Extended AIRCOSAVER guidelines for installation and demo (e.g. general suitability, split units, larger aircon systems, dual compressor systems, etc.)

The purpose of this document is to serve as extended technical guidelines for an AIRCOSAVER installer.

This document is mainly targeted at new distribution partners to cover some basics and frequently asked questions.

For a deeper understanding this document should also be seen in relation with the collection of charts explaining the AIRCOSAVER principle in more detail (available as PDF document, usually part of the initial AIRCOSAVER info package).

EXTENDED AIRCOSAVER GUIDELINES FOR INSTALLATION AND DEMO (E.G. GENERAL SUITABILITY, SPLIT UNITS, LARGER AIRCON SYSTEMS, DUAL COMPRESSOR SYSTEMS, ETC.) 1

How do I find out if an air conditioning system is suitable for AIRCOSAVER installation?

Apart from the general criteria (DX air con, no multi-splits, no inverters, etc), it makes sense to look at some further criteria before an installation.

Do not install on systems that never manage to reach the thermostat set point. This behaviour can have several different reasons.

This especially includes undersized aircon units which are not capable of handling the typical heat load in an application anyway (i.e. WITHOUT the AIRCOSAVER, the compressor is usually running constantly all day and the thermostat is never satisfied).

Also NOT suitable are very poorly serviced aircon units with blocked filters or poor refrigerant level.

Do not install and AIRCOSAVER in systems that do not produce typical cooling output.

An easy way to test this is to

- Turn the air conditioning unit on and set the thermostat to a low temperature, e.g. 18 degrees Celsius.
- Let the air conditioning unit run for a while if it had been off for a long period (15 minutes should usually already give you a clear picture).
- Measure the temperature of the cold air that is coming from the evaporator. This air should always be (clearly) under 20 degrees Celsius in a well performing airconditioning unit. **If this is not the case, DO NOT install an AIRCOSAVER.**

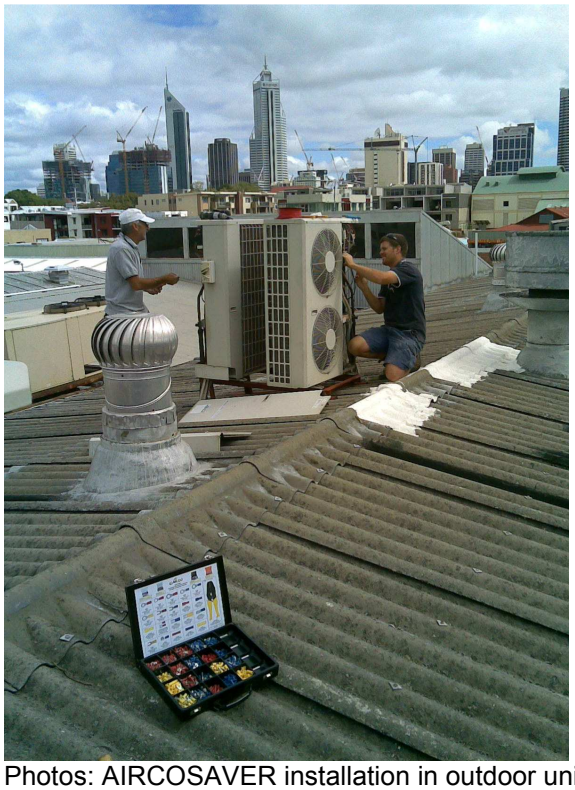
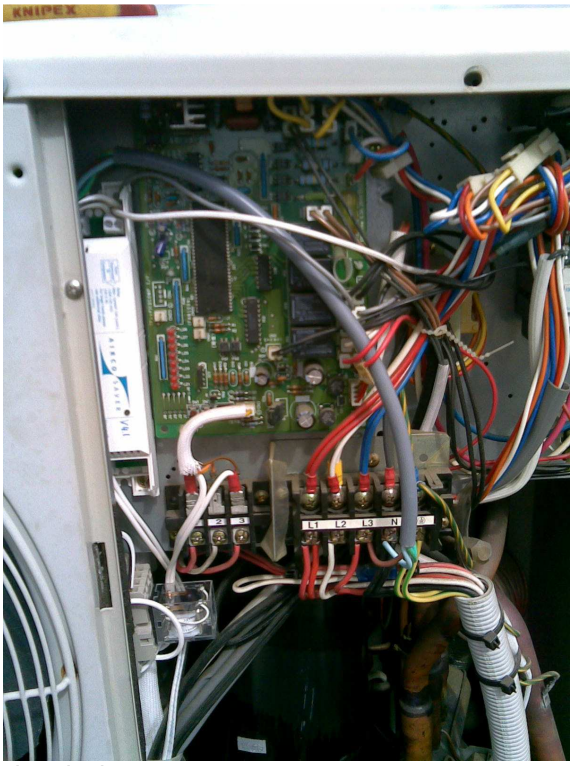
AIRCOSAVER installation on split systems

General rule: The installation in split systems is logically identical to that in packaged or window units. The difference is simply that indoor and outdoor parts are some distance apart. This causes some questions about where to mount the AIRCOSAVER and how to get the temperature sensor positioned in the cold air stream.

Option 1: Install the AIRCOSAVER in or at the outdoor unit.
This is often an easy option where the outdoor unit has a spacious and well enclosed electrics compartment into which you can fit the AIRCOSAVER and if the installation site allows for the connection of the temperature sensors from its measurement position at the evaporator to the outdoor unit (the temperature sensor still needs to be mounted in the cold air stream from the evaporator!).

On split systems, this can be a challenge when indoor and outdoor unit are far apart. The temperature sensor cable can be extended up to 9m and even more (but please use good electrical wire for long extensions).

Whether outdoor unit installation is an option mainly depends on the existing connections between indoor and outdoor unit and the holes in the wall – these are often well sealed or poorly accessible and therefore the temperature sensor connection can not easily be made.

Photos: AIRCOSAVER installation in outdoor unit electrical compartment.

Option 2: Install the AIRCOSAVER in or near the indoor unit.
In most single split systems this is the easier way of installation. After removing the covers of the indoor unit, you should usually have

- Access to a power supply that you can use for the AIRCOSAVER
- Be able to position and fix the temperature sensor into the cold supply air and
- Find the required switching wire that turns the compressor in the outdoor unit on/off or either directly (small aircon units) or which switches the contactor relay.

In modern indoor units, space is extremely limited. Often the AIRCOSAVER does not fit inside and therefore needs to be installed outside of the indoor unit (next to / underneath / on top, etc).

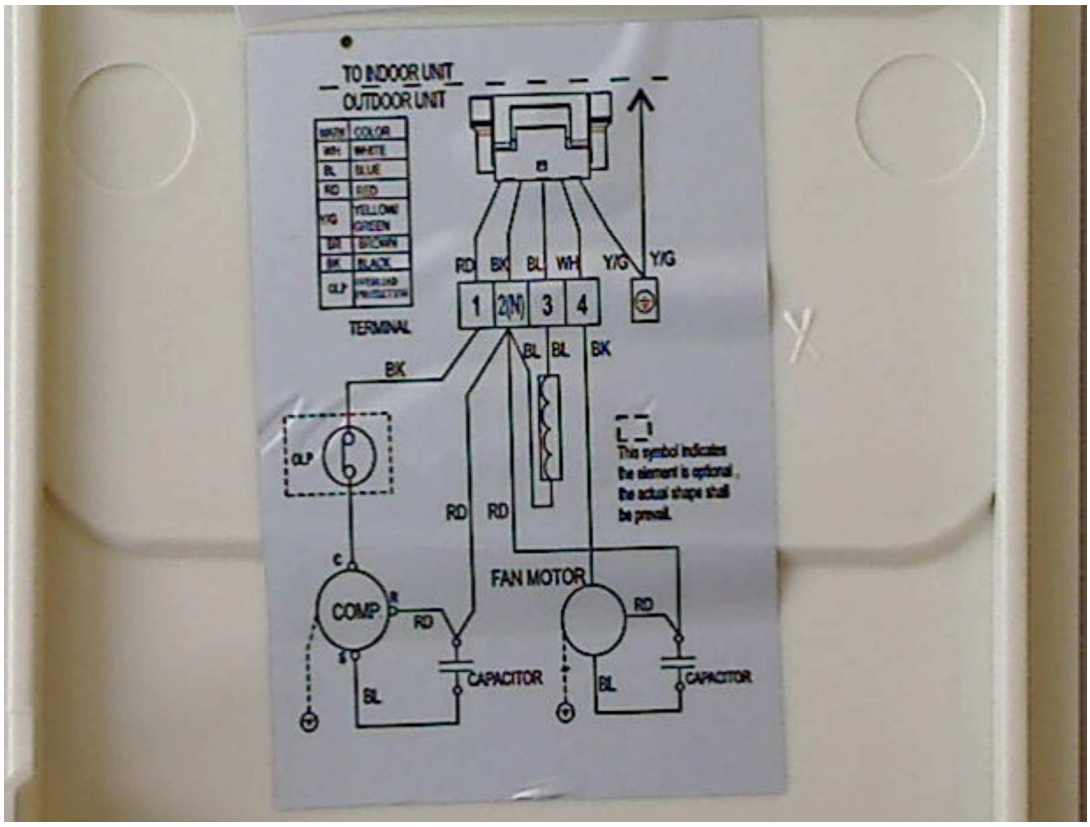
Check for wiring diagrams. Typical locations are

- Underneath the front plastic cover of the indoor unit,
- At the side of the indoor
- In the technical manual
- Sometimes also the diagram of the corresponding outdoor unit can help if nothing else is available. These diagrams can typically be found inside of the cover lid of the electrical connection box of the outdoor unit.

The AIRCOSAVER needs to (logically!) work in series with the thermostat.

Diagram inside of the indoor unit cover.

Diagram on outdoor unit cover handle



<u>PLEASE NOTE:</u>
The AIRCOSAVER needs to be wired in a way that it can switch the compressor on/off, just like the thermostat. There is usually one wire from the indoor unit going to the outdoor unit that does this (often black colour).

In most cases, you do <u>NOT</u> need to interfere with the tiny low-voltage wires and electronics of the actual thermostat circuitry or thermostat circuit board.

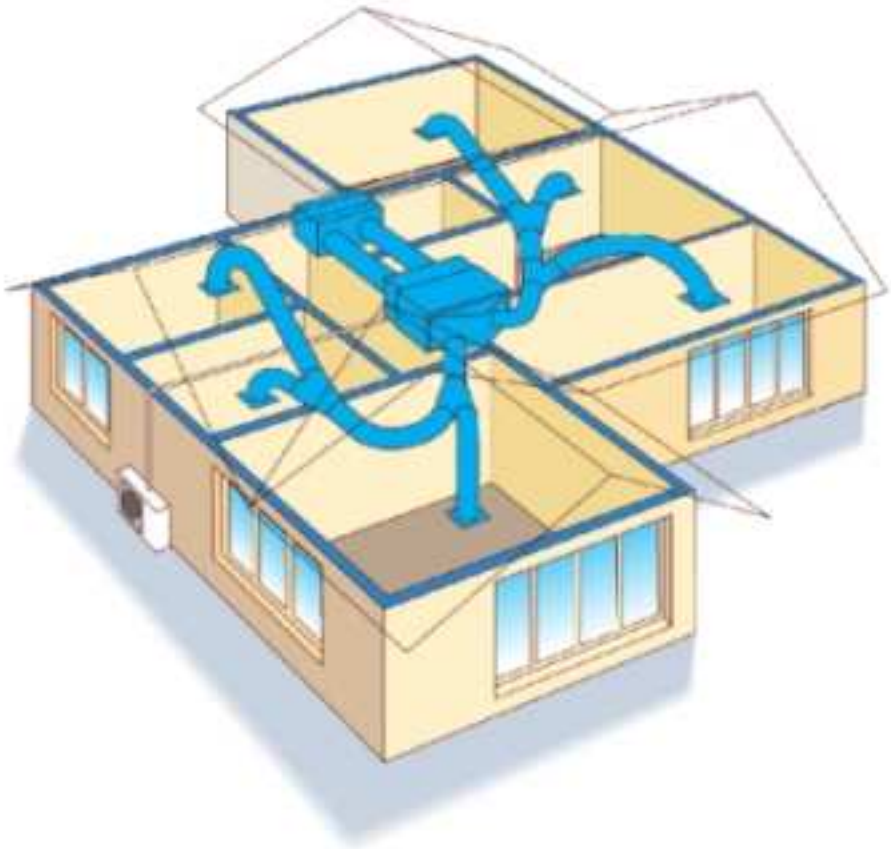
Example: Installation in indoor unit

AIRCOSAVER Installation on Packaged Units

Packaged units are in terms of installation extremely similar to small window units as evaporator and condenser are situated in one enclosure. This makes installation very simple.

AIRCOSAVER installation on small central air conditioning systems

Central air conditioning systems typically have one central evaporator that produces the cool air and then, following this evaporator, the cold air stream is split into smaller streams that are carried through ductwork to various areas or rooms.



Graphic: Principle of a central air conditioning system with ducts to the areas / rooms.
Image copyright: Excel Air Conditioning Australia. http://www.excelaircon.com.au/images/general/ducted.jpg

An AIRCOSAVER can be installed on most of these systems but it is essential that the AIRCOSAVER temperature sensor is positioned in the main air stream **BEFORE** the air is split into the different ducts.

AIRCOSAVER installation on systems with more than one compressor

For improved efficiency, many larger air conditioning systems use more than one compressor (typically 2, sometimes more).

In these cases it very important to understand how the compressors work in relation to the load. For example, in a dual (2) compressor system, usually one compressor will take care of the base load (that means it will run a lot and usually at its full capacity, i.e. no savings on this compressor possible) and one compressor for peak load. The peak load compressor only runs occasionally and then mostly in partial load with excess capacity (so there are certainly savings on this compressor possible).

So the general rule is: Only install the AIRCOSAVER on the PEAK load compressor (not the BASE load compressor(s)).

So far, so simple. However, when you look at the wiring, things get rather complicated because there are all sorts of different arrangements in use.

Some systems have a fixed allocation of the compressors to the load, i.e.the same compressor is always responsible for base load and the other one always for peak load. Their roles do not change. This is the good case; you can install an AIRCOSAVER on the peak load compressor.

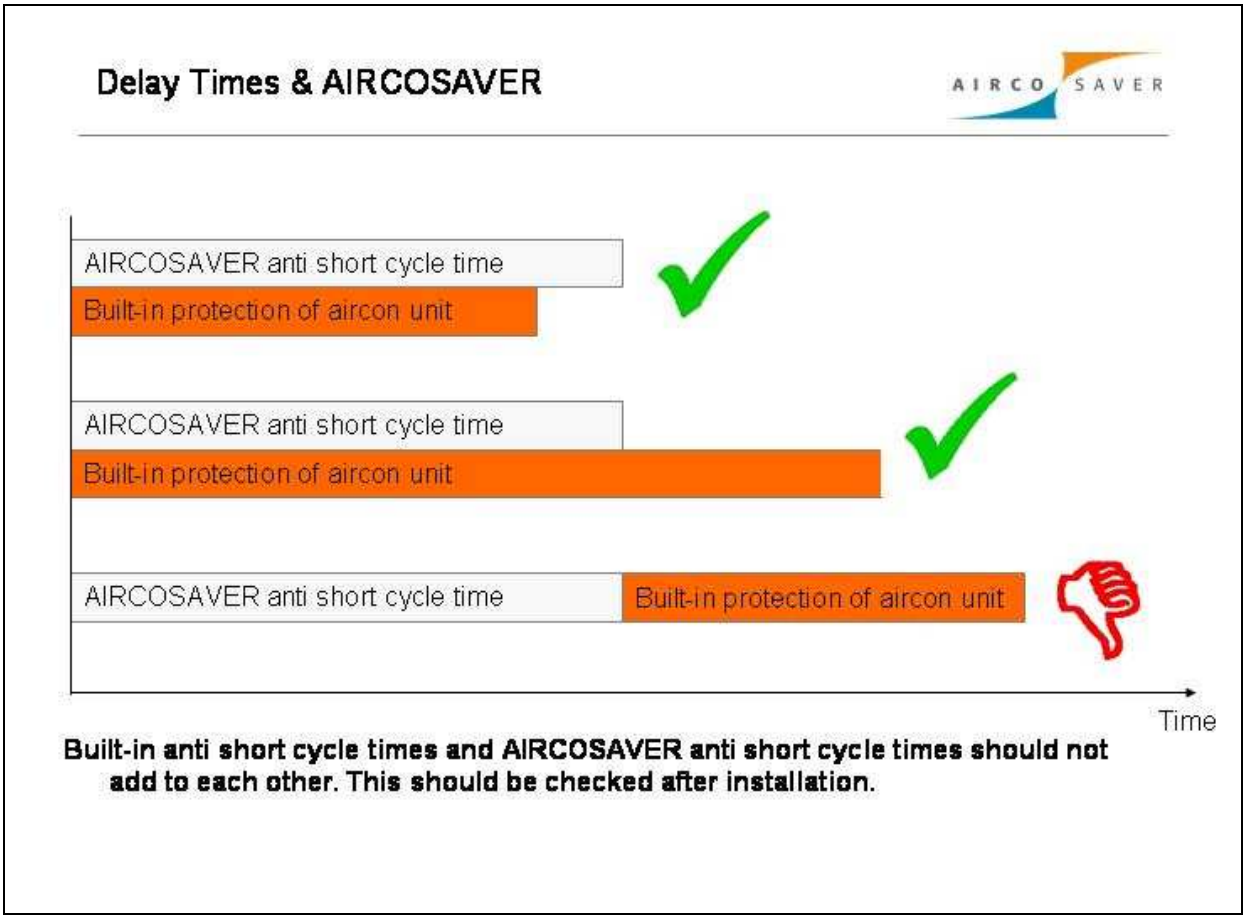
Other systems swap the roles of the compressors automatically with a built-in control after some time to achieve overall similar run times of the compressors. Since various different controls are in use for this purpose, it can be quite tricky to wire the AIRCOSAVER in a way that it always only controls the peak load compressor.

If the wiring diagrams or other available technical information does not clarify this or if you are not sure, do not install an AIRCOSAVER.

Overall, the savings on dual compressor systems can be expected to be lower than on single-compressor systems (because they are a bit more efficient in the first place, that's the reason for dual compressor systems).

Existing anti short cycle timer elements

In case that the air conditioning unit has built-in timer elements, these timers should work in parallel with the AIRCOSAVER. It is important that these times do not ADD to each other as this could potentially cause comfort complaints.



How to do a basic check after an AIRCOSAVER installation

1. Check if you can observe phase 1 (compressor off for 1 minute) when the AIRCOSAVER is first connected to its power supply or after power was disconnected and reconnected to the AIRCOSAVER. After 1 minute the compressor will come on and the AIRCOSAVER moves on into phase 2. This indicates that you are using the correct switching wire to the compressor.

2. Check if the AIRCOSAVER moves onwards from phase 2 into phase 3 (and onwards). This indicates that the temperature sensor is positioned correctly and that your aircon is cooling properly. If your AIRCOSAVER remains in phase 2, the first thing to check is if the AIRCOSAVER's temperature sensor is positioned fully in the cold supply air to the room, close to the evaporator coils.

During a regular cycle the AIRCOSAVER will go in this order: Phase 1(first cycle only), Phases 2, 3, 4, 5, 6 (6 can be very short). Then the cycle starts again with 2, 3, 4 and so on.

AIRCOSAVER basic demo measurement principle: Before and after comparison

No matter in which way the measurements are done, the basic principle is always the same: We need to make a simple before and after comparison of the aircon system's energy consumption (kWh), for example one day with the AIRCOSAVER and one day without the AIRCOSAVER.

Testing can be done in real-life applications or in special laboratory testing situations.

Make sure that the conditions in the day-to-day or week-to-week comparisons in terms of ambient temperature, ambient humidity and heat load in the testing room **are as equal as possible** (similar number of occupants in the room, same heat from lighting, same frequency of opening of doors / windows etc.).

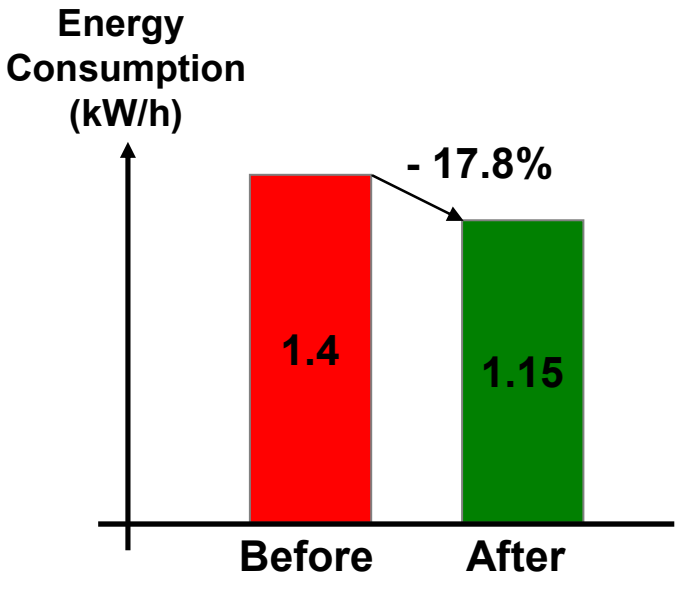
How long should my demo measurement be?

Generally, the rule is: The longer the better.

If you only measure for very short periods of time (let's say for one hour or so) then the measurements can more easily be disturbed by outside factors such as fluctuations in heat load from open windows, different number of persons in the rooms, etc. Over time, these tend to even out.

More importantly, in such a short measurement interval, the AIRCOSAVER has no chance to fully adapt its settings to your aircon system and to the current heatload.

If you only have very short time available for measurement, we suggest to measure for at least 2 hours with and 2 hours without the AIRCOSAVER.



AIRCOSAVER Example Measurement Result

For future references it is also useful to record the software version of your AIRCOSAVER on the measurement report. You can find this version information on the small white sticker on the side of your AIRCOSAVER and on the white cardboard box, it is something like 2.2, 3.6, 4.1 etc.).

Which values can / should be measured?

Measurements can done be in various forms and levels of detail, depending on the effort you want to invest and which equipment you have available. Very simple and quick measurements start with the consumed energy in kWH, more complex measurements include a whole range of further information:

1.) Consumed energy in KWh (or close approximations) – essential

This is the essential measurement. Your clients usually pay for consumed true power in kWh. Therefore, the most important thing to measure is the consumed KiloWattHours (kWh) over the testing period.

kWh is the consumed true power in Watts, as opposed to kVA which defines the apparent power if your aircon's power factors is not 1.

As a side note, most aircon systems have a power factor of 1 or very close to it anyway thanks to internal power factor correction measures. Therefore, the potential for power factor correction on aircon systems is extremely limited.

In any case, true kWh is usually what the client pays for in his energy bill, not kVA.
The AIRCOSAVER does not change the power factor (cos phi) of an aircon systems.

If you can not measure for the same time intervals with and without the AIRCOSAVER, it is a valid approach to calculate the kWH consumption per hour and compare these values.

The kWH values can either be recorded (logged) continuously in intervals - for example every 5 or 15 minutes - or can be taken at the end of the measurement period as a total - do not forget to record the duration of each test.

If you have no option to measure KWh consumption, you can measure the Ah (Ampere hour) consumption since Voltage does not change substantially, and Amps x Volts = Power in Watts (at power factor 1). So the Ah consumption is proportional to the kWh measurment and shows the same savings percentage.

Alternatively, but more imprecise, you could record the runtime of the compressor. Assuming constant current, this also gives a (rougher) first indication of the savings. Use this option only if no other measurement options are available.

The power readings can be either single phase or 3-phase, depending on your aircon unit.

2.) Indoor temperature – optional, recommended

The aim of the AIRCOSAVER is to achieve energy savings without compromising on the cooling comfort.

Therefore, it makes sense to also measure the indoor temperature. You might say that the thermostat takes care of the room temperature and that is actually correct. The AIRCOSAVER software (from version 3.x onwards) recognizes the thermostat status and takes it as an input into the algorithm.

That means it understands if the the thermostat is being reached at all or not and gradually adapts its settings accordingly. Nonetheless, a separate temperature measurement in the room can be helpful to illustrate that the same room temperatures are being achieved.

This value is usually recorded in intervals with a data logger, for example every 15 minutes.

3.) Ambient (outdoor) temperature – optional, recommended

In order to confirm that testing conditions in the before and after case are very similar, it is worth to also record the ambient temperature. Like the indoor temperature, this value is typically logged in intervals.

4.) Indoor and Outdoor humidity – optional

To datalog these values completes the picture of testing conditons and performance but can require more extra equipment.

5.) Compressor cycle pattern

The data logging of the compressor on/off cycles is more of an informative measurement.

However, it can be helpful when discussing the results with a client, for example when discussing the slightly more frequent cycling of the compressor with the AIRCOSAVER.

Measuring Equipment

The following is a list of some selected equipment suppliers for data logging instruments.

Simple single-phase plug-in kWh meters

For some quick demos on smallish single phase aircons, a simple plug-in kWh meter will already be sufficient.

In many countries (small) aircon units are plugged into a dedicated power point so if you plug the single-phase meter into this power point and then plug the aircon unit into it, you only measure the energy that is consumed by this aircon unit.

These simple devices are available for every type of plug format and can record, kWh, power factor and measurement duration. They will sometimes also directly give you the kW per hour (kW/h) value.

ZIMMER

Rather expensive lab grade equipment:
http://www.zes.com/

HOBO

Hobo loggers have proven to be reliable, (relatively) affordable and versatile
http://www.onsetcomp.com

ACR

Also used were instruments from ACR systems, especially for simple temp. measurements the ACR smartbutton. I think at least their smartreader2 has both temp and RH channels.
ACR seems also recommendable in terms of value for money.

http://www.acrsystems.com/products/

FLUKE

The classic but also quite expensive.
http://www.fluke.com

ATAL

Dutch company. Offers single phase and 3 phase recording and monitoring equipment.
http://www.atal.nl

If you use others which are not on this list and are happy with them, we would love to hear your feedback to complete this list!