MS1-7679 Ed01


## ENERGY METER USER MANUAL

# ULYS MD45-M EV Modbus

CHAUVIN ARNOUX
ENERGY

# Table of contents

# 1 Safety Instructions

This manual does not contain all the safety measures necessary for operation of this meter because specific operating conditions or local standards may imply additional conditions. However, the information it contains must be observed for your safety and to avoid damage to the meter. This information is highlighted by the following pictograms:

 **Danger**

 ***Warning***

Failure to follow these instructions could result in death, serious injury, or substantial property damage.

### Qualified personnel

Installation and use of this equipment must only be performed by qualified personnel. Persons previously trained and authorised to work in an electrical environment in accordance with local standards are considered qualified.

### Use for intended purposes

This product must only be used according to the technical requirements specified in the catalogue or user manual.

### Getting started

Optimal operation of the product requires appropriate transport, storage, installation and connection as well as appropriate maintenance operations. Certain parts of the meter may contain elements at a dangerous voltage.

- Only use tools suitable for the voltages for which this product is intended.
- Do not connect the meter before the facility has been powered off.
- Place the meter in a dry environment.
- The meter is intended for indoor use and must be installed in an enclosure, in accordance with local regulations.
- Do not install the meter in an explosive, too dusty or too humid area.
- Ensure that the wire gauges are suitable for the maximum current supported by this product.
- Check and tighten all connections before powering up.
- Do not touch the connection terminals with bare hands, metal, bare wire or any other conductive material as this could expose you to an electric shock which could cause serious injury or death.
- Ensure that the protective covers are in place after installation.
- Maintenance and repair of this meter may only be performed by qualified personnel.
- Do not open the meter and do not break any seals. This may affect the functionality and accuracy of the meter and voids any warranty.
- Do not drop the meter and avoid physical impact.

### Disclaimer / *Exclusion of liability*

We have checked the contents of this manual and particular care has been taken to ensure that the descriptions are as accurate as possible. However, although deviations from the description cannot be completely excluded, no liability can be accepted for errors or omissions in the information provided. The data contained in this manual is subject to regular checks and the necessary corrections will be incorporated in subsequent versions. Do not hesitate to contact us if you have any suggestions to submit.

### Manual subject to change without notice

# 2 Characteristics

## 2.1 Technical specifications

### General characteristics

| | |
|---|---|
| AC voltage (Un) | 230V |
| Voltage range | 176~276 VAC |
| Base current (Ib) | 5A |
| Max. current (Imax) | 45A |
| Min. current (Imin) | 0.25A |
| Starting current | 0.4% of Ib |
| Power consumption | <2W/10 VA |
| Frequency | 50/60Hz(±10%) |
| Alternating voltage withstand | 4KV for 1 minute |
| Impulse voltage withstand | 6KV - waveform 1.2μs |
| Overcurrent withstand | 30 × Imax for 0.01s |
| Pulse output rate | |
| -Pulse output 2 | 1000 imp/kWh (default) |
| -Pulse output 1 | 1000/100/10/1 imp/exp/kWh/kVArh (configurable) |
| Display | Backlit white LCD |
| Max. reading | 99,999.9kWh |

### Performance criteria

| | |
|---|---|
| Operating temperature | -25°C to +55°C |
| Storage and transport temperature | -40°C to +70°C |
| Reference temperature | 23°C±2°C |
| Relative humidity | 0 to 95%, non-condensing |
| Altitude | up to 2,000m |
| Stabilization time | 3s |
| Installation category | CAT II |
| Mechanical environment | M1 |
| Electromagnetic environment | E2 |
| Degree of pollution | 2 |

### Accuracy / *Precision*

| | |
|---|---|
| Voltage | 0.5% of maximum range |
| Current | 0.5% of nominal |
| Frequency | 0.2% of centre frequency |
| Power factor | 1% of unity |
| Active power | 1% of maximum range |
| Reactive power | 1% of maximum range |
| Apparent power | 1% of maximum range |
| Active energy | IEC62053-21 Class 1<br>EN50470-1/3 Class B |
| Reactive energy | IEC62053-23 Class 2 |

## Pulse output specifications

The energy meter has two passive type pulse outputs.
Pulse output 1 is configurable. It can be configured to generate pulses representing total/consumed/produced kWh or kVArh.
The pulse constant can be configured to generate 1 pulse per: 0.001 (default)/0.01/0.1/1kWh/kVArh.
Pulse width: 200/100/60ms
Pulse output 2 is not configurable. It expresses the total kWh. The constant is 1000 pulses/kWh.

## RS485 output specifications for Modbus RTU

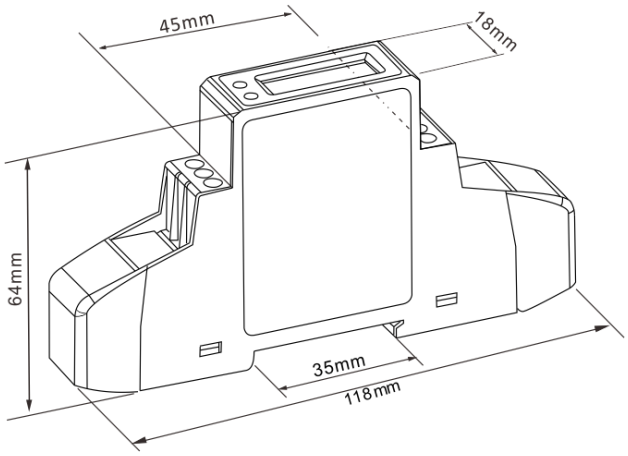
The meter has an RS485 port for remote communication. Modbus RTU is the protocol used. RS485 communication parameters for Modbus RTU can be set in the configuration menu.

**Bit rate:** 1200, 2400, 4800, 9600 bps. Default: 2400
**Parity:** NONE/EVEN/ODD
**Stop bits:** 1 or 2
**Modbus address:** 1 to 247 (1 by default)

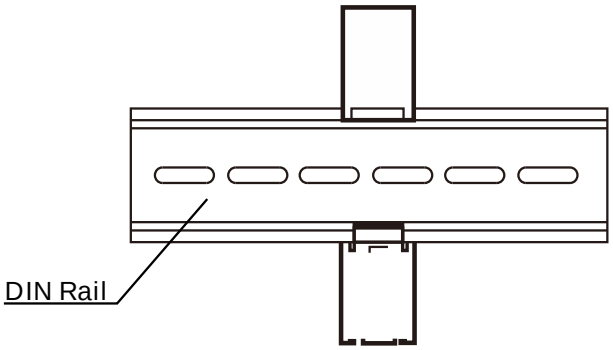
## 2.2 Mechanical and mounting characteristics

| | |
|---|---|
| Dimensions | 18x118x64 (WxHxD) DIN 43880 |
| Mounting | 35mm DIN rail |
| Protection index | IP51 (indoor) |
| Material | UL94V-0 self-extinguishing |

The dimensions of the Ulys MD45-M EV Modbus are shown below:

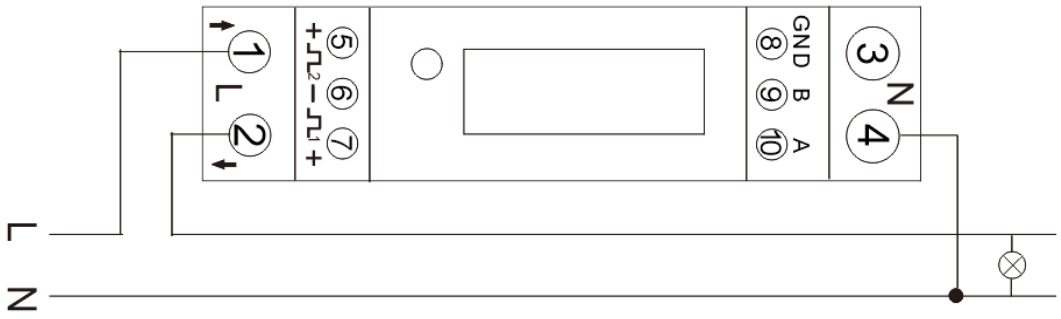



Mounting is done on a DIN rail. Below is a rear view of the mounted product:



## 2.3 Connection schematic

Cable connection must comply with the following schematic:




1 Phase input (L-IN)
2 Phase output (L-OUT)
3 Neutral input (N)
4 Neutral output (N)

8-9-10 Modbus Communication (GND/RS485 B-/RS485 A+)
5-6-7 Pulse output 2+/COM/Pulse output 1-

# 3 Installation

 **Danger**  **Warning**

- Cut off all power sources of the meter and, if possible, of the equipment connected to it before any intervention
- Always use a voltage absence detection device to confirm that the power is off
- Installation must be carried out by qualified personnel familiar with the various standards in force
- Use insulated tools to install the product
- A fuse, a thermal circuit breaker or a single-pole circuit breaker must be provided and installed for protection and at least on the phase

- Cable sectional areas must be sized in accordance with local regulations regarding the maximum capacity of the circuit breaker or any other protection used in the circuit.
- An external protection must be installed on the supply circuit in order to isolate the meter from the electrical circuit. It is recommended to place this protection upstream and as close as possible to the meter. The protection used must comply with the building's electrical network specifications and local regulations.
- To avoid any alteration of the meter, use a suitable enclosure equipped with a closing device, in particular if it is exposed to dust or any other contaminant.
- The meter should be installed in a dry and ventilated place.
- The meter can be sealed immediately after installation and verification of its operation.
- The product can be installed on a 35mm DIN rail.
- The meter should be installed in a location where it can be easily read.
- If the meter is installed in an area subject to frequent overvoltages due, for example, to lightning, welding equipment, etc., it must be protected by suitable equipment.

# 4 Display

## Indication of energy flow

The red LEDs on the front panel indicate the energy flows measured by the meter. When energy is flowing, the LEDs blink. The faster it blinks, the greater the flow. For this meter, the red LEDs blink XXX times per kWh and per kvarh, i.e. one blink every 0.1wh/varh.

## Start screen

When turned on, the meter initializes and performs a self-test.

| | | |
|---|---|---|
| 1 |  | Start screen<br>This screen is displayed for 3 seconds. |
| 2 |  | Software version<br>This screen is displayed for 3 seconds. |

When the self-test is complete, the meter displays the total active energy (kWh)

## Meter display screens

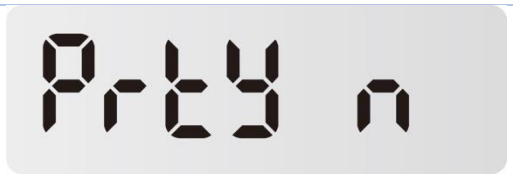
This button is located on the front panel.

After initialisation and self-test, the meter displays the measured values. By default, it displays total kWh. If the user wishes to view other information, he must press the scroll button on the front panel.

| | |
|---|---|
|  | Pressing the button scrolls through the measurements on the display. |
| | Holding down the button for 3 seconds switches the meter to configuration mode. |

| | | |
|---|---|---|
| 1 |  | Total active energy（kWh）<br>Display format: 0000.00→9999.99→10000.0→<br>99999.9→0000.00 |

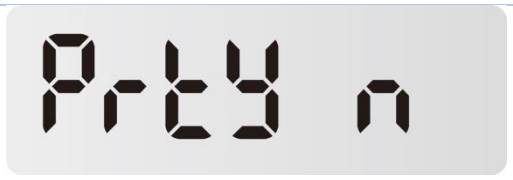
| | | |
|---|---|---|
| 2 |  | Active energy consumed（kWh）<br>Display format: 0000.00→9999.99→10000.0→<br>99999.9→0000.00 |
| 3 |  | Active energy consumed (kWh)<br>Display format: 0000.00→9999.99→10000.0→<br>99999.9→0000.00 |
| 4 |  | Voltage (V) |
| 5 |  | Current (A) |
| 6 |  | Active power (W) |
| 7 |  | Frequency (F) |
| 8 |  | Power factor (PF) |
| 9 |  | Modbus address (ID)<br>By default: 001 |
| 10 |  | Bit rate<br>By default: 2400 bps |

| | | |
|---|---|---|
| 11 |  | Parity<br>Choice of none/even/odd<br>Default: none |
| 12 |  | Software version |

## Meter configuration

To enter Configuration mode, the user must press and hold the button for 3 seconds.

This operation puts the meter into a configuration loop of three parameters that can be changed from the meter screen:

| | | |
|---|---|---|
| 1 |  | Modbus address (ID)<br>By default: 001 |
| 2 |  | Bit rate<br>By default: 2400 bps |
| 3 |  | Parity<br>Choice of none/even/odd<br>Default: none |

Regarding programming:

- To move from one parameter to the next in the loop, you must press the button briefly
- To enter programming for each parameter, perform a long press of 3 seconds. The parameter can be changed when it begins to blink.
- To exit from parameter programming and enable its validation, wait for 3 seconds. The parameter stops blinking when validated.

Exit from the configuration loop occurs naturally after a period of inactivity of 10 seconds.

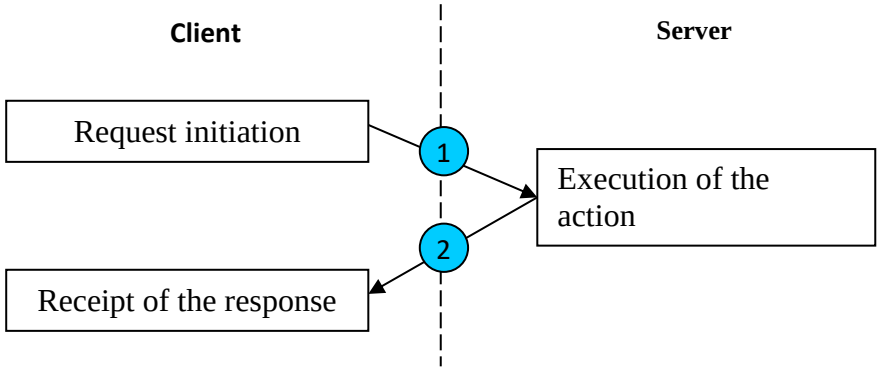
This setting makes it possible to make the meter communicate via its Modbus interface, and it is then possible to access a wider range of functions via communication. For more details, refer to paragraph 5 “Mapping of Modbus registers”.

# 5 Modbus table and communication

## 5.1 Modbus communication

### 5.1.1 Modbus transactions

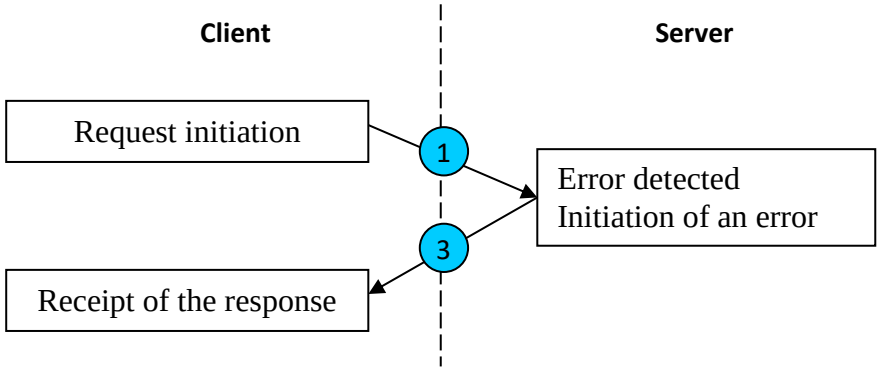
- A client sends a request to the server. The server performs the action related to the request and prepares the response. The server then returns the response and the client receives the response from the server.




*Transition 1: Function code + data*

*Transition 2: Response: Function code + any data*

- The server may detect an error when receiving the client request or while processing the request. In this case, an exception is returned to the client.




*Transition 3: Error Flag + Function Code + Error Code*

### 5.1.2 Addressing

**In Modbus RTU**

- The slave address is between 1 and 247.
- Address 0 is reserved for "broadcast" messages (a message addressed to several devices on the same bus).
- Addresses 248 to 255 are reserved.
- Two customers cannot have the same address.

**In Modbus TCP**

The notion of addressing is an IP address, the header also comprising an Identifier which allows a slave to be selected when it is on the serial bus of an IP gateway.

### 5.1.3 Modbus RTU frames

Frame data is encoded in Big Endian format. The maximum size of a Modbus/RTU frame is 256 bytes. Therefore, the maximum number of words that can be read (for example with function 3) is 125 and the maximum number of words that can be sent (function 16) is 123.

#### *5.1.3.1 Modbus query*

- The first byte contains the slave number to which the frame is addressed.
- The second byte contains a function code telling the addressed slave what type of action is requested.
- The data contains additional information that the slave needs to perform this function.
- The control bytes field allows the slave to ensure that the content of the query is complete. In Modbus, error checking takes the form of a 16-bit CRC with a polynomial of 0xA001. Please note that the two control bytes are transmitted in Little Endian.

| Slave no. | Function code | Specific information regarding the request | Control bytes |
|---|---|---|---|
| 1 byte | 1 byte | n bytes | 2 bytes |

#### *5.1.3.2 Response*

| Slave no. | Function code | Data received | Control bytes |
|---|---|---|---|
| 1 byte | 1 byte | n bytes | 2 bytes |

#### *5.1.3.3 Exception response*

| Slave no. | Function code + mask | Exception code | Control bytes |
|---|---|---|---|
| 1 byte | 1 byte | 1 byte | 2 bytes |

The response frame contains the function code with the most significant bit at 1. Example, if the request function code is 0x03, an exception response will return a function code equal to 0x83.

The standard exception codes are the following:

| Exception code | Modbus name | Comments |
|---|---|---|
| 0x01 | Illegal Function Code | Function not supported by the product |
| 0x02 | Illegal Data Address | Prohibited address |
| 0x03 | Illegal Data Value | Incorrect data |
| 0x04 | Server Failure | The Modbus server generated an error |
| 0x05 | Acknowledge | Release |
| 0x06 | Server Busy | Server busy |
| 0x07 | No acknowledge | Non-release |
| 0x08 | Write Error | Write error |
| 0x09 | Overlapped Area | Area overlap |
| 0x0A | Gateway problem | Unable to access gateway |
| 0x0B | Gateway problem | Exception generated by gateway |

### 5.1.4 Modbus TCP

In this mode, the frames are amputated by two CRC bytes (data integrity is ensured by the TCP/IP layer) and a new header is appended to the start of the frame.


7 bytes up to 253 bytes

This header is called MBAP and contains the following information:

| Field | Size | Description | Client | Server |
|---|---|---|---|---|
| Transaction Identifier | 2 bytes | Identifies the Modbus transaction | Initialised by the client | Copied by the server into the response frame |
| Protocol Identifier | 2 bytes | 0 = Modbus Protocol | Initialised by the client | Copied by the server into the response frame |
| Length | 2 bytes | Number of bytes that follow | Initialised by the client in the query | Initialised by the server in the response |
| Unit identifier | 1 byte | Modbus identifier of a remote slave | Initialised by the client (set to 0xFF by default) | Copied by the server into the response frame |

Modbus TCP uses reserved port number 502 and must therefore be freely accessible on the network, but the standard specifies that any Modbus/TCP server must be able to use a second listening port because certain security configurations prohibit port 502.

## 5.2 Modbus communication table

The meter can communicate with an external system via an EIA-485 interface (ex RS-485) under Modbus RTU Protocol. To read the meter registers, install and configure software beforehand. Use an RS485 converter if necessary to connect the system to the meter. The cable must be connected to terminals (A+) and (B-), respecting the polarity. The slave address (ID) of the meter is 1 by default.

A Modbus register corresponds to a 16-bit word.

| **Modbus function code** | |
|---|---|
| **04** | To read I/O registers (read only) |

| **Input registers** | | | **Starting Modbus Address (Hex)** | |
|---|---|---|---|---|
| **Parameters** | **Unit** | **Format** | **High Byte** | **Low Byte** |
| Voltage | V | Floating | 00 | 00 |
| Current | A | Floating | 00 | 06 |
| Active power | W | Floating | 00 | 0C |
| Apparent power | VA | Floating | 00 | 12 |
| Reactive power | VAr | Floating | 00 | 18 |
| Power factor | - | Floating | 00 | 1E |
| Frequency | Hz | Floating | 00 | 46 |
| Imported active energy | kWh | Floating | 00 | 48 |
| Exported active energy | kWh | Floating | 00 | 4A |
| Imported reactive energy | kVArh | Floating | 00 | 4C |
| Exported reactive energy | kVArh | Floating | 00 | 4E |
| Average total power | W | Floating | 00 | 54 |
| Maximum average total power | W | Floating | 00 | 56 |
| Average imported power | W | Floating | 00 | 58 |
| Maximum average imported power | W | Floating | 00 | 5A |
| Average exported power | W | Floating | 00 | 5C |
| Maximum average exported power | W | Floating | 00 | 5E |
| Average current | A | Floating | 01 | 02 |
| Maximum average current | A | Floating | 01 | 08 |
| Total active energy | kWh | Floating | 01 | 56 |
| Total reactive energy | kVArh | Floating | 01 | 58 |

| Modbus function code | |
|---|---|
| **16** | To write to an editable "holding register" |
| **03** | To read an editable "holding register" |

| **Editable registers (Holding Registers)** | | **Modbus address at start (Hex)** | | **Description** |
|---|---|---|---|---|
| **Parameters** | **Format** | **High Byte** | **Low Byte** | |
| Averaging period | Floating | 00 | 02 | Averaging period: 0, 5, 8, 10, 15, 20, 30, 60 minutes, default 60.<br>Choosing 0 for the period will display the present current as the average current, and the maximum average current since the last reset.<br>**Length: 4 bytes** |
| Pulse width 1 | Floating | 00 | 0C | Pulse width 1 in milliseconds: 60, 100 or 200, default 60ms.<br>**Length: 4 bytes** |
| Number of stop bits | Floating | 00 | 12 | EIA485 port parity and stop bits.<br>Or:<br>0 = One stop bit, no parity<br>1 = One stop bit, even parity (default)<br>2 = One stop bit, odd parity<br>3 = Two stop bits, no parity<br>Requires a reboot to take effect<br>**Length: 4 bytes** |
| Meter Modbus ID (server address) | Floating | 00 | 14 | Address from 1 to 247, ID by default: 1<br>**Length: 4 bytes** |
| Transmission speed (Baud) | Floating | 00 | 1C | Baud rate for MODBUS RTU, where:<br>0 = 2400 baud (default)<br>1 = 4800 baud.<br>2 = 9600 baud<br>5 = 1200 baud<br>**Length: 4 bytes** |

| | | | | |
|---|---|---|---|---|
| Pulse output 1 mode | Floating | 00 | 56 | Pulse output 1 mode:<br>1: Imported active energy,<br>2: Total active energy (Imp + Exp)<br>4: Exported active energy (default).<br>5: Imported reactive energy<br>6: Total reactive energy (Imp + Exp)<br>8: Exported reactive energy<br>**Length: 4 bytes** |
| Clear history | Hex | F0 | 10 | 00 00: RAZ of averages<br>**Length: 2 bytes** |
| Display time<br>(self scrolling) | BCD | F9 | 00 | Display time from 0 to 30s<br>0: (default) no automatic scrolling of the display<br>**Length: 2 bytes** |
| Pulse output 1 | Hex | F9 | 10 | Pulse weight<br>0: 0.001kWh/imp (default)<br>1: 0.01kWh/imp<br>2: 0.1kWh/imp<br>3: 1kWh/imp<br>**Length: 2 bytes** |
| Calculation method | Hex | F9 | 20 | 1: mode 1 (total = import)<br>2: mode 2 (total = import + export) (default)<br>3: mode 3 (total = import - export)<br>**Length: 2 bytes** |
| Serial number | int32<br>Unsigned | FC | 00 | Serial number<br>**Length: 4 bytes**<br>Note: Read only |
| Meter code | Hex | FC | 02 | Meter code = 00 20<br>**Length: 2 bytes**<br>Note: Read only |
| Software version | Hex | FC | 03 | Software version<br>**Length: 2 bytes**<br>Note: Read only |

**Example of frames:**

Request for information on the certificate: 01 03 E0 26 00 7D 53 E0

Response: information on the certificate (1st frame): 000012-Rx:01 03 FA 05 01 data crc crc

Data: 248 bytes

Response: information on the certificate (2nd frame): 000012-Rx:01 03 FA 05 02 data crc crc

Data: 248 bytes

Response: information on the certificate (3rd frame): 000012-Rx:01 03 FA 05 03 data crc crc

Data: 248 bytes

Response: information on the certificate (4th frame): 000012-Rx:01 03 FA 05 04 data crc crc

Data: 248 bytes

Response: information on the certificate (25th frame): 000012-Rx:01 03 FA 05 05 data crc crc

Data: 1 - 248 bytes

**MANUMESURE**
45 Route de Saint Eugène
14130 REUX
Tel: +33 2 31 64 51 00
Fax: +33 2 31 64 51 52
info@manumesure.fr

http://www.enerdis.com
http://www.manumesure.com

**CHAUVIN ARNOUX ENERGY**
16 Rue Georges Besse
92182 ANTONY Cedex
Tel: +33 1 75 60 10 30
Fax: +33 1 46 66 62 54
info@enerdis.fr