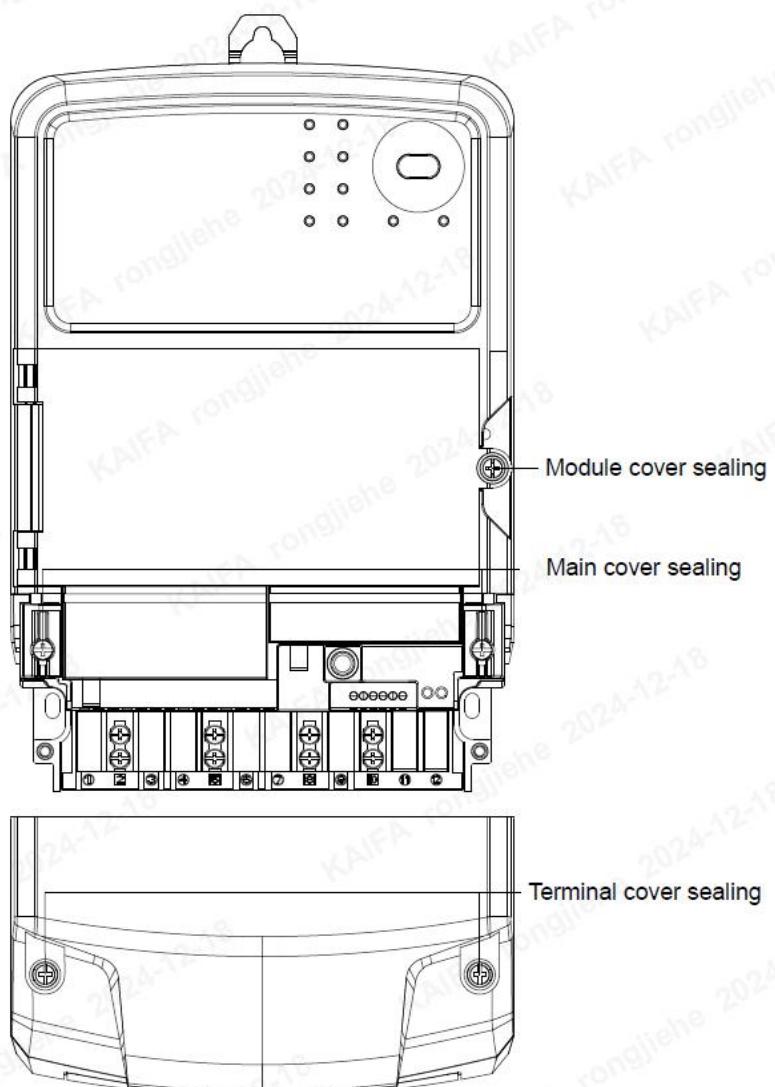


Figure - 10 Sealing of DCU

## 4 DCU Function

### 4.1 Circuit block

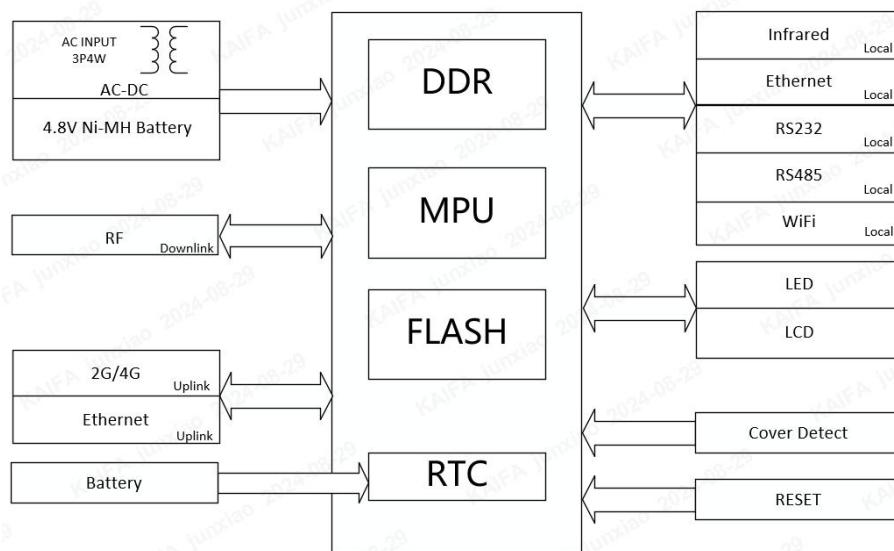


Figure - 11 Circuit block of DCU

The processing and storage system consist of DDR, MPU, FLASH and RTC that is responsible for data processing and system control.

The AC-DC circuit supplies power to the entire system by converting the 3P4W AC grid into DC power.

When the AC power down, a 4.8V NIMH battery will be used as a backup power supply to power the system.

The RF circuits are used for the downlink communication with meter.

The 2G/4G Ethernet circuits are used for uplink communication with head end system.

The Infrared, Ethernet circuits RS232 RS485 and WIFI are used for local communication.

The LED circuit is used to indicate the operation status of the DCU, the LCD used to display various status of DCU, and the button is used to switch what displayed on the LCD.

The cover detect circuit can detect the status of the main cover and terminal cover during power on and power off condition.

The reset circuit is used to reset the DCU when DCU is running abnormally.

The battery circuit supplies the RTC circuit.

### 4.2 Clock Management

#### 4.2.1 Real Time Clock

DCU has a RTC which complies with IEC 62052-21/62054-21. At reference voltage and reference temperature (23°C), clock accuracy is  $\pm 0.5$  s/day.

The RTC supports leap year, day light saving time. In case of power off, clock of DCU is active for at least 3 years after manufactured with internal battery support. The lifetime of internal battery is 15 years.

DCU automatically synchronizes its clock with SNTP server every day.

The HES can synchronize the DCU's clock.

When the DCU's clock is invalid, DCU will not automatically collect the data from meters.

### 4.2.2 Synchronize Meter Clock

DCU automatically synchronizes the clock of the meters once a day.

DCU interrogates the clock of meters. Depending on the clock difference, DCU take following action:

Clock difference	DCU action
>= 30 seconds And < 10 minutes	Set the clock of meter.
>= 10 minutes	DCU will not set the clock of meter, and DCU will report the event to HES, HES will make further decisions, automatically or manually synchronizes meter clock
< 30 seconds	No action, the meter's clock will be synchronized in next day's clock synchronization procedure of DCU.

Table 2 - Clock parameter configuration

## 4.3 Meter Network Management

### 4.3.1 Meter Discovery and Auto-routing

DCU automatically discover the new-installed meters. Automatically routing will be provided by DCU for meters.

Once DCU discovers new meter, if the meter is not registered in the DCU, DCU will records the meter's register information into the meter discovery table and report the register information to HES, then HES can read the meter discovery table and download the meter archive information into DCU.

### 4.3.2 Meter Register Management

DCU can manage meter registration in the grid, to solve the crosstalk issue, DCU provides the whitelist function, etc. The DCU supports remote or local maintenance of these functions.

## 4.4 Indicators

### 4.4.1 DCU LED indicators

DCU has ten LEDs to indicate the working status.

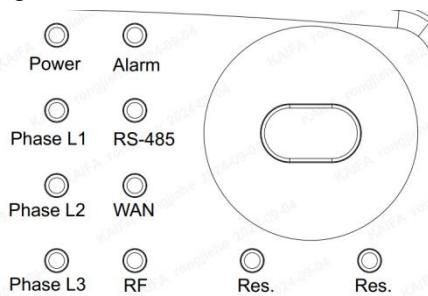


Figure - 12 LED indicators of DCU

No.	LED	Status	Description
1	Power	ON	Always on when power supply is ok
2	Phase L1	ON	Phase L1 Power On
		OFF	Phase L1 Miss
		BLINK	Phase L1 Power On, but _neutral miss
3	Phase L2	ON	Phase L2 Power On
		OFF	Phase L2 Miss
		BLINK	Phase L2 Power On, but _neutral miss
4	Phase L3	ON	Phase L3 Power On
		OFF	Phase L3 Miss
		BLINK	Phase L3 Power On, but _neutral miss
5	Alarm	RED BLINK	Alarm (LTE module failure, RF module failure, Optical port failure, Main cover removal, Terminal cover removal, module cover removal, RS-485 port failure, Internal battery low Clock invalid) is detected in DCU
		OFF	No alarm
6	RS-485	RED BLINK	RS485 is receiving data
		GREEN BLINK	RS485 is transmitting data
		RED ON	RS485 interface failure
7	WAN	RED BLINK	4G/2G/Ethernet is receiving data
		GREEN BLINK	4G/2G/Ethernet is sending data
		RED ON	4G/2G/Ethernet failure
		GREEN ON	HES connected
		OFF	4G/2G/Ethernet is not sending or receiving
8	RF	RED BLINK	RF is receiving data
		GREEN BLINK	RF is transmitting data
		RED ON	RF module failure
9	Reserved	-	-
10	Reserved	-	-

Table - 3 Descriptions of key event logs

#### 4.4.2 4G/2G module LED indicators

DCU has three LEDs to indicate the working status of 4G/2G module.



Figure - 13 LED indicators of 4G/2G module

No.	LED	Status	Description
1	Power	GREEN ON	4G/2G Module Power On
		GREEN OFF	4G/2G Module Power Off
2	NET	GREEN ON	Module register network success
		GREEN BLINK	Network registering
		GREEN OFF	Module don't register network
3	4G/2G Signal	GREEN ON	The signal quality is good
		GREEN BLINK	The signal quality is poor
		GREEN OFF	The signal quality is poor or no SIM Card

Table - 4 Descriptions of LEDs of 4G/2G module

#### 4.4.3 RF communication module LED indicators

DCU has five LEDs to indicate the working status of RF communication module.



#### CR197 RF Module

Figure - 14 LED indicators of RF communication module

No.	LED	Status	Description
1	Power	GREEN BLINK	RF Module Power On
2	URAT_RX	GREEN BLINK	URAT is receiving data
3	URAT_TX	GREEN BLINK	URAT is sending data
4	RF_RX	GREEN BLINK	RF Module is receiving data
5	RF_TX	GREEN BLINK	RF Module is sending data

Table - 5 Descriptions of LEDs of RF communication module

## 4.5 Automatically Meter Data Collection

DCU automatically collects the data from single phase meter, three phase meter. The data type for automatically connection includes monthly billing data, daily profile data, load profile data, and meter event logs. It is configurable(base time, enable, disable, frequency, etc.) the data collection for each type of data via remote or local interface. The data collection support real-time push to HES and also supports on-demand reading.

### 4.5.1 Re-collect the Data

In case of missing some data for the meters, DCU will automatically re-collect it from the meters:

Data Type	Re-collection Period
Monthly billing data	Last two month
Daily profile data	Last two days
Load profile	Last two days

Table - 6 Re-collected parameter configuration

### 4.5.2 Storage Capacity

Below table defines the storage capacity for each meter's monthly billing data, daily profile data, load profile data and meter event logs:

Data Type	Capacity
Monthly billing data	24 months
Daily profile data	93 days
Load profile	15 days
Meter Event logs	31 days

Table - 7 Storage capacity of DCU

Current DCU design meets the storage requirement, Meanwhile, DCU also supports USB memory scalable/upgradable. The data will be first in first out (FIFO).

The data will be stored in a compressed and encryption manner.

### 4.5.3 Data Upload to HES

HES can read the meters' data stored in DCU through DLMS protocol via the DCU's WAN communication port. The new read data will be compressed in files and sent to the HES by FTP. It is configurable for the FTP data uploading schedule.

### 4.5.4 Meter Alarm Report To HES

When a meter generates an abnormal alarm and reports it, the DCU can receive the alarm and forward it to the HES, so that the HES can view the alarm list of each electric meter. For the detailed alarm list of the meter, refer to the relevant documents of the meter.

## 4.6 On Demand Request and Response Transferring

DCU works transparently to get the on request from the HES, and transfer the request to specified meter, and transfer the response from the meter to the HES. DCU does not interpret the request and response. In any moment of time the On-Demand request is the highest priority.

The request to meter includes but not limit to:

- 1) Read meter status, energy registers, instant parameters, other registers
- 2) Read tariff schedule(Season, Week, Day, Special days, etc.)
- 3) Read clock
- 4) Set meter parameters, tariff schedule
- 5) Remote upgrade the meter
- 6) Set clock
- 7) Connect or disconnect the meter
- 8) Read monthly billing data, daily profile data, energy load profile data, power quality load profile data, and event logs.

## 4.7 Self-diagnose and Working Status

DCU self-diagnose the communication ports (i.e. 4G/2G module, RF, RS485, RS232, optical port etc) and clock.

The DCU status word shows the self-diagnostic result and the current working status:

Bit No.	Description	Set Condition	Reset Condition
0	Device power up	DCU is power up	
1	4G/2G module failure	4G/2G module failure	Recovered from failure
2	4G/2G signal level is too low	4G/2G CSQ less than 11, signal quality level is too low	LTE CSQ is not less than 11
3	Reserve	Reserve	Reserve
4	RF module failure	RF communication module failure	Recovered from failure
5	Flash space full alarm	Flash memory is occupied over 80%	Flash memory is not full
6	Main cover removal	Main cover is removed	Main cover is closed
7	DCU unlock	DCU is unlock	DCU is locked
8	Optical port failure	Optical port self-diagnose failure	Recovered from failure
9	RS-485 failure	RS-485 self-diagnose failure	Recovered from failure
10	Terminal cover removal	Terminal cover is removed	Terminal cover is closed
11	Clock invalid	Clock is invalid	Clock is set
12	Neutral lost	DCU neutral line disconnected	DCU neutral line reconnection
13	Reserve	Reserve	Reserve
14	Phase failure	Any phase is power down	All phase is power up
15	Image download flag	Meter firmware upgrade is in progress	Meter firmware upgrade is not running
16	Module cover removal	Module cover is removed	Module cover is closed

Table - 8 Self-diagnose parameter

## 4.8 Firmware Upgrade

### 4.8.1 DCU Firmware Upgrade

Firmware upgrade of DCU supports local upgrade and remote upgrade.

Upgrades can be performed via DLMS protocol or FTP protocol.

### 4.8.2 Meter Firmware Upgrade

HES can request DCU to upgrade the meter's firmware. DCU will firstly download the meter firmware from HES via FTP protocol or DLMS protocol, then start to download the firmware to the specific meters. The meter firmware upgrade procedure compliant to the DLMS firmware upgrade procedure.

## 4.9 Event Logs

DCU will record all key event information, all event information is recorded in DCU internal storage, some of which will be reported to HES immediately, of course, HES can also read all event records from DCU by any time.

DCU supports last gasp function. Once a power off is detected, with the supports of super-capacitors, DCU will immediately push a last gasp event to HES before it is power off. The DCU records the following events. It is configurable whether push the event to HES. In the following table, the column “Push” describes which events are pushed by default once they are generated.

Group	Event Code(hex)	Description	Push	Capture Object
Standard	0x00010001	DCU Power On	YES	Event code, Timestamp
	0x00010002	DCU Start DC power supply	YES	
	0x00010005	DCU Power Off	YES	
	0x00010006	DCU Failure DC power supply	YES	
	0x00010007	DCU Low battery	YES	
	0x00010009	DCU Time change	YES	
	0x0001000F	DCU Minimum free flash memory reached	YES	
	0x00010013	DCU parameters change	YES	
	0x0001001A	DCU Low Battery Recovery	YES	
	0x00010021	DCU Clock sync mode change	YES	
	0x00010029	Clock invalid	YES	
	0x0001002A	Gprs modem fail	YES	
	0x0001002C	RF module error	YES	
	0x0001002F	DCU Voltage Cut L1	YES	
	0x00010030	DCU Voltage Cut L2	YES	
	0x00010031	DCU Voltage Cut L3	YES	
	0x00010032	DCU Neutral Line Missing	YES	
	0x00010035	DCU Maximum CPU utilization reached	YES	
	0x0001003B	DCU reboot	YES	
	0x00010040	Fail to synchronize DCU clock by SNTP.	YES	
	0x00010043	Less than the minimum threshold of SNTP	NO	
	0x00010044	Greater than the maximum threshold of SNTP	NO	
	0x00010045	DCU Remove battery	YES	
	0x00010046	Gprs modem reset	YES	
	0x0001004A	New meter has been discovered.	YES	
4GLTE-log	0x0001004C	power off and external battery capacity above 20%	YES	
	0x0001004D	power off and external battery capacity is less than or equal to 20%	YES	
	0x00010057	Replace Battery	YES	
	0x00040009	DCU Low Mobile Network Signal	NO	
	0x0004000A	DCU Mobile Network connection down	NO	
	0x0004000B	DCU No SIM card	NO	
	0x0004000C	DCU The SIM card is asking for a PIN code	NO	

	0x00040026	GPRS Sim success	NO
Fraud	0x00070001	DCU top cover open	YES
	0x00070002	DCU Top cover closed	YES
	0x00070003	DCU terminal cover open	YES
	0x00070004	DCU Terminal covers closed	YES
	0x00070005	DCU module cover open	YES
	0x00070006	DCU module covers closed	YES
	0x0007000A	I/O status change digital	NO
	0x0007000C	DCU box close	YES
	0x0007000D	DCU box open	YES
	0x0007000E	SPD connect	YES
	0x0007000F	SPD disconnect	YES
Communication Event	0x0503	Local communication connection happened	No
	0x0505	Remote communication connection happened	No
	0x0502	Error communication key	Yes
Meter Event	0x3201	Meter is unreachable	Yes
	0x3202	Meter is reachable	Yes
	-	All types of meter event pushed by meter	Yes
Firmware	0x004B	Firmware upgrade end	Yes
	0x0052	Firmware upgrade start	Yes
	0x0301	DCU firmware upgrade successfully	Yes
	0x0315	RF firmware upgrade successfully	Yes

Table - 9 Descriptions of key event logs

## 5 Communication Interfaces

The DCU provides following communication interfaces:

Function	Interface	Baud Rate	Protocol
Local	Optical port	9600 bps	DLMS/COSEM HDLC profile
	LAN Ethernet	10/100M	DLMS/COSEM TCP/IP Profile.
WAN	4G/2G	Downlink transfer: max. 10Mbps Uplink transfer: 5Mbps	DLMS/COSEM TCP/IP Profile.
	WAN Ethernet	10/100M	DLMS/COSEM TCP/IP Profile.
LAN	One Lora RF port	Communication frequency band: 915MHz~918MHz Channel: CH0: 915.4MHz CH1: 916.2MHz CH2: 916.95MHz CH3: 917.75MHz Communication bandwidth: 500kHz Spreading factor: SF8 Communication data rate: 12500bps Maximum TX power: 22dBm	DLMS/COSEM TCP/IP Profile.
	RS-485	Up to 115200bps, default 9600bps	DLMS/COSEM HDLC profile

Table - 10 Baud rate of communication interfaces

### 5.1 Local Communication

#### 5.1.1 Optical Port Communication

The Optical Port is based on IEC 62056-46 direct HDLC profile. All read-out procedures need to be compliant to DLMS / COSEM. It is used to read DCU and configure the DCU parameter or control the DCU locally. In general, PC software is used to communicate with DCU via this optical port.

#### 5.1.2 RJ-45 Ethernet Communication

The RJ-45 Ethernet is based on DLMS/COSEM TCP/IP Profile protocol. It is used to read DCU and configure the DCU parameter or control the DCU locally.

## 5.2 WAN Communication

The DCU has one replaceable 4G/2G module as the main WAN communication interface, and has an Ethernet communication interface as a backup WAN communication interface.

DCU supports all the following protocols: TCP/IP, ipv4, ipv6, DHCP, NTP, VPN, IPsec, and SSL/TLS Internet.

### 5.2.1 4G/2G

Remote communication uses 4G/2G, and bases on DLMS/COSEM TCP/IP profile. The key features of 4G/2G are listed in below table:

<b>General Function</b>	<b>Performance &amp; Availability</b>	<ul style="list-style-type: none"> <li>- FDD-LTE CAT1 B1/B3/B28, TDD-LTE CAT1 B40/B41, GPRS 900/1800 MHz</li> <li>- Control via AT commands</li> <li>- Operation temperature: -25°C to +80°C</li> <li>- Support reconnection behavior after detecting an unexpected interrupted communication session.</li> </ul>
	<b>Roaming</b>	<p>Support national roaming between 4G/2G networks of different national telecom providers.</p> <p>Support SIM cards with multiple IMSI.</p>
	<b>SIM</b>	Support 2FF SIM card. Specially, the recommended thickness is 0.76mm.
	<b>LED</b>	<p>Indicate 4G/2G signal strength in a minimum of 3 separate levels.</p> <p>In addition, the module also has three indicators to indicate some states. Refer to LED indicators.</p>
	<b>Antenna</b>	<p>Support both internal antenna and external antenna. Exchange the antenna without de-energizing the device.</p> <p>Default configuration: Internal Antenna, which under terminal cover</p>
<b>Access and connection</b>	<b>Wake-up</b>	<p>Support fully qualified domain names.</p> <p>Receive and store the IP addresses of the primary and secondary address when establishing a PDP context based on the DHCP protocol</p> <p>Support data pushing.</p>
	<b>Authentication and security</b>	<p>Changeable APN/password</p> <p>Support RADIUS authentication using PAP or CHAP.</p> <p>Network access information is not saved on the SIM cards</p> <p>Communication settings to be remotely configurable</p>
	<b>Assign IP address</b>	4G/2G module support both dynamic IP address assignment and static IP address

Table - 11 Key features of 4G/2G

The 4G/2G parameters are generally programmed in the factory. It is also possible to change the communication parameter remotely or locally.

Three communication LEDs are used to indicate the communication status, refer to LED indicators chapter for the 4G/2G status indication.

## 5.2.2 RJ-45 Ethernet Communication

DCU supports two Ethernet ports which can be used for remote communication and local communication.

## 5.3 LAN Communication

DCU supports two LAN communication interfaces:

- 1) One Lora RF port, which is embedded in the main board
- 2) A RS-485 communication interface.

### 5.3.1 RF Communication

RF communication is based on DLMS/COSEM HDLC profile. The key features of RF are listed below:

- ◆ Communication frequency: 915.25M, 915.85M, 916.60M, 917.10M, 917.75M
- ◆ Auto-repeater, network self-healing
- ◆ Meter auto-registration
- ◆ Up to two repeater levels

Refer to LED indicators chapter for the RF communication status indication.

### 5.3.2 RS-485 Communication

DCU has one RS-485 communication port, which can be used to connect to CIU (Customer Interface Unit). The interface supports DLMS/COSEM HDLC profile.

### 5.3.3 Physical Security

The DCU has two seals for module cover, two seals for main cover, one seal for the terminal cover, one seal for battery cover, one seal for 4G/2G module cover. It is impossible to access the DCU internal part unless physically and transparently destroy the seals and the DCU main or terminal cover. The DCU records the main cover removal event and terminal cover removal event in both power on condition and power off condition.

## 5.4 Communication Security

The DCU supports state-of-art security for data access and data transportation basing on a role-based security. Each role has its own access privileges. Here below table lists all the roles, their privileges, security mechanism:

Role	Client ID	Privileges	Security Mechanism
Public	16	Read limited DCU information, like the DCU serial number.	No
Read-Only	2	Read DCU	LLS Mechanism id 1
Read-Write	1	Read DCU, configure DCU parameters	HLS Mechanism id 2

Table - 13 Communication security

## 5.5 Keys of DCU

The DCU has the following keys for each DLMS client.

No	Type Name	Description
1	Secret	Password for LLS client
2	Authentication key	Ensure data integrity and authenticity
3	Encryption key	Ensure data confidentiality
4	Master key	Use to change other keys

Table - 14 Different keys of DCU

Each DCU has its own individual keys once out of factory. The key will record in shipment file and provide to customer separately

## 5.6 LAN Communication Security

DCU follows smart meter's security policy. All communication to meters are authenticated and encrypted, and the DCU keys is updatable from HES.

## Annex 1 RF communication channel

Channel	Frequency(MHz)	Channel	Frequency(MHz)
1	915.40	3	916.95
2	916.20	4	917.75