Fixed System
Installation Instructions

ClimaCheck

Performance Analyser

PA Pro

Measuring and Analysing System for Refrigeration, Air-conditioning and Heat Pumps

Updated for software v3.50

2015-04-07

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Safety Precautions

Read the instruction manuals for all relevant equipment carefully before starting to use ClimaCheck Performance Analysing systems.

If equipment is used in a way not specified by producer the protection and safety provided may be impaired.

For activities related to electrical systems, pressurised systems as well as systems charged with refrigerants certifications/licenses are required in most countries. ClimaCheck products are only intended for use by competent technicians/engineers with on each market required certifications/licenses.

Any work with electricity, pressurised systems and refrigerant involve potential dangers to human health and system integrity if not conducted with caution. In many cases the value of products or cost of production loss represents great values. ClimaCheck do not assume any responsibility for injuries or costs occurring if failures are caused in connection with measurements. It is the user that must evaluate if an installation can be carried out without risks to cause injuries and/or damage. Installation should only be carried out when it can be done with proper safety margins.

Table of contents

1 Introduction to ClimaCheck[1]

ClimaCheck is a measuring and analysing system developed to give detailed evaluation of refrigeration, air-conditioning and heat-pump systems in development laboratories, production tests and in the field.

The method is based on measurements in the refrigeration circuit and a fixed installation of ClimaCheck can be made with minimum disruption to system. The advantages of easy connection and immediate and detailed information makes the ClimaCheck method superior for evaluating all refrigeration, air-conditioning and heat pump systems.

An increased focus on energy efficiency can be seen in the EU Directive 2002/91/Ec on the Energy Performance of Building and several other requirements on energy performance on other markets. This directive requires annual inspections with verifications of energy efficiency of all AC systems with more than 12 kW rated capacity. Measuring with ClimaCheck gives and excellent foundation for performance inspections.

The ClimaCheck Performance Analysing method allows **complete analysis** of energy performance as well as presenting all information to validate the individual components and their optimization making it possible to immediately identify and locate any deficiencies in the system. The method was patented in 1986 and has since been used in Sweden and internationally in the Product ETM 1500, ETM 2000, ClimaCheck PA 8:7 and now ClimaCheck PA Pro.

The server based monitoring software is constantly logging the performance of the system and uses the globally accepted equations for refrigerant properties in RefProp established by NIST (National Institute of Standards and Technologies in USA). Anyone with the user name and password can log in to the system from an Internet connected PC as well as have the server send alarms when important parameters falls outside of their specified ranges.

The ClimaCheck method is suitable for almost all compressor based refrigeration processes. All suction or discharge gas cooled hermetic and semi hermetic compressors can be fully evaluated without any compressor or system specific information. For open compressors the electrical motor efficiency is given as input and for compressors with external cooling of air, water, oil or liquid injection information on the cooling need to be entered to give a full capacity and COP accuracy. For many types of systems data on compressor cooling are well known and necessary parameters are known. ClimaCheck Specialists should be consulted to give advice on non-standard systems.

[1] ClimaCheck is a registered trademark.

2 Handling and safety

To ensure safe installation and operation the following instructions must be followed carefully:

- The equipment should be powered by either 90 – 264 V AC at 47 – 64 Hz or 120 – 370 V DC. The maximum power consumption of the system is 25 W.
- An easily reachable external switch for breaking power to the installation has to be available.
- Operating temperature range for the equipment is -20 to +50 °C.
- Operating humidity is R.H. 0 – 90 % non-condensing.
- Maximum operating altitude: 2000 m
- The equipment is designed for a maximum of Pollution Degree 2.
- The equipment enclosures have not been tested for UV-resistance and are thus not approved for outdoor installation.
- The enclosure must be mounted with at least three sides having a minimum clearance of 10 cm. The front must have a clearance of at least 30 cm.
- Burned out fuses must be replace in accordance to the table below. Use only UL/CSA approved fuses.

Marking on fuse holder	Marking on the enclosure	Fuse type
L	F1	T 1 A L, 250 V
N	F2	T 1 A L, 250 V
L1	F3	T 500 mA L, 250 V
L2	F4	T 500 mA L, 250 V
L3	F5	T 500 mA L, 250 V
N	F6	T 500 mA L, 250 V

- See section 4.3 for important safety instructions when connecting the power measurement.
- For all electrical wires not included with the equipment, use UL1569 AWG20 or better. Not that special considerations should be taken for the wiring of the power meters, see section 4.3.
- The standard enclosure is marked with protection class IP55, but the protection of the final installation may be lower depending on several factors. ClimaCheck do not guarantee a certain protection class.
- If the instructions in this section and the rest of the manual are not observed, the protection provided by the equipment may be impaired.

3 Required documents and equipment

In addition to this instruction you need a number of documents and equipment to successfully complete the installation:

- Flow chart of the system with sensor placement (included at the end of this manual or supplied separately)
- Wiring diagram of the system (included at the end of this manual or supplied separately).
- Small flathead screwdriver 2.5 x 0.5 mm.
- Aluminium tape.
- Insulation tape.
- A number of standard tools depending on the nature of the installation.

4 Connection of sensors to the system

Sensors should be placed in accordance with the supplied flowchart, and connected to the system as shown on the wiring diagram.

4.1 Mounting of pressure transmitters/transducers

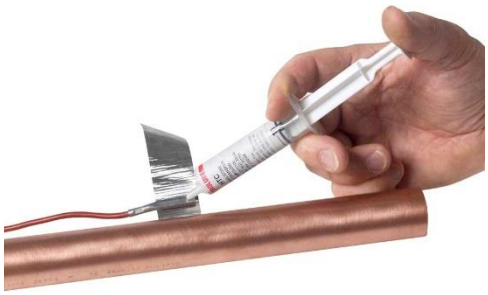
Pressure should be registered as close as possible to the compressor in- and outlet. Pressure drop between sensor and compressor will affect the accuracy.

4.2 Mounting temperature sensors

Temperature sensors may be mounted on the outside of piping with the ClimaCheck method due to the inherent low sensitivity to temperature errors. This is a critical advantage compared to traditional methods but should not be taken as an excuse to not follow the recommended procedures below. Temperature sensors should be mounted:

- 10-20 cm from the compressor, flanges, valves or other objects that can act change the surface temperature compared to the inner temperature of the tube.
- Maximum contact and insulation should be ensured by:
  - Removal of any insulation and paint on the tube.
  - When mounted in pockets the sensor must be securely pressed against the wall of the pocket.
  - Heat transfer paste should always be used for surface and "pocket" mounted sensors.
- Aluminium tape should always be used for surface mounting.
- Insulation should be carefully done and diffusion tight if the surface/object is cold. The openings of dip tubes/pockets should be sealed/covered with insulation.
- In the case of sensors with red four lead cables, the pairs with the same colour should be attached together to the terminals of the PA Pro.

Apply sensors with heat transfer compound, Aluminium and insulation.



4.2.1 Required insulation

Many factors have an impact on required insulation to achieve good accuracy:

- dT to ambient
  High dT obviously increases the error from poor insulation
- Radiation from surrounding hot/cold surfaces

- Material type in tube
  Good heat transfer decreases the error caused by the wall from best to worse copper - iron - stainless - plastic
- Material thickness in tube
  Dimension, pressure and material define thickness thicker tube wall increase need of insulation
- Condensation
  It is important to avoid condensation on or near sensor as this will have a significant impact on temperature reading
- Ice formation
  If ice is allowed to form around sensors (condensation on cold tubes) this creates an insulation

Importance of accuracy
A service check can allow a higher tolerance for errors than an inspection to validate that performance is according to contract.
Note that even if temperatures on secondary side do not have any impact on capacity and COP of refrigeration process, they will, if nominal data is taken from manufacturers, strongly impact these reference data.

We advise common sense to be applied, with special attention to discharge and suction line sensor on the refrigerant side due to high dT and risk of condensation.

For best accuracy, remove dirt, paint and corrosion, and avoid pushing sensors inside existing insulation - cut a hole in insulation instead. Always use heat transfer paste and aluminium tape to make insulation on cold tubes so that condensation or ice formation cannot take place on sensor.

Smaller size copper tube	minimum 60 mm x 8 mm tight insulation pressed against tube (thickness 8 mm or 3 turns of insulation tape)
Larger size CU (> 35 mm/1.5")	minimum 100 mm x 8 mm tight insulation pressed against tube (thickness 8 mm or 3 turns of insulation tape)
Steel/plastic/stainless piping	minimum 15 cm x 8 mm insulation

4.2.2 Compensating for changes in temperature sensor cable length

No configuration has to be made if using the entire white 5 m cable, or the entire red 10 m cable, of a temperature sensor. If a cable is shortened or lengthened the change in resistance needs to be compensated for. The standard temperature offset (0.35 K) needs to be **increased for a longer cable** or **decreased for a shorter cable**. The white cable got a resistance of 0.07 K/m and the red cable 0.035 K/m (using all four leads in pairs).

Settings for offset made in the PA Pro are permanent until changed again. For temporary compensation when using temperature sensor cable extensions see section *Error! eference source not found..*

To configure one of the temperature sensors connected directly to the PA Pro (number 1 to 8), follow the instructions below:

- Connect to the PA Pro to the PC.
- Open a web browser and enter the location "http://169.254.1.1".
- Login with username "config" and password "ef56".
- Choose **Settings** -> **Sensors & Actuators**.
- The temperature channels are positioned on the top left of. Click on the channel corresponding to the sensor with the changed cable length.

- Edit the value in the field next to **Offset**. Increase the standard value 0.35 if you have added cable or decrease it if cable has been removed.
- Click **Save Settings**.

The procedure for changing the offset for the temperature module RTD-04 is slightly different.

- Connect to the PA Pro to the PC.
- Open a web browser and enter the location "http://169.254.1.1".
- Login with username "config" and password "ef56".
- Choose **Settings** -> **Advanced** -> **External Units**.
- Select the RTD-04 unit you want to configure from the list.
- For each of the four temperature sensors, there is a field for the **offset**. Increase the value if you have added cable or decrease it if cable has been removed.
- Click **OK**.

4.3 Connection of power measurement

	**Warning - Working with electricity is potentially dangerous and should only be conducted by people with appropriate competencies and in accordance with local regulations.**

Important!

Improper use of the EP Pro (EM24) power meter may cause high voltage build up that can be dangerous both for equipment and operators. Adhere to the practices below to avoid this:

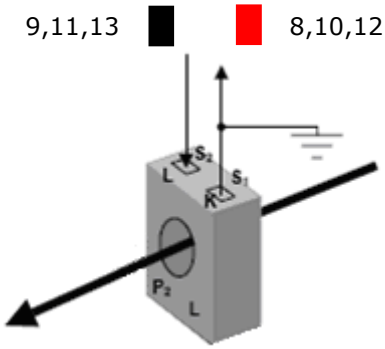
- **Make sure that any attached current transformers are fully connected to the EP Pro (EM24) before powering up the measured system.**
- **Never disconnect a current transformer while the measured system is turned on.**
- **The voltage measurement inputs of the EP Pro has an installation category of CAT III. They may be connected to equipment of CAT III or lower as specified by IEC60664/EN60664. The table below contains a summary of the definitions for each category:**

CAT IV	**Origin of installation, utility level and any outside cable run.**
CAT III	**Distribution wiring, including mains bus, feeders and branch circuits as well as permanently installed loads.**
CAT II	**Receptacle outlet circuit and plug-in loads.**
CAT I	**Protected electronic circuits.**

In addition follow the steps below to assure proper power and energy readings:

- In order to ensure accurate current readings the cables connecting the current transformers should have low resistance. We recommend using at least UL1569 AW18 (0,5 mm^2) and to keep the cable as short as possible. If the cable is longer than a couple of meter, a thicker cable should be used.
- It is important to only measure the power to the compressor. Make sure the measurement is done after the point where circulation pumps and fans are connected.
- Make sure that the voltage and current for each phase is paired up correctly, and that the current transformers are mounted to give the correct direction of the current.
- Check that the connections are correct by reading the voltage, current and power on the display of the power meter. If you find a problem remove the transformers and attach L1 followed by a control and then repeat the process for L2 and L3.

Most fixed current transformers are labelled as shown below, one side P1-K and the other P2-L. With current entering from P1 side as shown below the signal is from S1 through the instrument to S2.



The numbers shown above (9,11,13 and 8,10,12) corresponds to the points of connection on ClimaCheck EP Pro Power meter (EM24).

For more information about the EP Pro (EM24), see section 6.

5 Connecting the PA Pro to the server

The PA Pro can be connected to the ClimaCheck server either through a dedicated modem or the existing Internet connection available on the site of installation. Depending on the details of the ordering process the configuration of the connection may be complete on delivery, but in many cases some settings need to be adjusted.

5.1 Connecting the PA Pro to a local computer

In order to configure the PA Pro for connection by local network (section 5.2) or by direct modem (section 5.3) you need to connect a local computer directly to the PA Pro central unit. This type of connection can also be used to directly analyse the system with the PC ClimaCheck software as if using a mobile PA Pro unit. For this use please refer to the ClimaCheck Field Manual.

If the PA Pro central unit has the standard **IP 169.254.1.1**:

- Attach a "crossed" network cable between the PA Pro "Ethernet" socked and the network socket of your computer.
- A connection between PA Pro and your computer will be established automatically, but it might take a minute or two to finish. During this time you will see an animated connection symbol in the system tray.
- When the connection is established the network icon in the system tray should be marked with a small yellow triangle and you might get a message "*Connection to local network: This connection got no or limited connectivity"* or similar.
- In some cases having more than one active network connection will cause problems. Try disabling all network adapters except the one used for PA Pro. You will find this setting under **Start** > **Control Panel** > **Network connections** and then right clicking on the name of the network adapter. You will have to reactivate it in the same way when you need to use it again.

If the PA Pro central unit has any other IP:

- Attach a "crossed" network cable between the PA Pro "Ethernet" socked and the network socket of your computer.
- Configure your network connection to have an IP that is within the same range as the PA Pro. The PA Pro IP is usually printed on a sticker.

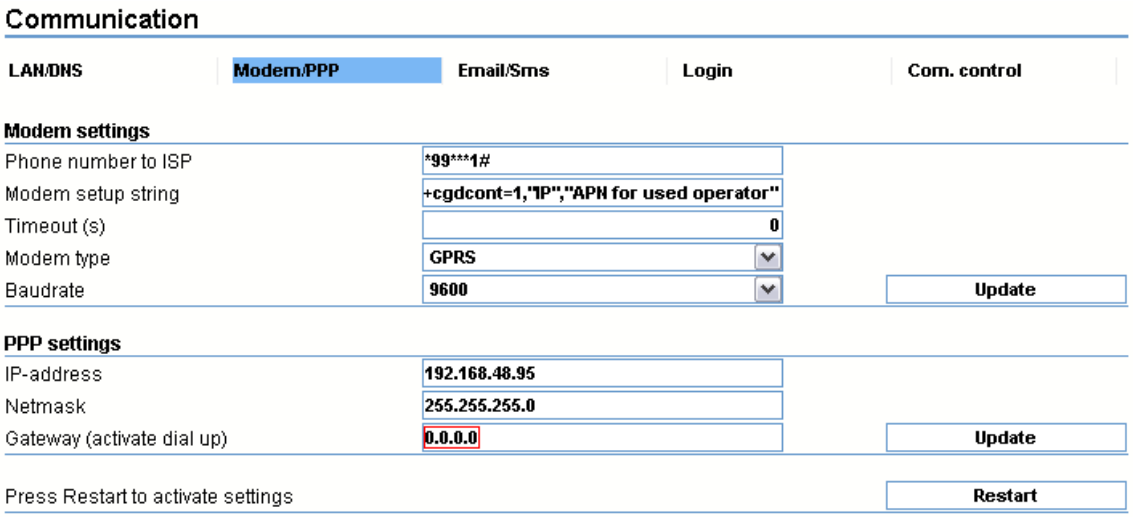
When the connection is established log in trough the web interface:

- Open a web browser and enter the IP of the PA Pro.
- Log in with **user name "config"** and **password "ef56"** (default).

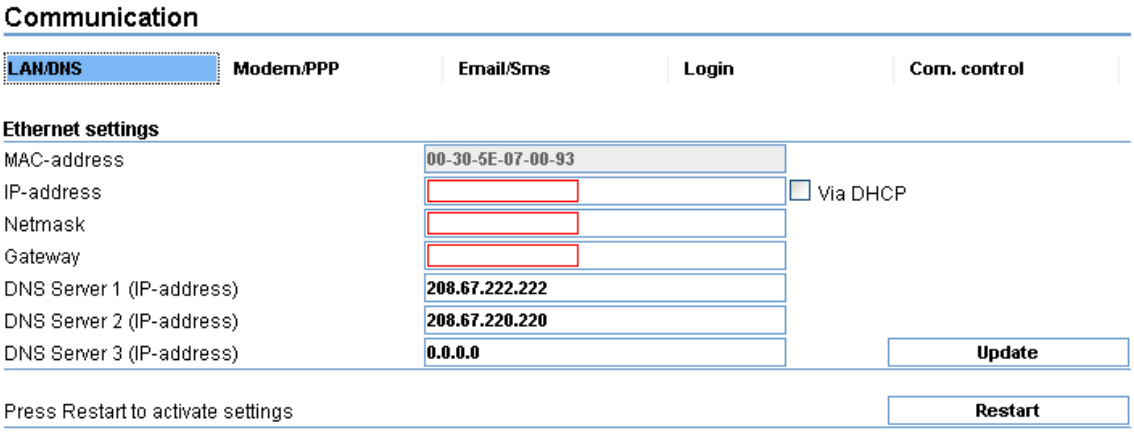
5.2 Connecting the PA Pro to a local network

In order for the PA Pro to communicate with the local network and use its internet connection, it needs a compatible IP.

- Connect to the PA Pro as described in section 5.1
- Choose **Settings** -> **Communication** -> **Modem/PPP Settings**.
- Make sure **Gateway** is set to **0.0.0.0**. If you need to change it click **Update**.



- Choose **LAN/DNS** and enter settings appropriate for the network. Ask the person responsible for the network for the correct settings.
- Click **Update**.
- Click **Restart** and close the browser.



PA Pro will restart with the new settings and you will lose connection with it. If you want to connect again you will need to use the new IP as described in section 5.1.

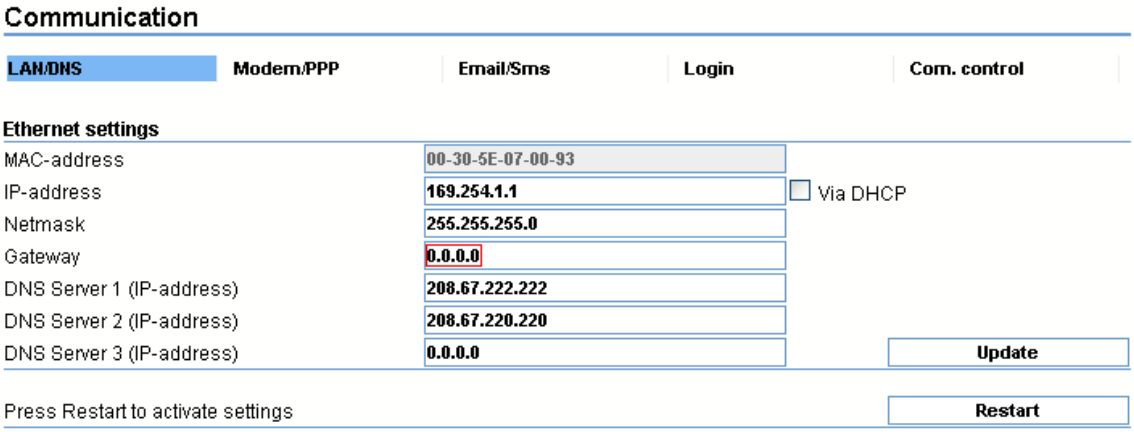
Important!

- Write down the new IP address. If you forget it the hardware will have to be factory reset.
- When the configuration is complete the PA Pro should be connected to the local network with a "straight" cable.

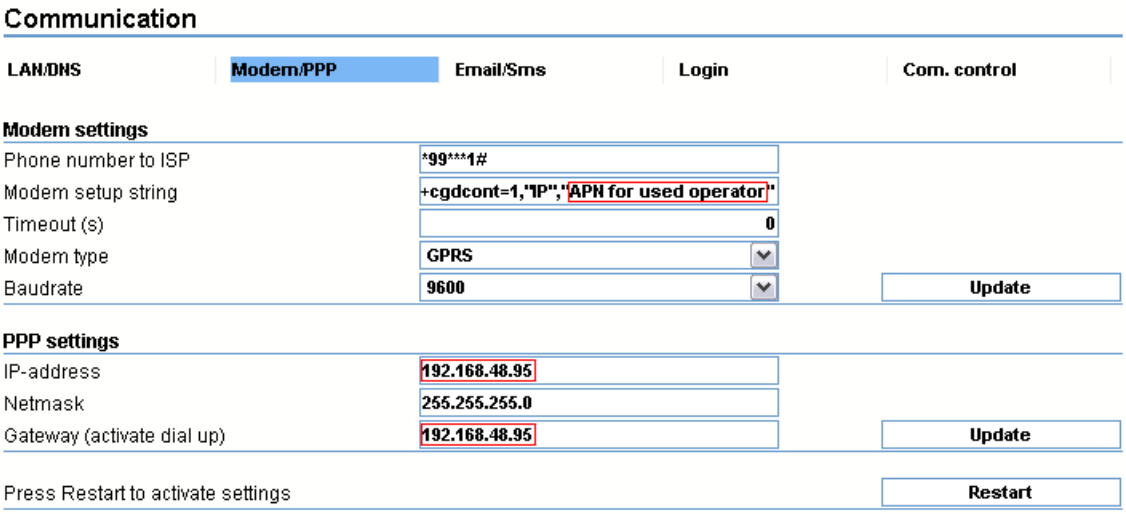
5.3 Connecting the PA Pro with a direct modem

When connecting one PA Pro the most common modem is the Cinterion BGS2. It is controlled and configured from within the PA Pro web interface. The setting that often needs to be changed is the APN for the used SIM card.

- Connect to the PA Pro as described in section 5.1
- Choose **Settings** -> **Communication** -> **LAN/DNS**.
- Make sure that **Gateway** is set to **0.0.0.0**. If you change it click **Update**.



- Choose **Modem/PPP Settings**.
- In the **Modem setup string** find the text **"APN for used operator"** last in the string. See figure below.
- Replace this text with the APN of the operator, leaving the quotation marks in place.
- Click **Update** to confirm your changes.
- Copy the number from the **IP-address** field to the **Gateway** field. The default IP-address/Gateway is **192.168.48.95**.
- Click **Update** to confirm your changes.
- Click **Restart** to restart with the new settings enabled.



APN for a number of operators:

Telia	online.telia.se
Maingate	maingate.telia.se
Maingate VPN	maingatelan.telia.se
Telenor	internet.telenor.se
O2 UK	mobile.o2.co.uk
Wireless Logic	gprs.mywasp.ws

5.4 Connecting the PA Pro with a router modem

When connecting several PA Pro systems to a single modem the most common method is to use the router modem ETM450 and a network switch. To configure the modem you need to log in to its own web interface. The setting of APN needs to be changed if the modem is used with a SIM card not supplied by ClimaCheck Sweden AB.

- Attach a "straight" network cable between your computer and a network socket on the switch. If no sockets are empty temporarily disconnect one of the connected PA Pro units.
- Configure your network connection to obtain an IP address automatically. The modem IP is usually printed on a sticker.
- Open a web browser and enter the IP of the modem.
  Note! When accessing the router modem you may get a warning saying "There is a problem with this website´s security certificate". Choose "Continue to this website"
- Log in with **user name "admin"** and **password "admin"** (default).

- In the Menu go to **Network** and **WAN.**
- Enter APN, ClimaCheck supplied SIM-card in example below.
- If your SIM-card use a PIN-code choose enable and enter it.
- Now press Apply Changes to save and the system will reboot.

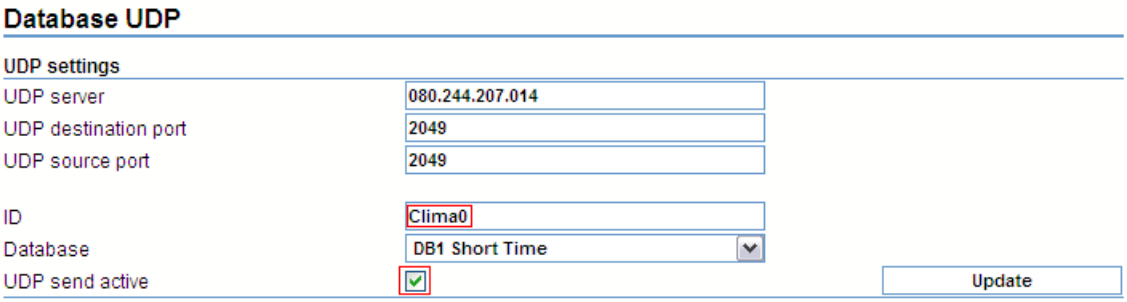
APN for a number of operators:

Telia	online.telia.se
Maingate	maingate.telia.se
Maingate VPN	maingatelan.telia.se
Telenor	internet.telenor.se
O2 UK	mobile.o2.co.uk
Wireless Logic	gprs.mywasp.wss

5.5 Changing the UDP ID

The UDP ID is needed for the server to correctly identify your system. It is usually correctly set at delivery but if needed it can be changed.

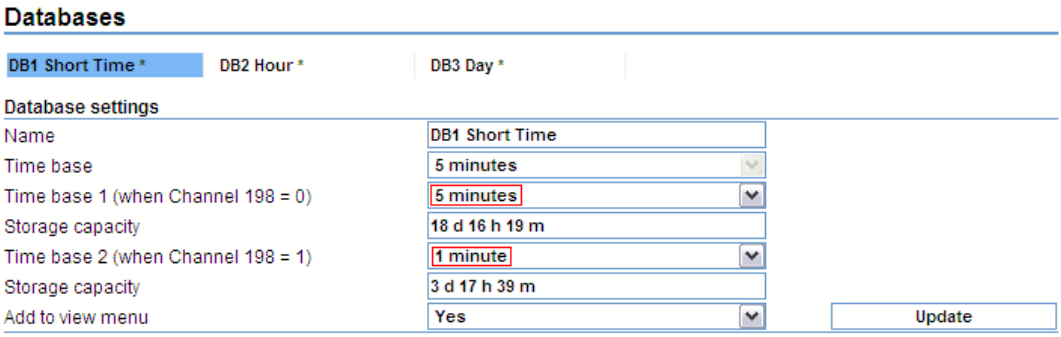
- Connect to the PA Pro as described in section 5.1
- Choose **Settings -> Advanced -> Database UDP**.
- Set **ID** to the correct identifier. It should always contain **six letters or digits**.
- Make sure the **UDP send active** is checked.
- Click **Update** to confirm your changes.



5.6 Changing the database sample interval

By default the PA Pro will send data to the server every minute as long as at least one compressor is running, and every five minutes at other times. These numbers can be changed if needed.

- Connect to the PA Pro as described in section 5.1
- Choose **Settings -> Advanced -> Databases -> DB1 Short Time**.
- Set **Time base 1** to the sample interval you want when the compressor is not running. We recommend **5 minutes** for most situations.
- Set **Time base 2** to the sample interval you want when the compressor is running. We recommend **1 minute** for most situations.
- Click **Update** to confirm your changes.



6 Configuration of Power Meter EP Pro (EM24)

This section explains how to change the most common settings on the EP Pro (EM24). In most cases the power meters will be delivered pre-configured to fit the system, but changes in the setup compared to the order may cause a need for change of these settings.

6.1 Configuration of electrical system

For EP Pro to report correct values it must be configured for the electric system used. The device can handle the following varieties:

- Unbalanced 3-phase with zero (default)
- Unbalanced 3-phase without zero
- Balanced 3-phase
- 2-phase
- 1-phase

Change the electric system by doing the following:

- Put the knob in position 1 to enable programming.
- Push in the joystick for three seconds.
- Enter the password by pushing up/down. Default setting is 0.
- Push in to enter the password.
- Push right three times to the menu section "SYS".
- Push in to change the setting (PrG is displayed).
- Push left/right to toggle between electric systems:
    - 3P.n = Unbalanced 3-phase with zero
    - 3P = Unbalanced 3-phase without zero
    - 3P.1 = Balanced 3-phase
    - 2P = 2-phase
    - 1P = 1-phase
- Push in to save the setting (PrG disappears).
- Push left four times to the menu section "End".
- Push in to end the programming.
- Put the knob back into position "locked".

6.2 Configuration of CT-ratio

The EP Pro (EM24) is normally pre-configured for the current transformers to be used, but change of plans may require the adjustment of the current ratio. The ratio is most often described as a ratio, for example 300:5 A. To get the correct value divide the first number by the second, for example 300/5 = 60.

- Put the knob in position 1 to enable programming.
- Push in the joystick for three seconds.
- Enter the password by pushing up/down. Default setting is 0.
- Push in to enter the password.
- Push right five times to the menu section "Ct rAtio".
- Push in to change the setting (PrG is displayed).
- Push right/left to toggle between different size ranges for the CT-ratio and up/down to set the exact value. A small "k" to the left of the value denotes a multiplier of 1000.
- Push in to save the setting (PrG disappears).
- Push left six times to the menu section "End".
- Push in to end the programming.
- Put the knob back into position "locked".

6.3 Changing the address

In a system with more than one power meter EP Pro (EM24) the units have different addresses for the central unit to distinguish among them. This address is normally correctly set when delivered but can sometimes need to be changed.

- Put the knob in position 1 to enable programming.
- Push in the joystick for three seconds.
- Enter the password by pushing up/down. Default setting is 0.
- Push in to enter the password.
- Push left three times to the menu section "AddrESS".
- Push in to change the setting (PrG is displayed).
- Push up to change address to the desired number.
- Push in to save the setting. The display will show "bAudrAtE".
- Push up and then right twice to the menu section "End".
- Push in to end the programming.
- Put the knob back into position "locked".

7 Installing an updated default configuration

In some cases a new version of the default configuration will have to be installed on the PA Pro. This could happen if for example a new feature that is has been introduced after the installation of the system, and that feature is needed. In this case you will have received a number of files, of which one got the extension **.bundle**.

To upload a new default configuration to your PA Pro follow the instructions below:

- Make sure to take note of all changes to the default configuration that you want to save, as these will have to be remade after installing the package. You will probably have been instructed on which settings you need to take note of when you received the update.
- Connect the PA Pro to your computer as described in section 5.1.
- Select **Settings** -> **System** -> **File Manager**.
- Click the **Erase** button under the **APPLICATION INIT** section.
- Wait a couple of minutes for the PA Pro to restart.
- Click **System** in the menu again to reload the page.
- Click the **Upload Bundle** button, navigate to folder containing your update files and select the one ending with **.bundle**.
- Wait for the installation to finish. This will take some time and the PA Pro will restart several times, breaking the network connection. The process is finished when the status box turns green and gives you a notification. Do not assume the update has failed unless you have left it to process for **at least 20 minutes**.
- If the updating process would for some reason fail, just start over from the beginning.

APPLICATION INIT

APPINIT.INI is a local copy of the application settings (stored in internal memory). Settings for channels, parameters, databases, alarms, curves, summaries and overviews are stored in this file. Running an application init file will reset the settings to the state they had when the file was created. This file works like a backup for application settings.
The application init file is used when a device is cloned, together with the user script and user files. Make sure the file is up to date before making a clone bundle.

Press Erase to erase the file contents.	**Erase**
Press Create to store the present settings.	**Create**
Press Use to restore settings from the file.	**Use**

8 Verification of connection to server and sensor readings

In order to minimize the risk of having to visit the site of installation a second time, if at all possible the server connection and sensor readings should be and verified.

- Start by accessing ClimaCheck online from any Internet connected computer (http://online.climacheck.com)
- Select the relevant system from those available on the account.
- Check for incoming data. Remember that by default the PA Pro only send data every five minutes when no compressor is running.
- Verify that values are reported from all connected sensors.
- Check the incoming values for plausibility.