



## **ADL3000-E-B**

Installation and operation instruction V1.0

**ACREL Co.,Ltd**

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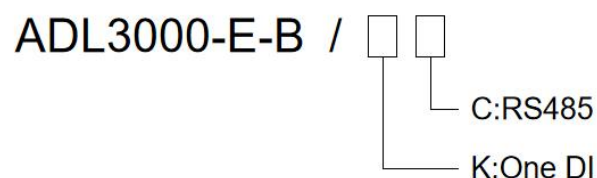
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## 1 General

ADL3000-E-B is a smart meter designed for power supply system, industrial and mining enterprises and utilities to calculate the electricity consumption and manage the electric demand. It features the high precision, small size and simple installation. It integrates the measurement of all electrical parameters with the comprehensive electricity metering and management provides various data on previous 12 months, checks the 31st harmonic content and the total harmonic content, realizes the remote communication and the remote control with switching input . It is fitted with RS485 communication port and adapted to MODBUS-RTU. ADL3000-E-A can be used in all kinds of control systems, SCADA systems and energy management systems. All meters meet the related technical requirements of electricity power meter in the IEC62052-11 、IEC62053-22 standards.

## 2 Type description



## 3 Function description

| Function                             | Function description                                                                                   | Function provide                |
|--------------------------------------|--------------------------------------------------------------------------------------------------------|---------------------------------|
| Measurement of kWh                   | Active kWh (positive and negative)                                                                     | ■                               |
|                                      | Reactive kWh (positive and negative)                                                                   | ■                               |
|                                      | A, B, C phase positive active kWh                                                                      | ■                               |
| Measurement of electrical parameters | U、IP、Q、S、PF、F                                                                                          | ■                               |
|                                      |                                                                                                        | ■                               |
| Measurement of                       | 2~31 <sup>ST</sup> Voltage and current harmonic                                                        | <input type="checkbox"/> Note 1 |
| LCD Display                          | 8 bits section LCD display, background light                                                           | ■                               |
| Key programming                      | 4 keys to communication and set parameters                                                             | ■                               |
| Pulse output                         | Active pulse output                                                                                    | ■                               |
|                                      | Reactive pulse output                                                                                  | <input type="checkbox"/>        |
|                                      | Clock pulse output                                                                                     | <input type="checkbox"/>        |
| Functions                            | Active switch input                                                                                    | <input type="checkbox"/>        |
|                                      |                                                                                                        |                                 |
| Communication                        | Infrared communication                                                                                 | ■                               |
|                                      | The first communication path:<br>Communication interface: RS485,<br>Communication protocol: MODBUS-RTU | <input type="checkbox"/>        |

“■” means standard, “□” means optional.

Note:

1: Harmonic is a standard while choosing outlay transformer, optional for another situation.

## 4 Technical parameter

|                                |                         |                                                                                                          |
|--------------------------------|-------------------------|----------------------------------------------------------------------------------------------------------|
| Specification                  |                         | 3 phase 4 wires, Earthed                                                                                 |
| Voltage                        | Reference voltage       | 3 ~ 66/115V、3 ~ 220/380V(Two sizes)                                                                      |
|                                | Input voltage tolerance | ± 30%                                                                                                    |
|                                | Consumption             | <10VA (Single phase)<br>(Rate current or power for power input <10VA(Single phase))                      |
|                                | Impedance               | >2MΩ                                                                                                     |
|                                | Accuracy class          | Error ± 0.2%                                                                                             |
| Current                        | Input current           | 3 ~ 1(6)A<br>Min:0.01A,Standard:1A,Max:6A                                                                |
|                                | Consumption             | <1VA (Single phase rated current)                                                                        |
|                                | Accuracy class          | Error ± 0.2%                                                                                             |
| Power                          |                         | Active, reactive, apparent power, error ± 0.5%                                                           |
| Frequency                      |                         | 45~65Hz, Error ± 0.2%                                                                                    |
| Energy                         |                         | Active energy (Accuracy class:0.5, 1), reactive energy (Accuracy class 2)                                |
| Energy pulse output            |                         | 1 active optocoupler output, Resistive load (Voltage is not more than 24V, current is not more than 5mA) |
| Switching input                |                         | 1 optocoupler input,Maximum allowed voltage: ~220V, OVC III                                              |
| Measurement category           |                         | CAT III                                                                                                  |
| Width of pulse                 |                         | 80±20ms                                                                                                  |
| Pulse constant                 |                         | 6400imp/kWh                                                                                              |
| Interface and communication    |                         | RS485: Modbus RTU                                                                                        |
| Range of communication address |                         | Modbus RTU:1~ 247;                                                                                       |
| Baud rate                      |                         | 1200bps~19200bps                                                                                         |
| Working temperature            |                         | -25℃~+55℃                                                                                                |
| Relative humidity              |                         | ≤95% (No condensation)                                                                                   |
| Altitude                       |                         | ≤ 2000m                                                                                                  |
| Installation environment       |                         | Indoor use                                                                                               |
| Pollution degree               |                         | Class 2                                                                                                  |

## 5 Dimension drawings

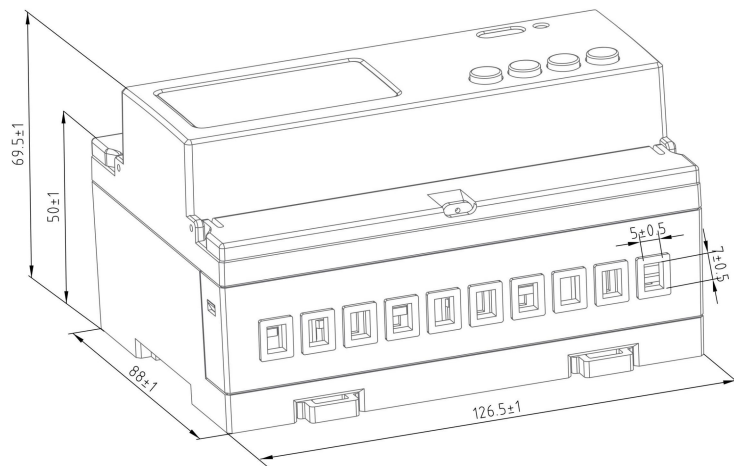


Fig 1 connect via CT

Note : Labels can only be wiped with dry cloth.

## 6 Wiring and installation

### 6.1 Safety instruction

#### Information for your own safety

This manual does not contain all of the safety measures for operation of the equipment (module, device), because special operating conditions, and local code requirements or regulations may necessitate further measures. However, it does contain information which must be read for your personal safety and to avoid material damages. This information is highlighted by a warning triangle and is represented as follows, depending on the degree of potential danger.

The external transformer shall maintain double or enhanced insulation with the current measuring loop of this product



The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



L’ apposition de ce symbole sur l’ étiquette de sécurité «danger» ou «avertissement» indique la présence d’ un danger électrique et le non-respect des instructions entraînera des blessures corporelles.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards.

Obey all safety messages that follow this symbol to avoid possible injury or death.



C' est un signe d' avertissement de sécurité. Utilisé pour vous alerter sur les risques potentiels de blessures corporelles. Suivez tous les conseils de sécurité derrière ce signe pour éviter d' éventuelles blessures ou décès.

## 6.2 Wiring sample of voltage and current

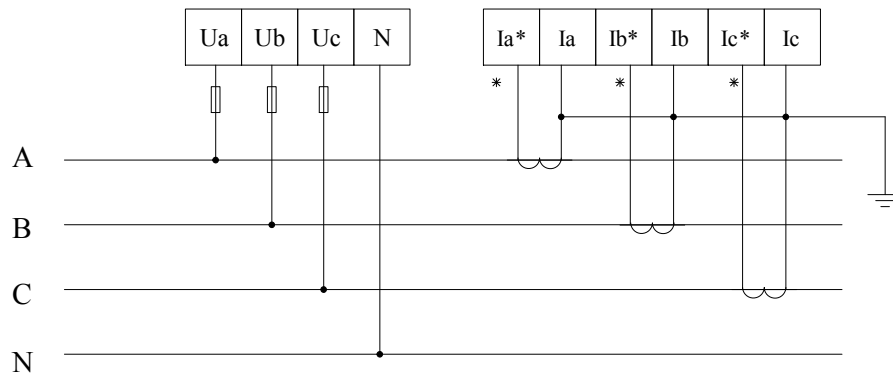
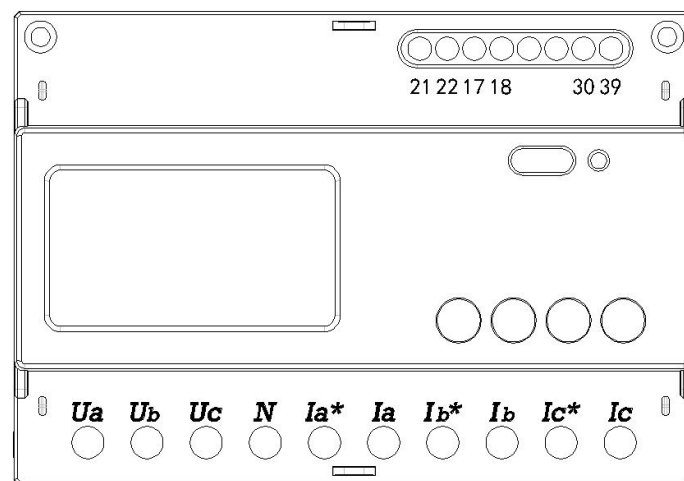


Fig 2 Three phase four lines connect via CT

Note :

1. ADL3000-E-b can adopt one access method: three-phase four wire.
2. One end of the transformer needs to be grounded (Fig2).



product drawing

| Port | Description       | Remark |
|------|-------------------|--------|
| Ua   | Ua Volatge Input  |        |
| Ub   | Ub Volatge Input  |        |
| Uc   | Uc Volatge Input  |        |
| N    | Neutral Line      |        |
| Ia*  | Ia Currten Input  |        |
| Ia   | Ia Currten Output |        |

|     |                   |  |
|-----|-------------------|--|
| Ib* | Ib Currten Input  |  |
| Ib  | Ib Currten Output |  |
| Ic* | Ic Currten Input  |  |
| Ic  | Ic Currten Output |  |

- Recommended cross section: 1...16 mm<sup>2</sup> (17...5 AWG)
- The necessary torque is 2 N•m (18 lb-in) .



## WARNING

- Use copper wire rated for 500V.
- Minimum temperature rating of the cable to be connected to the field wiring terminals, 80 °C.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**



## AVERTISSEMENT

- Utilisez un fil de cuivre évalué pour 500V.
- Température nominale minimale du câble à connecter aux bornes de câblage sur le terrain, 80 °C.

**Le non-respect de ces instructions peut entraîner la mort, des blessures graves ou des dommages à l' équipement.**

| Port | Description           | Remark |
|------|-----------------------|--------|
| 21   | RS485 port A          |        |
| 22   | RS485 port B          |        |
| 17   | Active pulse output + |        |
| 18   | Active pulse output - |        |
| 30   | Digital input         |        |
| 39   | Digital input common  |        |

- Recommended cross section: 0.08...2.5 mm<sup>2</sup> (30...14 AWG)
- The necessary torque is 0.56 N•m (5 lb-in) .



## WARNING

- Use copper wire rated for 500V.
- Minimum temperature rating of the cable to be connected to the field wiring terminals, 80 °C.

**Failure to follow these instructions can result in death, serious injury,**

**or equipment damage.**



## AVERTISSEMENT

- Utilisez un fil de cuivre évalué pour 500V.
- Température nominale minimale du câble à connecter aux bornes de câblage sur le terrain, 80 ° C.

**Le non-respect de ces instructions peut entraîner la mort, des blessures graves ou des dommages à l' équipement.**

### Installation Requirements

Check that the ambient air temperature and the ambient humidity are within their specified ranges in Environmental Specifications.

Be sure that heat from surrounding equipment does not cause this product to exceed its standard operating temperature.

Din-Rail 35mm mounted device, open type, shall be installed within appropriate enclosures.

Overcurrent protection shall be provided in the end installation.

For use with listed Energy-Monitoring Current Transformers.

Leads of the current transformers shall be maintained within the same end-product enclosure.

The current transformer and its leads shall be segregated from other circuits.

The current transformers are intended for installation within the same enclosure as the equipment. These may not be installed within switchgears and panel boards.



## CAUTION

For use with listed Energy-Monitoring Current Transformers.



## Remarque

à utiliser avec les transformateurs de courant de surveillance d' énergie énumérés.

### Disclaimer

If the equipment is not used in the manner specified by the manufacturer, the protection provided by the equipment may be weakened.

### 6.3 Communication, Switch input

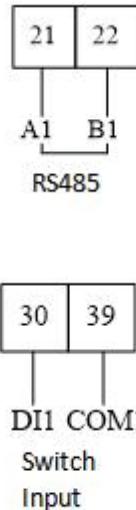


Fig 4 Communication, Switch input

The switch input adapts the method of on-off signal input and powered by outer power supply. It can be gotten by meter when there is a change of on or off via a switching input module. The parameter of switching input can not only get and show the state of local switching information but also achieve the communication via RS485, which called “remote information” function.

## 7 Maintenance

### Replacing the Battery

When the system date or time display is abnormal, it indicates that a battery in the controller needs to be replaced, please inform the manufacturer to replace the battery in time.



### WARNING

- Replacing the Battery can only be operated by the manufacturer's personnel.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**



### AVERTISSEMENT

- le remplacement des piles ne peut être effectué que par le personnel du fabricant.

**Le non-respect de ces instructions peut entraîner la mort, des blessures graves ou des dommages à l'équipement.**

## 8 Function description

### 8.1 Measurement

The meter can measure all electrical parameters such as voltage, current, active power, reactive power, apparent power, power factor, frequency, 31<sup>st</sup> harmonic and total harmonic. The value format of voltage, current, frequency and power are listed as below.

Example:  $U = 220.1V$ ,  $f = 49.98Hz$ ,  $I = 1.99A$ ,  $P = 0.439kW$

### 8.2 Calculating

The meter can calculate the current active energy, forward active energy, reversing active energy, forward reactive energy and reversing reactive energy.

### 8.3 Switching input and output

The switch input adapts the method of on-off signal input and powered by outer power supply. It can be gotten by meter when there is a change of on or off via a switching input module. The parameter of switching input can not only get and show the state of local switching information but also achieve the communication via RS485, which called “remote information” function.

## 9 Operation and display

### 9.1 Key function description

| Key symbol                                                                          | Key name                | Function                                                                          |
|-------------------------------------------------------------------------------------|-------------------------|-----------------------------------------------------------------------------------|
|  | Menu                    | Enter/quit menu                                                                   |
|  | Voltage and current, up | Check the voltage and current<br>Leftward and change flash in<br>programming menu |
|  | Power, down             | Check the power<br>Rightward and change the value on flash                        |
|  | Energy, enter           | Check the energy<br>Enter in programming menu                                     |

### 9.2 Display menu

The meter will show the forward active energy after powering. The customers can change the information showing by pressing the keys. The menu description is listed as below:

|                                                                                     |                                                                                                                                                      |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Voltage on A, B, C phase, Current on A, B, C phase, Frequency, Date, Time, Address, Version, Test on display                                         |
|  | Total active/reactive/apparent power and on A, B, C phase, Total power factor and on A, B, C phase, Forward/reversing active/reactive maximum demand |
|  | Total forward/reserving active/reactive energy, forward/reserving active/reactive                                                                    |

|  |                                                 |
|--|-------------------------------------------------|
|  | energy, forward active energy on A, B, C phase. |
|--|-------------------------------------------------|

Note:

1 All the display menus above are in the model of ADL3000-E-B three phases four lines with multi-tariff rate function and can be changed by the keys.

2 There will not be power or power factor on each phase and will only show total power and power factor (Active, reactive, apparent) under the three phase three lines.



Current forward active energy 12.34kWh



Current reversing active energy 12.34kWh



Current forward reactive energy 12.34kWh



Current total power is 1.234kW



Voltage on A phase is 123.4V



Current on A phase is 12.34A

Note: There are parts of the display function, and other menus are familiar with the example above. The customers can understand the meaning refer to the above examples.

### 9.3 Key Menu

Press  at any main menu and get in "PASS" interface, and then press  show

“0000”, and enter the code. If you enter a wrong code, it will show “fail” and back to main menu; and if you enter a right code, you can set the parameter. After setting the parameter and press , it will show “save” and save the change by pressing  in “yes” interface and quit without save by pressing  in “no” interface.

#### 9.4 Data settings

| Num | First menu |                        | Second menu |                     |                                                        |
|-----|------------|------------------------|-------------|---------------------|--------------------------------------------------------|
|     | Symbol     | Mean                   | Symbol      | Mean                | Range                                                  |
| 1   | BUS        | Communication settings | ADDR        | Address setting     | 1-247                                                  |
|     |            |                        | Baud        | Baud rate           | 19200、9600、4800、2400、1200                              |
|     |            |                        | Parity      | Parity              | None、Even                                              |
| 2   | SyS        | System settings        | PL          | Network             | 3P4L:<br>3 phase 4 lines<br>3P3L:<br>3 phase 3 lines   |
|     |            |                        | EF.E        | Multi-tariff rate   | EF:<br>Multi-tariff rate<br>E:<br>No multi-tariff rate |
|     |            |                        | Code        | Code setting        | 1-9999                                                 |
|     |            |                        | LED         | Time of light       | 1-9999                                                 |
| 3   | In.        | Transformer settings   | Pt          | Voltage transformer | 1-9999                                                 |
|     |            |                        | Ct          | Current transformer | 1-9999                                                 |

Note: Customers can choose None or Even under Modbus protocol.

## 10 Communication description

The meter adapts MODBUS-RTU protocol, and the baud rate can be chosen from 1200bps、2400 bps、4800 bps、9600bps and 19200 bps. The parity is None.

The meter needs shielded twisted pair conductors to connect. Customers should consider the whole network’s parameters such like communication wire’s length, the direction, communication transformer and network cover range, etc.

Note:

Wiring should follow the wiring requirements;

Connect all the meter in the RS485 net work even some do not need to communication, which is benefit for error checking and testing;

Use two color wires in connecting wires and all the A port use the same color.

No longer than 1200 meters of RS485 bus line.

## 10.1 ADDR list

MODBUS-RTU protocol has 03H and 10H command to read and write registers respectively. The following chart is registers' address list:

| Address         | Variable                                | Length | R/W | Notes                                                                                                                                                                                    |
|-----------------|-----------------------------------------|--------|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0000H           | Current total active energy             | 4      | R   | E=data*PT*CT*0.01                                                                                                                                                                        |
| 000AH           | Current forward active total energy     | 4      | R   | Data: data read in the communication,<br>Pt: voltage ratio<br>CT: current ratio<br>Unit:kWh (active)<br>kVarh(reactive)<br><br>This formula is applicable to all electric energy values. |
| 0014H           | Current reversing active total energy   | 4      | R   |                                                                                                                                                                                          |
| 001EH           | Current total reactive energy           | 4      | R   |                                                                                                                                                                                          |
| 0028H           | Current forward reactive total energy   | 4      | R   |                                                                                                                                                                                          |
| 0032H           | Current reversing reactive total energy | 4      | R   |                                                                                                                                                                                          |
| 003FH high byte | First communication path: Address       | 1      | R/W | 1 ~ 247                                                                                                                                                                                  |
| 003FH low byte  | First communication path: Baud rate     | 1      | R/W | 1: 9600pbs<br>2: 4800pbs<br>3: 2400pbs<br>4: 1200pbs                                                                                                                                     |
| 0040H           | Pulse constant                          | 2      | R   |                                                                                                                                                                                          |
| 0061H           | Voltage of A phase                      | 2      | R   | U=data*PT*0.1<br>Unit:V                                                                                                                                                                  |
| 0062H           | Voltage of B phase                      | 2      | R   |                                                                                                                                                                                          |
| 0063H           | Voltage of C phase                      | 2      | R   |                                                                                                                                                                                          |
| 0064H           | Current of A phase                      | 2      | R   | I=data*CT*0.01<br>Unit:A                                                                                                                                                                 |
| 0065H           | Current of B phase                      | 2      | R   |                                                                                                                                                                                          |
| 0066H           | Current of C phase                      | 2      | R   |                                                                                                                                                                                          |
| 0067H-0076H     | Reserve                                 |        |     |                                                                                                                                                                                          |
| 0077H           | Frequency                               | 2      | R   | F= data*0.01<br>Unit:Hz                                                                                                                                                                  |

|                    |                                                                                     |   |     |                                                                                        |
|--------------------|-------------------------------------------------------------------------------------|---|-----|----------------------------------------------------------------------------------------|
| 0078H              | Voltage between A-B                                                                 | 2 | R   | U=data*PT*0.1<br>Unit:V                                                                |
| 0079H              | Voltage between C-B                                                                 | 2 | R   |                                                                                        |
| 007AH              | Voltage between A-C                                                                 | 2 | R   |                                                                                        |
| 0087H              | Forward active energy of A phase                                                    | 4 | R   |                                                                                        |
| 0089H              | Forward active energy of B phase                                                    | 4 | R   |                                                                                        |
| 008BH              | Forward active energy of C phase                                                    | 4 | R   |                                                                                        |
| 008DH              | Voltage transfer(PT)                                                                | 2 | R/W |                                                                                        |
| 008EH              | Current transfer(CT)                                                                | 2 | R/W |                                                                                        |
| 008FH              | State of DDO, over-voltage, loss-voltage                                            | 2 | R   |                                                                                        |
| 0090H              | Reserve                                                                             | 2 | R   |                                                                                        |
| 0091H<br>high byte | Running state 1                                                                     | 1 | R/W |                                                                                        |
| 0091H<br>low byte  | Running state 2                                                                     | 1 | R/W |                                                                                        |
| 0092H              | Zero sequence current                                                               | 2 | R   |                                                                                        |
| 0093H              | Voltage imbalance                                                                   | 2 | R   | unit 0.1%                                                                              |
| 0094H              | Current imbalance                                                                   | 2 | R   |                                                                                        |
| 0095H              | First communication path:<br>Testing byte (High 8 bytes)<br>Stop byte (Low 8 bytes) | 2 | R/W | testing byte:<br>0: none<br>2: even<br>stop byte:<br>0: 1 stop byte<br>1: 2 stop bytes |
| 0096H-<br>0163H    | Reserved                                                                            |   |     |                                                                                        |
| 0164H              | Active power of A phase                                                             | 4 | R   |                                                                                        |
| 0166H              | Active power of B phase                                                             | 4 | R   |                                                                                        |

|       |                           |   |   |                                                                                                                                                                                       |
|-------|---------------------------|---|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0168H | Active power of C phase   | 4 | R | $PQS = \text{data} * PT * CT * 0.001$<br>Unit: KW(active)<br>kVar(reactive)<br>kVA(apparent)<br>Active power and reactive power are signed data, please set them as signed variables. |
| 016AH | Total active power        | 4 | R |                                                                                                                                                                                       |
| 016CH | Reactive power of A phase | 4 | R |                                                                                                                                                                                       |
| 016EH | Reactive power of B phase | 4 | R |                                                                                                                                                                                       |
| 0170H | Reactive power of C phase | 4 | R |                                                                                                                                                                                       |
| 0172H | Total reactive power      | 4 | R |                                                                                                                                                                                       |
| 0174H | Apparent power of A phase | 4 | R |                                                                                                                                                                                       |
| 0176H | Apparent power of b phase | 4 | R |                                                                                                                                                                                       |
| 0178H | Apparent power of c phase | 4 | R |                                                                                                                                                                                       |
| 017AH | Total apparent power      | 4 | R |                                                                                                                                                                                       |
| 017CH | Power factor of A phase   | 2 | R | $PF = \text{data} * 0.001$<br>Data is signed data, please set them as signed variables.                                                                                               |
| 017DH | Power factor of B phase   | 2 | R |                                                                                                                                                                                       |
| 017EH | Power factor of C phase   | 2 | R |                                                                                                                                                                                       |
| 017FH | Total power factor        | 2 | R |                                                                                                                                                                                       |

## 10.2 Sub harmonic data

ADL3000-E-B has function of harmonic. The function include 31<sup>st</sup> harmonic statistics of voltage and current, harmonic voltage and current of each phase apparently, harmonic active/reactive power of each phase apparently, fundamental voltage and current of each phase apparently and fundamental active/reactive power of each phase apparently.

| Addr  | Name  | Length | R/W | Note                                                                                       |
|-------|-------|--------|-----|--------------------------------------------------------------------------------------------|
| 05DDH | THDUa | 2      | R   | Total distortion rate of voltage and current on each phase<br>Int<br>Keep 3 decimal places |
| 05DEH | THDUb | 2      | R   |                                                                                            |
| 05DFH | THDUc | 2      | R   |                                                                                            |
| 05E0H | THDIa | 2      | R   |                                                                                            |
| 05E1H | THDIb | 2      | R   |                                                                                            |
| 05E2H | THDIc | 2      | R   |                                                                                            |
| 05E3H | THUa  | 2 × 30 |     | Harmonic voltage on                                                                        |

|       |                                       |        |  |                                   |
|-------|---------------------------------------|--------|--|-----------------------------------|
| 0601H | THU <sub>b</sub>                      | 2 × 30 |  | 2 <sup>nd</sup> -31 <sup>st</sup> |
| 061FH | THU <sub>c</sub>                      | 2 × 30 |  | Int                               |
| 063DH | THI <sub>a</sub>                      | 2 × 30 |  | Keep 3 decimal places             |
| 065BH | THI <sub>b</sub>                      | 2 × 30 |  | Harmonic current on               |
| 0679H | THI <sub>c</sub>                      | 2 × 30 |  | 2 <sup>nd</sup> -31 <sup>st</sup> |
| 0697H | Fundamental voltage on A phase        | 2      |  | Int                               |
| 0698H | Fundamental voltage on B phase        | 2      |  | Keep 2 decimal places             |
| 0699H | Fundamental voltage on C phase        | 2      |  |                                   |
| 069AH | Harmonic voltage on A phase           | 2      |  | Int                               |
| 069BH | Harmonic voltage on B phase           | 2      |  | Keep 1 decimal places             |
| 069CH | Harmonic voltage on C phase           | 2      |  |                                   |
| 069DH | Fundamental current on A phase        | 2      |  |                                   |
| 069EH | Fundamental current on B phase        | 2      |  |                                   |
| 069FH | Fundamental current on C phase        | 2      |  | Int                               |
| 06A0H | Harmonic current on A phase           | 2      |  | Keep 2 decimal places             |
| 06A1H | Harmonic current on B phase           | 2      |  |                                   |
| 06A2H | Harmonic current on C phase           | 2      |  |                                   |
| 06A3H | Fundamental active power on A phase   | 2      |  |                                   |
| 06A4H | Fundamental active power on B phase   | 2      |  |                                   |
| 06A5H | Fundamental active power on C phase   | 2      |  |                                   |
| 06A6H | Total fundamental active power        | 2      |  |                                   |
| 06A7H | Fundamental reactive power on A phase | 2      |  |                                   |
| 06A8H | Fundamental reactive power on B phase | 2      |  |                                   |
| 06A9H | Fundamental reactive power on C phase | 2      |  | Int                               |
| 06AAH | Total fundamental reactive power      | 2      |  | Keep 3 decimal places             |
| 06ABH | Harmonic active power on A phase      | 2      |  |                                   |
| 06ACH | Harmonic active power on B phase      | 2      |  |                                   |
| 06ADH | Harmonic active power on C phase      | 2      |  |                                   |
| 06AEH | Total harmonic active power           | 2      |  |                                   |
| 06AFH | Harmonic reactive power on A phase    | 2      |  |                                   |
| 06B0H | Harmonic reactive power on B phase    | 2      |  |                                   |
| 06B1H | Harmonic reactive power on C phase    | 2      |  |                                   |

|       |                               |   |  |  |
|-------|-------------------------------|---|--|--|
| 06B2H | Total harmonic reactive power | 2 |  |  |
|-------|-------------------------------|---|--|--|