



IEC 61036
IEC 1107

C1000 Single-phase Multifunction Meter

*Product Description
Operating Instructions
Features and Technical Data
Maintenance Instructions
Diagrams and Figures*

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1. Features and Applications

Blue Star's C1000 Multifunction Meter meets the IEC 60687 (class 0.5S) standard for multifunctional energy meters. The main features of the product include none physical adjustment components, digital signal processing, digital filters, digital error correcting, digital calibration, immunity to temperature fluctuation, and excellent stability. Due to its twelve times overload multiplier, the meter can record extremely low energy usage. C1000 can also measure voltage, current, power factors, and power accurately.

The basic functions of C1000 include data processing units of 4-tariff active bidirectional (import and export) energy, coincident 4-tariff maximum demand indications and other related functions.

Data can be retrieved through energy registering system, which consists of load-control terminal or other data terminal devices via RS485 interface. The communication protocol complies with DL/T 645-1997 standard (Communication Protocol Standard for Multifunction Energy Meters).

Infrared communication protocol complies with DL/T 645-1997 norm too. Blue Star's handheld terminal PR310 supports infrared communications and is compatible with all our previous products. Users do not need to select meter types because programming machine can automatically identify the type and set up the meter correspondingly.

Available C1000 models:

- | | | |
|-----------------|---------------|-----------------------|
| 1. 1.5 – 6 (A) | Constant 4000 | Range 0 – 99999.99kWh |
| 2. 5 – 60 (A) | Constant 4000 | Range 0 – 999999.9kWh |
| 3. 10 – 120 (A) | Constant 4000 | Range 0 – 999999.9kWh |

Optional Functions:

1. Temperature Compensation: With a temperature measurement IC, C1000 can adjust the internal clock precision according to environmental temperature fluctuation.
2. Display during Power-off: During power-off time, C1000 can stay in sequential display mode, C1000 will update LCD display every 8 seconds to display current total, spike, peak, level and valley active import (export counted in active) energy for 24 hours, then C1000 will turn off display mode automatically.

C1000 Meter data processing functions include:

1.1 Energy Metering

1. Energy measurement using digital measuring chips, therefore metering precision can be digitally verified.

2. 4-Tariff active import and export energy and total energy metering through data provided by energy measuring integrated chips.
3. Reactive energy is counted into active energy register too, i.e. active = reactive + active. There is another group of energy registers for metering reactive energy only, this way C1000 can flexibly meter bidirectional energy.
4. There is one pulse output which can be used for verifying pulse or collected by other equipments. The pulse width is 80 ms. Telecontrol pulse will be output upon both active import and export energy.
5. Pulse indication of energy metering using one bright LED which indicates active energy. (The LED's on time equals to the output width of verifying pulse).

1.2 Demand Indicating

1. Calculating functions of active import and export energy four-tariff demands include total 10 demand data with the occurrence time of each demand data. The format of time data is "month, date, hour, minute". The month is displayed in hexadecimal format, A for 10 (October), B for 11 (November) and C for 12 (December). The indication range of energy demand (including power) is 0 - 99.9999 kW.
2. Calculating mode can be Block or Rolling (see definitions for two modes in Multifunction Energy Meter Standard DL/T 614-1997).
Rolling Mode: Rolling interval can be set to 1, 2, 3, or 5 minutes and demand cycle can be set to 5, 10, 15, 30, or 60 minutes. If demand cycle is set to 60 minutes, rolling interval can only be set to 2, 3, or 5 minutes. Demand cycle must be integer multiple of rolling interval.
Block Mode: Demand cycle can be set to 5, 10, 15, 30, or 60 minutes.
3. In order to gather more data, C1000 provides power calculation function, which calculates the average power in a cycle shorter than demand calculation cycle. In rolling mode, the cycle equals to the rolling interval. In block mode, it can be set independently to 1, 2, 3, or 5 minutes, but it needs to be integer multiple of demand cycle. (If demand cycle is set to 60 minutes, then the power calculation cycle can only be 2, 3 or 5 minutes). In addition C1000 also calculates Second Instantaneous Power and Minute Average Power. Second Instantaneous Power is the average power in one second, which is updated every second and can be used as real-time monitoring of electricity use status; Minute Average Power is the average power in one minute, which is updated every minute and can be used to judge if the actual meter load exceeds the up limit.
3. Each average power of demand cycle is calculated and saved, which can be displayed or read through load curve.
4. When time block changes, the update of tariff demand occurs after the period of "demand calculating cycle", but the total demand is not affected and may update anytime. In general, total demand equals a certain tariff demand. But sometimes total demand may exceed all the demand combined. In other words, the maximum demand is recorded when time block is changed.

1.3 Time of Use (TOU) Revenue

1. TOU can be controlled by configuring the parameters that are based on the meter's internal hardware real-time clock.
2. There are 3 levels of TOU controls, in preferential sequence, they are: "Public Holiday", "Weekend" and "Season".
3. There are 4 sets of "daily-profile" tables and 4 controlling schemes for fixed tariffs. In each "daily-profile" table, one day can be divided into 10 time sections and each time section can be assigned one of 4 tariffs. Time section of weekend and season can be controlled by selecting one of 4 "daily-profile" tables. In order to save time section table resources, when it is possible to set a fixed tariff for a certain day (i.e. there is no time block switch in that day), user can directly select tariffs when setting tariff for weekends and seasons without using a whole time block table.
4. TOU can set 10 years of holiday tables for public holidays, and each year may set 24 days for public holidays.
5. Weekend TOU can have up to 2 days as weekends for each week.
6. A year can be divided into up to 10 time sections. The shortest section is one day and the longest section one year.
7. "Daily-profile" can divide a day into 10 time sections. Each section can select one of 4 tariffs. The shortest time is one minute, and the longest one day.
8. When setting daily-profile table and season in handheld terminal, user should not input other data after inputting the initial number and tariff (time-section table) of the last time section. User must end input with a "confirmation" command. Program will automatically connect the "end" of the last time section with the "head" of the first time section to ensure that uncertain time section will not occur in one day (or one year).
9. There are 4 sets of daily-profile and 4 fixed tariffs. "Public holiday", "Weekend" and "Season" can be controlled by selecting one of 4 daily-profiles.

1.4 Automatic Meter Reading

1. C1000 meter can be configured to record dynamic data at a pre-selected time to achieve the tasks of energy storing and demand reset automatically. The time is specified by 'day/date' and 'hour'.
2. The automatic meter reading cycle can be monthly or weekly. Each cycle may execute up to eight times of automatic meter-reading, i.e. eight times per month or per week. The date of automatic meter reading can be set as non-zero value, namely date XX hour XX or weekday X hour XX, so one day can have multiple meter-reading. When cycle value is "month", meter-reading date can only be set from 1 to 28.
3. Automatic meter reading can be configured to execute energy recording and demand reset independently.
4. If the meter reading happens when power is off, C1000 will execute a reset when it powers up.

1.5 Data recording

Sixteen energy and demand data can be recorded respectively to match with this product's multiple automatic meter-reading function and its multiple reset options. Time value for each reset operation (year/month/day/hour/minute/second) can be read through extended DL/T645 protocol. Corresponding reset option is recorded also.

1.6 Recording of power outage time

1. C1000 meter can record up to 64 times of power outage with "month/day/hour/minute" time stamp of power-down and power-up time in order to analyze meter's working status, this data can prevent human-related malfunction and improved metering reliability.
2. Data recording always keeps the last 64 power outage records. These records will be cleared after programming again.

1.7 Inputs and outputs

1. Powerless pulse output interface with optical-coupling insulation.
2. Data output interface (RS485 port) with optical-coupling insulation.
3. Infrared display with remote control to replace keypad.
4. Infrared remote control programming and meter reading interface, which is in accordance with DL/T 645 standard.

2. Operation Instructions

2.1 Running and display

2.1.1 Operation

There are two modes after data processing unit powers up:

1. Running Mode: In this mode, C1000 meter can perform timeswitch metering, demand calculating and load monitoring, and automatically display data at given time as programmed;
2. Programming mode: C1000 will switch to this mode after holding reset button for 8 seconds. In this mode, LCD will display message "PRG". It will only process energy counting, demand calculating and time-section switch without handling other functions such as timing display or load monitoring. C1000 will exit from this mode when reset button is pushed again, or exit automatically if no button was pushed for 4 minutes.

When data processing unit is running, LED will flash once an effective energy pulse is registered, no matter which mode it is in.

2.1.2 Data display

1. There are 3 types of data display modes:
 - 1) Timing display: user can choose from four types of time intervals. The display is automatic and can be used for routine monitoring.
 - 2) Inquiry display: User may continuously push button until the needed data is displayed. This can be used to check records in the meter.
 - 3) Voltage, Current and Power Monitoring Display: User can set the interval (0-15 seconds). Except when displaying the meter number, storage value, time block, battery outage symbol, C1000 will display the values of voltage, current and power alternatively.

The above 3 display modes can be set through communications protocol, and the display codes are open to user, so he can configure display by programming.

2.2 Programming

C1000 meter's parameters can be configured from PC or from handheld programmer according to communications protocol. Programming counts and times are also recorded which can be read through communications.

2.2.1 Programming protection

In order to ensure data security and prevent non-authorized operation, this C1000 provides 2 levels of programming protection. User can select

either of them:

Level 1: This level of protection supports password-programming mode of DL/T 645 protocol. User can directly program through infrared channel or through RS485 channel without opening seal as long as password is correct. This is factory default option.

Level 2: User can enter “programming mode” by pushing reset button only after the seal is opened. Then program C1000 same as level 1.

Two levels of protection are listed in PC’s programming software, from which user can select either one.

2.2.2 Password

According to DL/T 645-1997 standard, C1000 supports 2 levels of password. Level “0” is used in programming and demand resetting. Level “1” can be used only in demand resetting. Two levels of passwords can be modified through password modification command specified in DL/T 645-1997 standard. User can return the meter back to factory if he loses password.

Level “0” password is set to “666666” by default. Neither PC nor handheld terminal programming software provided by manufacturer supports password modification until product reaches end user. End user should set a new password through DL/T 645-1997 Standard compatible program or software provided by our company and keeps it securely.

2.2.3 Programming method

Parameters of data processing unit with “level 1” protection can be programmed as long as the communication connection is correct.

In order to set the parameters in data processing unit with “level 2” protection, user needs to unlock the seal on the right side of LCD first to open the case cover, then press reset button (approximately 8 seconds) until LCD screen displays “program”. Now data processing unit is ready for programming. Follow the instructions described in “level 1” protection.

Cautions when programming:

1. When programming through handheld programmer on meter-calibration desk, please turn off infrared meter-calibration photoelectric head and other infrared source.
2. C1000 will switch to programming mode after reset button is pressed and held for approximately 8 seconds. “RES” will be displayed approximately 3 - 4 seconds after reset button is being pressed if manual reset is enabled.
3. Load curve parameter can be programmed only through RS485 port, not by handheld terminal PR300 due to its internal storage space limit.
4. There should be no current when setting up bottom number, constants,

demand calculating period and rolling interval. Otherwise metering error may occur. If demand calculating cycle and rolling interval are changed, demand-reset operation should be performed.

5. User should avoid assigning the same serial number to different meters. Otherwise meters can not be programmed through infrared when they are put side by side.

2.3 Constants Setting

C1000's constants are set fixed and can not be changed by user.

2.4 Initial Value Pre-setting

User can pre-set the initial value of active/reactive energy into total energy register and one certain tariff register by programming. Other tariff registers values will be cleared. User can select which tariff register to have an initial value. Active energy value will be set to positive direction register while negative direction registers will be cleared. Reactive energy will be set to quadrant-1 while all other quadrants values will be cleared.

C1000 can save up to 16 historical data, only latest 4 data will be cleared when clearing the historical data. When communicating through infrared port, historical data will not be cleared because there are too many data. User should use "demand clearing" command to clear all the historical data.

2.5 Reset

Reset energy data and current maximum demand data.

C1000 provides the following 4 types of reset operations:

Manual Reset is done by pressing the reset button embedded inside the front cover until "RES" is seen on the screen, then energy data and current demand data will be cleared.

RS485 Reset is done by sending a "maximum demand clearing" command defined in DL/T 645 standard to the meter through RS485 bus. This function is the same as manual reset type.

Infrared Reset is done by sending a "maximum demand clearing" command defined in DL/T 645 standard to the meter through infrared channel. This function is the same as manual reset type.

Automatic Reset is done by setting automatic meter-reading date. The cycle of automatic meter-reading can be "month" or "week". Up to 8 automatic meter-reading can be set in each cycle, i.e. 8 times per month or per week. The value of automatic meter-reading time can be set to none-zero, i.e. day xx hour xx to allow more than one meter-reading in one day. When "month" is selected as cycle, meter-reading date can be chosen only from 1 to 28. Energy storing and demand clearing can be executed separately in automatic meter-reading operation once set at

programming.

Energy Storing operation performs:

1. Storing current active import, export and total energy at reset (meter-reading)
2. Saving of historical demand data in rolling mode.
3. Recording the operating time (year month day hour minute second) and operating mode (Manual, Infrared, RS485, and Automatic).

Demand Reset operation performs:

1. Saving the active import, export and energy value, maximum demand data as well as the corresponding time (month day hour minute) before reset (meter-reading)
2. Saving historical demand data in rolling mode
3. Clearing current maximum demand data
4. Counting the times of reset command (data clearing) executed
5. Recording the operating time (year month day hour minute second) and operating mode (Manual, Infrared, RS485, and Automatic).

2.6 Meter-reading

To retrieve data from energy meter

2.6.1 Manual meter reading

All data selected by programming can be displayed by pressing display button or using remote control.

2.6.2 Reading meter using handheld terminal

(See handheld terminal explanation for details)

Traditional manual meter-reading can hardly avoid all reading errors when a lot of data are programmed to display. Reading meter using meter-reader will be the primary option. Manual meter reading might be used as a supplement or as an arbitral means when an argument occurs.

3. Specifications and technical data

4.1 Specifications

4.2 Technical data

4.2.1 Power supply

Meter type	Current (mA)	Power consumption (VA)	Power (W)
220V (transformer)	<5	<1	<0.7
110V (transformer)	<4	<0.8	<0.5

3.2.2 Pulse output

There is one channel of pulse output which will output fixed 80 ms wide telecontrol pulse upon both active import and export energy. The output is passive optical-coupling.

Telecontrol pulse may also be used as verifying pulse.

3.2.3 Maximum demand indication

Calculation method: rolling or block

Calculation cycle: 5, 10, 15, 30, or 60 minutes

Rolling interval: 1, 2, 3, or 5 minutes

Recording range: 99.9999 kW

Additional error: $\pm (0.5+0.05 P_m/P_n) \%$

P_m - power value at I_{max} ($\cos\phi=1.0$)

P_n - equivalent real power value on demand indicator

Reset mode: manual, automatic, infrared, and RS485

3.2.4 Clock

Electric clock: displaying year, month, day, week, hour, minute, second; in 24-hour format.

Error at $23^\circ\text{C}\pm 2^\circ\text{C}$: ± 0.5 seconds/day

Error limits under working condition: ± 2 seconds/day

Errors less than 5 minutes can be corrected according to the method specified in DL/T 645 standard. See DL/T 645 for details.

3.2.5 Delay of time block switch

Less than 0.1 second

3.2.6 Back-up battery

One long-lifetime super lithium battery is provided to be used for power-down protection for clock, data and time block settings. One extra button lithium battery is also provided to act as backup for the super lithium battery.

- Lifetime of the button lithium battery: ≥10 years. Lifetime of the super lithium battery: ≥30 years.
- Sustaining time during continuous power-off period with either battery working alone: > 6 years.
- Two batteries are parallel connected to guarantee excellent reliability.

3.2.7 External size and weight

External Size: 11.3 x 6.6 x 3.3 (286 x 168 x 85 mm)

Weight: 1.8 kg (4 lbs)

3.2.8 Data output interface

1. C1000 provides an infrared data communication channel to transfer data by using 38 kHz modulated infrared signal. The communication protocol complies with DL/T 645-1997 <multifunction energy meter communication standard>.
2. There is an isolated RS485 data communication channel. Baud rate can be 1200, 2400, 4800, or 9600 bps. Default value is 1200. It supports various communication protocols including DL/T 645-1997
3. Power supply for output interface can be selected from external 9-12 V DC power supply or internal isolated power supply.
4. The RS485 interface supports various protocols including DL/T 645-1997 protocol. The protocol can be selected through programming.
5. Infrared communication supports DL/T 645-1997 protocol only.
6. All parameters can be set and all data can be retrieved through infrared and RS485 data communication channels.
7. “Energy freezing” and “time synchronization” (clock adjustment) can be set through data communication.

4.3 Detailed explanation of DL/T645-1997 communication protocol support

3.3.1 Command types supported

The meter supports read command, write command, broadcasting time-synchronization command, password-change command, maximum demand clearing command, and communication speed change command. It does not support following commands: read command, rewrite command, and device address write command.

3.3.2 Data available for read command

3.3.2.1 Data types supported

The meter supports read operation of four data types from class 9 to class C.

3.3.2.2 Data mark and muster

Four kinds of read operations are supported for class 9 (energy register) and class A (maximum demand) data. They are single record read, cluster read, positive/negative direction combination, and active/reactive energy combination.

Three types of read operation are supported for demand supporting time of class B, i.e. single data read, cluster read, and positive/negative direction muster. Data single read and data cluster read are supported for other items in class B.

Data single read and data cluster read are supported for all data except C 3 XX in class C. C 3 XX does not support data single read.

3.3.2.3 Data items that can be supported in various types of data

Maximum demand occurring time in class 9 (energy quantity), class A (maximum demand) and class B: data of active/reactive import/export energy direction and reactive energy of four quadrants are supported.

Commands of B634 and B635 in class B are not supported.

Only data of B 210-B 214, B61X, B62X, B630 in class B can be supported.

Data of C410-C41D and C5XX in class C are not supported because load curve record is continuous and there is no specified starting time. Instead, they can be read through extended command.

C113 and C114 data are returned as "BB" because each display data has different display time.

Writable Data items in write command

Data items of C010, C011, C032, C033, C034, C111, C112, C117, C119, C11A, C211, C32F, C33F, C34F, C35F, and C36F are supported.

Be cautious while writing C111 and C112 data because demand period should be divided exactly by glide time. Glide time C112 should be written first, then is demand period C111.

After data C117 is written, the multiple "automatic meter-reading days" sets using our company's programming software will be deleted and only written meter-reading date will be reserved. Also only three

modes of reset, i.e. automatic, 485 port, and infrared port are allowed.

Load representing date does not support read and write commands.

Be cautious when writing energy initial numbers of C119 and C11A:

The initial number is specified in the protocol as 6 digits of integers, 1 digit of decimal and 4 bytes long. In order to be complied with class 9 data, one digit of decimal is added, namely 6 digits of integers and 2 digits of decimals. The corresponding four bytes consist of three bytes of integers and one byte of decimal.

It is suggested to set initial number through programming software provided by our company.

Output pulse breadth C211 can only be set as 20-150 ms. The minimum resolution is 10 ms. The highest digit and the lowest digit of four digits of parameters while setting will be omitted. Error will occur if pulse breadth is "0" or bigger than 150 ms.

Password authorization and password C212 only support modifying password command (OFH). They do not support write command.

Time-section data must be written in the form of data block. The number of time-section and time period should be larger than "0" and less than or equal to "10".

C37F - C3AF are defined as single tariff in this product corresponding to four tariffs of climax, peak, pain and valley. They cannot be set.

4. Use, transportation and storage conditions

- Same requirements as indoor meters.
- The number of piling layers should not exceed five in original package.
- Moisture absorbent must be provided inside sealed package.
- It is strictly forbidden to store the meter in the environment of high temperature or dense moisture for long period of time. Humidity and temperature requirement should strictly comply with article 8.2.3 of DL/T 614-1997 standard (0 - 40 °C, <85% RH, and no erosive substance).

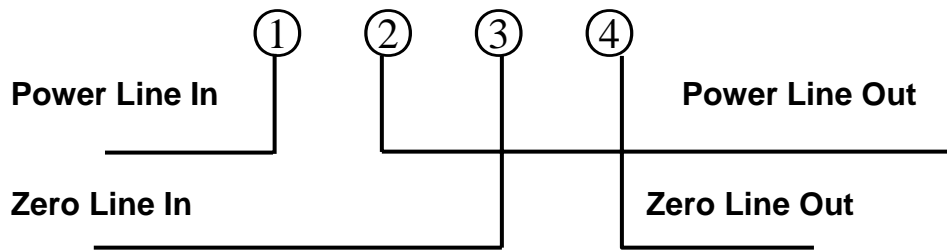
5. Warranty

The product will be repaired or replaced free of charge within 18 months if technical data do not comply with the standards when the product has been used properly according to the manufacturer's manual and the seal remains intact.

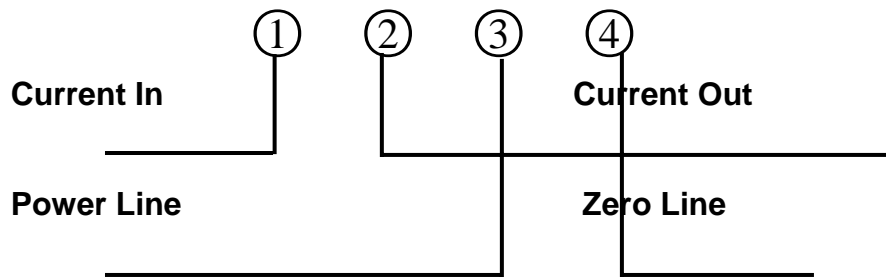
6. Ordering

Meter types and specifications must be specified in the orders. Either pulse output or data output should be specified. If data output is selected, whether two-line or four-line connection pattern should be specified.

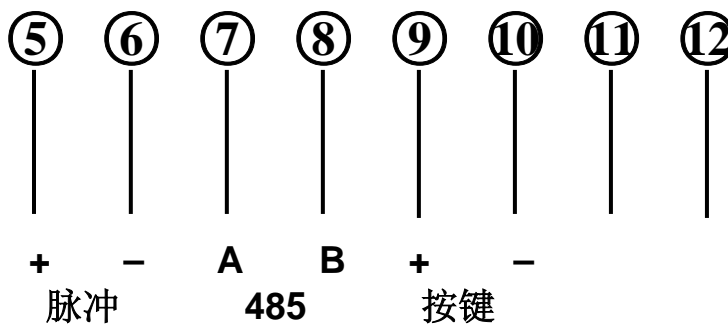
Appendix A: Connection Diagram – Direct Mode



Appendix B: Connection Diagram – Inductive Mode



Appendix C: Signal Connectors



Note: There is 110 V signal on the circuit board. Please don't touch the board while it is power up, even there is protection in the circuit.