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Users Manual

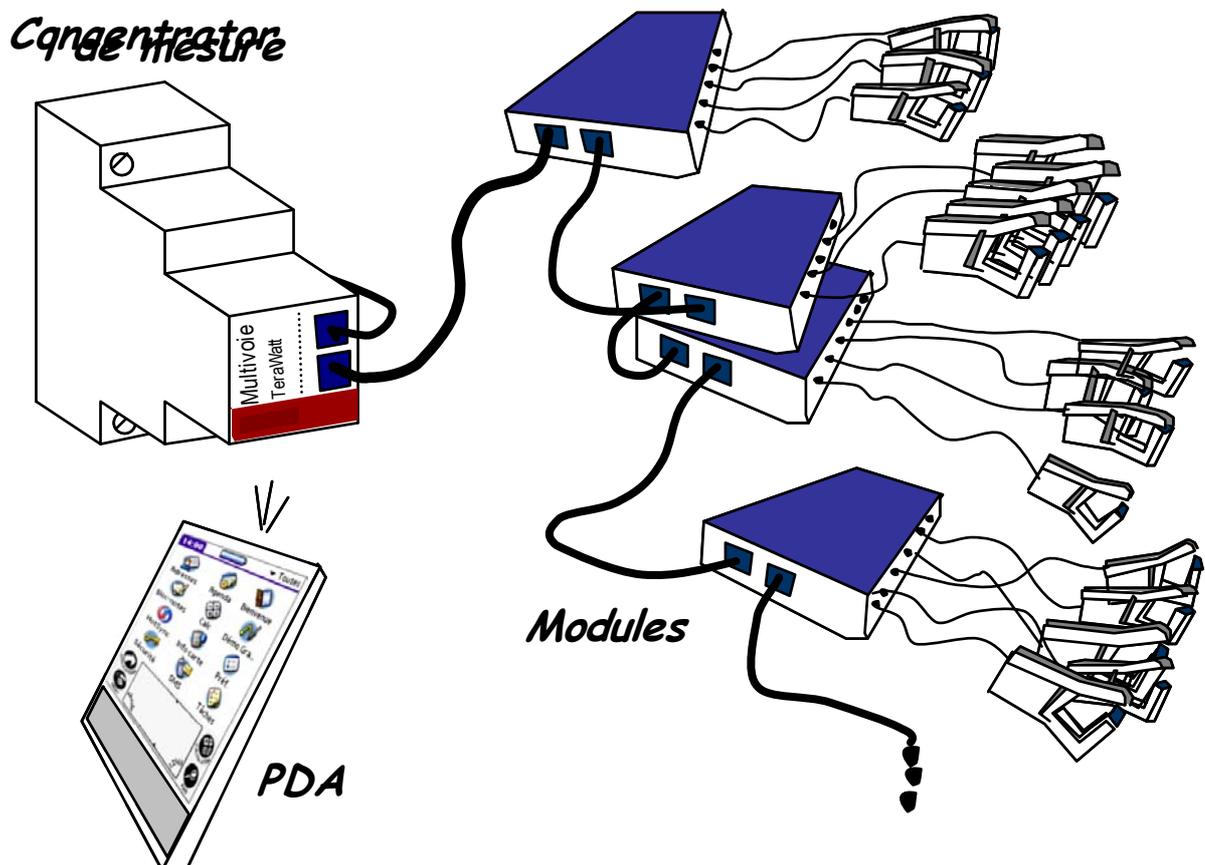# *MULTIVOIES*

12 - 2009

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1 <u>OVERVIEW</u>

The MULTIVOIES^{tm} system is designed for the measurement of a large number of channels of power consumption and energies in electrical switch boxes. It includes a Din rail mounted concentrator to measure voltages and supply power to the system, and several modules equipped with current sensors.

The system interfaces with the user thanks to a Personal Digital Assistant, using Infrared communication or low power radio (Bluetooth).

The concentrator and the modules are connected to a high speed industrial data bus with factory assembled RJ11 connectors.

The modules are fitted with various current sensors depending upon applications :

- Standard closed miniature current transformers (0-45 Amps)
- Miniature opening jaws MC1 (0-60 Amps)
- Industrial Openable current jaws (0-90 / 0-180 Amps)
- Flexible Rogowski coils up to 1000 Amps.

1.1 Safety remarks :

The Multivoies system was designed and tested in accordance with CEI 61010-1/EN 61010-1/VDE 0411-1 and CEI 61010-2-032/EN 61010-2-032/VDE 0411-2-032.

The safety of the operator and system is garantied provided that it is correctly used. The Multivoies system must be installed only by qualified electricians. The installator should read completely and thouroughly the whole present manual. Please respect all instructions for your own safety and to avoid any risk to others. The Multivoies system should only be installed in norms compliant electrical panels.

Meaning of the symbols :

: Danger ! please the manual.

: Double insulation

: CE conform

CAT III, 250Vac : The maximum allowable voltage between each phase (inputs 2, 4, 6) and neutral line (inputs 1, 3, 5) is 250 Vac.

The system is designed to be installed in electrical switch boxes or panels and connected to a grid with overvoltage limited to 4kV or less. If necessary, additional protections should be added before the system can be installed.

The measurement system should not be used in case :
• the outer cover of the main module is opened
• external damages are visible
• the connecting wires are damaged or pourly insulated
• after extended storage periods in severe conditions (humidity, dust, low temperature...)

Safety recommandations :
• The system enclosures and sensors should not present traces of dust, humidity or grease.
• Before installation, we strongly recommand to adaquately and surely remove any dangerous voltage in the vicinity and to use safety tools such as glasses and insulated gloves.
• Avoid large mecanical stress such as chocs, vibrations, high temperatures or magnetic fields.
• The systems enclosured must be closed using their original screws.

• When using openable jaws on energetized circuits, the operators fingers should never exceed the flange position.

Attention !
The niminal voltages of circuits under test should never exceed 250 Vca between phase and neutral. The currents to be measured should remain below the following :

- Standard closed miniature current transformers (0-45 Amps)
- Miniature opening jaws MC1 (0-60 Amps)
- Industrial Openable current jaws (0-90 / 0-180 Amps)
- Flexible Rogowski coils up to 1000 Amps.

Do not used the current sensor beyond their capacity !
Do not use this system to measure currents on bare or pourly insulated wires or conductors.
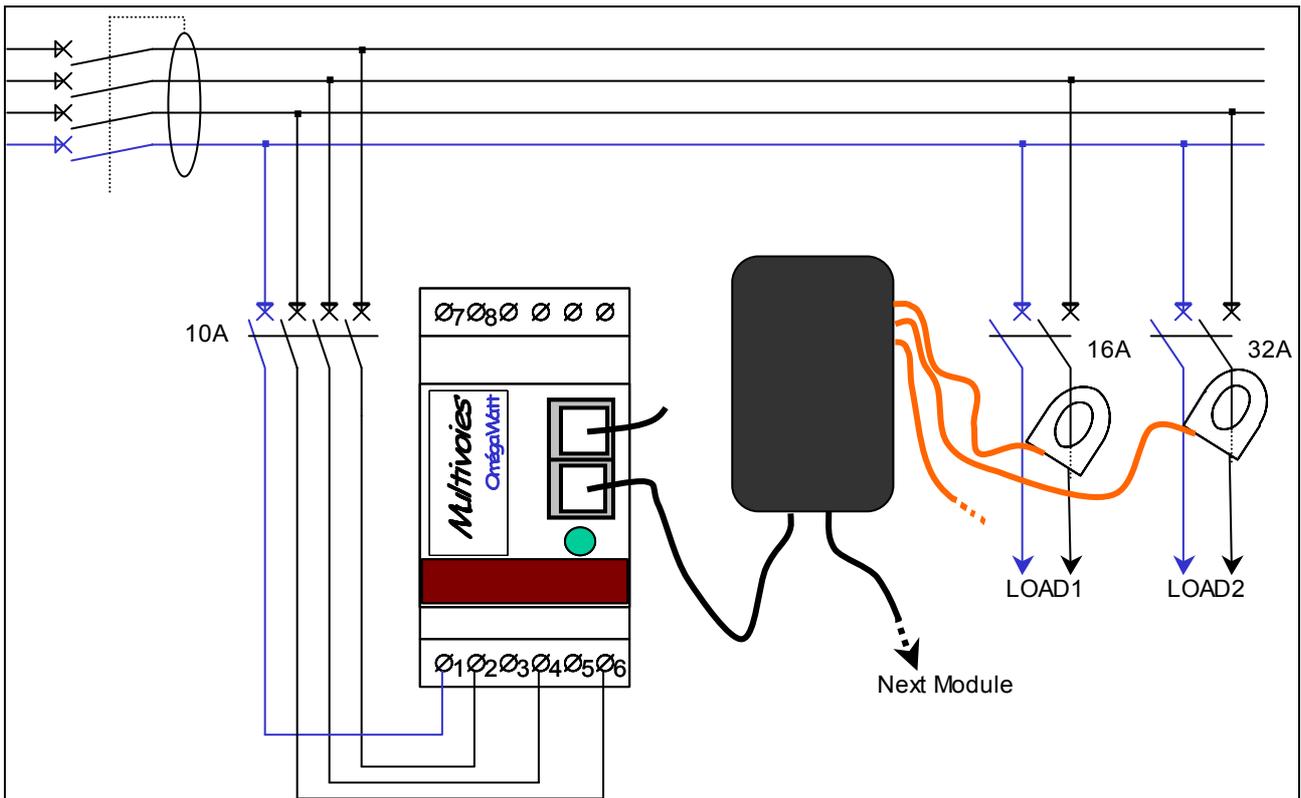

2 **MAIN FEATURES**

• Simultaneous measurement of electric power in tens of lines per switch box or electric panel.

• Measurement of active power ranging from 2 W to 230 kW per phase with a wide range of current sensors (Current jaws, miniatures current transformers, Rogowski coils). Typical accuracy : 2%.

• Recording of active energy and average voltage with intervals of 1 second to 60 minutes (5 month memory for 10 minutes period – independent on the number of current modules)

• User Interface on a colored display Palm Pilot. The PDA has wireless communication to the Multivoies system via radio (BlueTooth) or infrared (IrDA). Measurement data are uploaded to the PC with standard USB cable and the standard synchronization software of the PDA.

• Real time display of measured power of all channels on the PDA. It is therefore easy to locate every appliance consumption or the loads supplied by each circuit breaker. It is a very efficient way to balance the loads on 3 phases systems and also to assess the reactive power producers.

• Real time display of apparent power and waveform (current and voltage)

• Records power quality (voltage sags).

• The systems is compatible with very weak grid. It works with only 120 Vac (referenced to neutral line) on either of the three phases and can accommodate with 0V sags during 500ms.

• System total consumption is very limited (typically below 1 Watt) and can generally be neglected in detailed monitoring application. (which is not the case when using standard meters)

3 **INSTALLATION**

The concentrator must be wired behind a fuse or circuit breaker. Make sure it is normally never switched off ! A low amperage breaker (10 Amps or less) will be preferred.

In three phase panels, it is necessary to connect the neutral line first and then the three phases P1, P2 et P3 as shown below. **The system cannot be used on 3 wire 3 phases systems** (i.e. when the neutral line is not available)

In single phase panels, simply connect the neutral line and phase P1.

Example of use in a tri phase electric panel

Junction :
1. Neutral line
2. Phase 1
3. Neutral line
4. Phase 2
5. Neutral line
6. Phase 3
7. Earth

Max. voltage between any phase and neutral line : **275Vac**.

Be aware that all 3 Neutral line inputs are internally shorted.

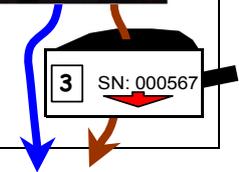The green LED flashes when the concentrator is powered.

View of the concentrator
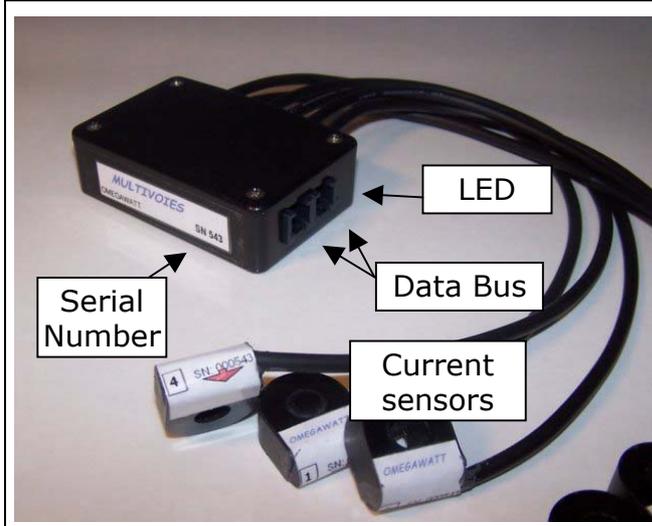
Connecting the current sensors :

The phase line must to be rewired through the sensor.

The red arrow shows the direction of the current to the load in the phase line.

The modules are connected one to another using RJ11 wires. Check the proper « click » sound when inserting the RJ11 connectors in the plugs.
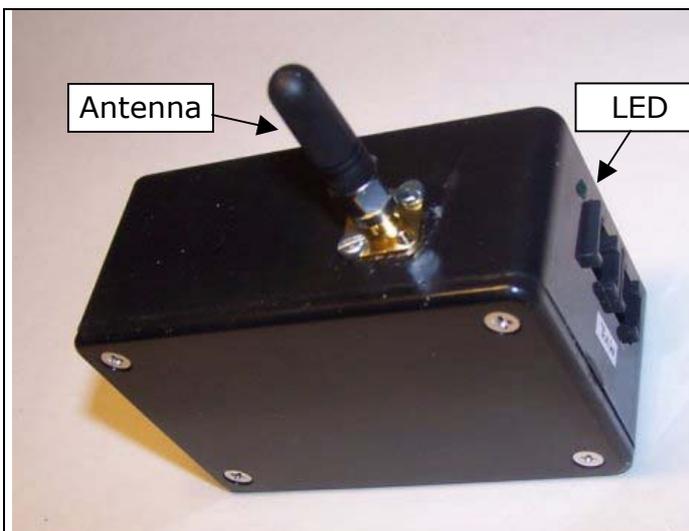
(some versions come with a blue enclosure)

The radio module (Bluetooth) is connected to the data bus just like the current measurement modules.

It has a green LED which is on at startup and flashes rapidly when the radio connection is established (with the PDA).

The antenna can be replaced by a more efficient model to increase the range (2.4 GHz Dipole or Patch antenna with standard sma connectors).
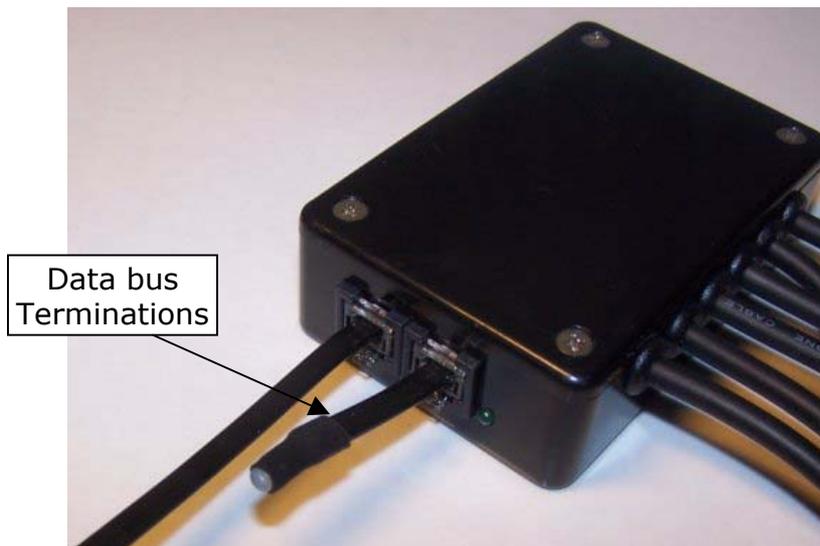
The position of each element (modules, concentrator and if present, the radio module) in the data bus is of no importance. But we advise to connect the radio module at one end of the bus in order to reduce radio interferences. This also allows to add or remove the radio module easily so as to reuse it for another Multivoies system. (beware to close the data bus with network terminations when you remove the radio module – see below)

It is possible to connect tens of modules on the same bus. The total length of the network is limited to approximately 5 meters, depending on the noise level of the site (especially in large power panels with motor drives). It is recommended to keep the cable length between concentraor and modules as short as possible.
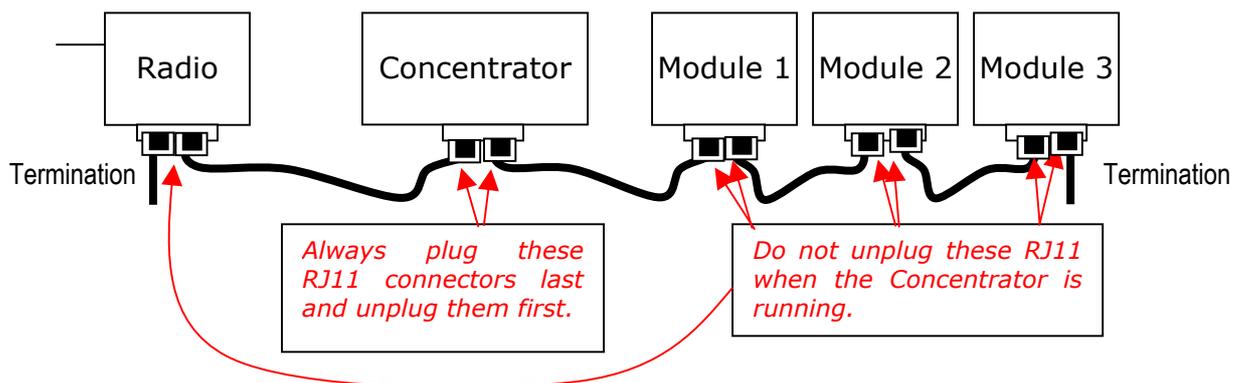
The data bus and all modules are galvanically isolated from the electrical panel. The current sensors and radio module are referenced to earth when the pin 7 of the concentrator is wired to the earth (which is recommended).

Even if normally not at a dangerous potential, we do not recommend to plug in or out the RJ11 wires of the bus when the concentrator is on. If the concentrator cannot be switched on and off easily, it is acceptable to unplug the RJ11 wires from the concentrator before altering the data bus configuration.

The terminations should always be in place when the data bus is active (i.e. connected to a powered concentrator). Ignoring this rule could result in damages to the hardware.

Data bus Terminations

Example of data bus :

Radio   Concentrator   Module 1   Module 2   Module 3

Termination   Termination

Always plug these RJ11 connectors last and unplug them first.
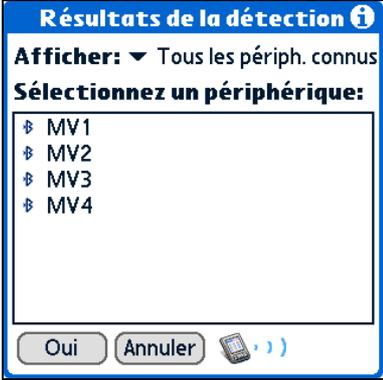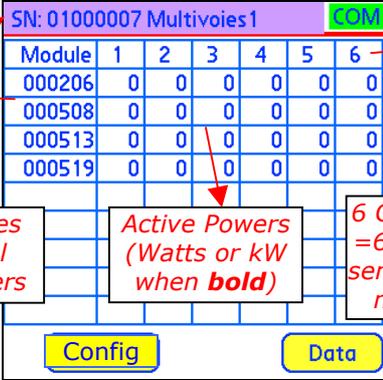
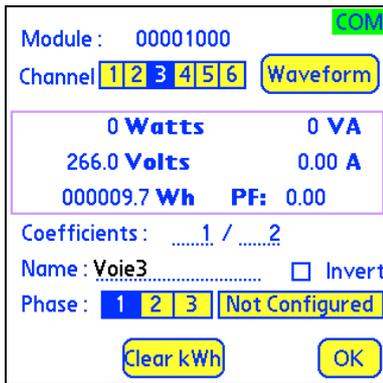*Do not unplug these RJ11 when the Concentrator is running.*

4 <u>USING THE PDA</u>

The configuration and visualization of data is possible with a Palm powered PDA (the MV1BT.prc and/or MV1IR.prc software must be installed first on your PDA) :

- Infrared (IrDA) : The PDA must be directed to the concentrator. The range is limited to about 1 meter in direct sight.
- Bluetooth radio : A radio module must be connected to the data bus.

	On the PDA screen, launch : - MV1BT if you want to use the Bluetooth radio communication. - MV1IR for Infrared communication. In this case, target your PDA at the concentrator first and then start MV1IR. Special versions (Infrared Only): - MV1IR2 is intended for OMAP processor based Palms like Tungsten E. (But **Not** Tungsten E2...) - MV1NB is a black and white version for older Palms.
 In this window, the language is the one of your PDA	PDA with Bluetooth only. (For infrared communication, next window appears immediately) Display : All known peripherals or nearby. Select the peripheral (the one whose name is indicated on your radio module – MVx.) and then click OK – ("Oui").
	When the communication is established the PDA automatically displays the serial number and name of the concentrator and the serial numbers of all modules detected. The active power for each current channel is displayed in columns 1 to 6 for each module and is updated in real time. In case more than 9 modules are connected, a scroll control appears on the left side of the screen.

The "Start Config" button stripes all cells in red until they are, one by one (each channel of each module), configured using the following menu :

|	
Module : 00001000 `COM` Channel `1` `2` `3` `4` `5` `6` `Waveform` 0 **Watts** 0 **VA** 266.0 **Volts** 0.00 **A** 000009.7 **Wh** PF: 0.00 Coefficients : ....1 / ....2 Name : Voie3.............................. ☐ Invert Phase : `1` `2` `3` `Not Configured` `Clear kWh` `OK`	Click on the module serial number or on one active power cell to access the configuration menu of the corresponding module. Select the channel (corresponding to sensor 1-6 of this module). Select the phase line of the wire which this sensor is measuring. (buttons `1`, `2` or `3`). **ATTENTION :** if the phase is not properly set, the measured powers and energy are totally wrong.

This menu has the following other features :
- Input of a name for each channel (1-6) : Use the field « Name », (here : "Voie3"). This name appears in the file resulting from a measuring campaign. (maximum : 15 characters)
- « Clear kWh » resets the energy counter. (here : 9.7 Wh)
- Display waveforms of voltage and current, click on « Waveform »
- Change channel, simply click its number (buttons `1` to `6` .)
- The coefficients are multiplicands or dividers for current measurements. They vary with the sensor type and should not be modified by the user.
- If needed (sensor mounted upside down or on the neutral line), check the invert ☐ checkbox. The effect can be seen on the « Waveform ».
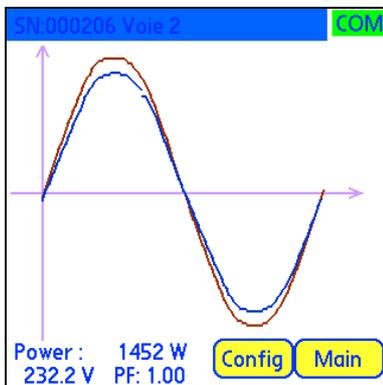
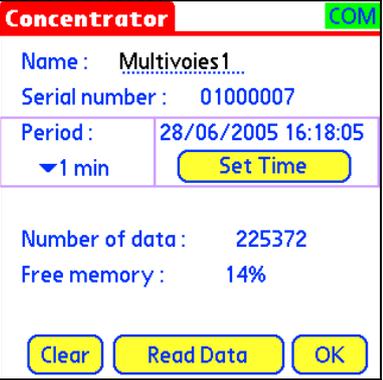|	
SN:000206 Voie 2 `COM` (voltage red and current blue waveform) Power : 1452 W `Config` `Main` 232.2 V PF: 1.00	Click the « Waveform » button to check if the configuration is correct: The voltage (red) and current (blue) waveforms are displayed in real time. Check that : - Active power is positive. - the power factor (PF) seem correct. Click « Main » to return to main menu.

SN: 01000007 Multivoies1 `COM` 	Module	1	2	3	4	5	6
---	---	---	---	---	---	---
000206	0	**2.1**	0	**1.0**	0	0
000508	0	0	0	0	0	0
000513	0	0	0	0	0	0
000519	0	0	0	0	0	0 | `Calibration` `Data`	In the main menu, active powers are displayed in Watts. Beyond 999 Watts, powers are displayed using a bold font (**2.1**) and then mean kiloWatts. Numbers in red color mean negative powers. In this case, configuration should be double checked (click on the serial number of the module). Probably the selected phase is wrong.

	Then click on « Data » « Set time » sets the clock of the concentrator (from the PDA clock – which should be set first…) Select the time period of recording. To start a new campaign, click « Clear » and confirm that you wish to erase all previous data.
	During or at the end of a measuring campaign, click "Read Data" to download the data to the PDA. Choose the file name (default name is Testxxxx where xxxx is a number which keeps increasing) Check the **number of modules**. If not correct, Cancel and return to the main menu to activate the modules auto-detection. Otherwise, some data will be missing in the file. Then click "START" to begin reading. (can last for several minutes depending upon the number of data and number of modules)
	Once the transfer is complete, click "DONE" to return to the main menu.
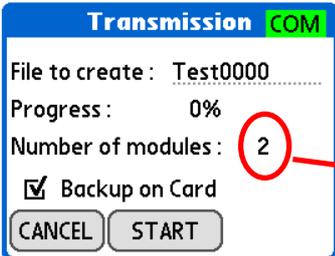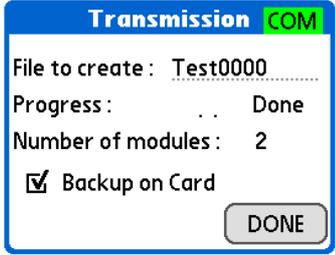
During radio or infrared communication, the info COM shows the communication state. If red, COM, the communication is interrupted. Check that the PDA is properly targeted (perpendicular) at the concentrator IR window (range of about 0,5..1 meter). With the radio link, try to move the PDA to another place. The range is in the order of 20 meters in building and can be increased with appropriate antennas (2.4 GHz, sma plug). The use of Bluetooth repeaters is not recommended.

5 DATA FILE DOWNLOAD

After download, the data files are stored in the PDA memory as databases (with default name Testxx.pdb). These database are automatically transferred to the PC during HotSynch (refer to your PDA documentation) :

- Install Palm Desktop on the PC.
- Plug the USB cable to the PC and to the PDA.
- Turn on the PDA.
- Make sure the Palm Desktop software is started.
- Click the « HotSync » button (Star)

The databases are by default located in :

C:\program files\palmone\name_of_the_PDA\backup

C:\program files\palmone : installation directory of the Palm DESKTOP software.

Name_of_the_PDA is the name you have to input at first Hotsynch to the PC with the PDA.

6 DATA FILES TREATEMENT

First install CREBASE1.EXE. Backup the database in your database directory. (recommended). Launch CREBASE1.

Select the file to convert :
  Testxx.PDB

Click « Make»

Wait until « Done » appears in the state bar.
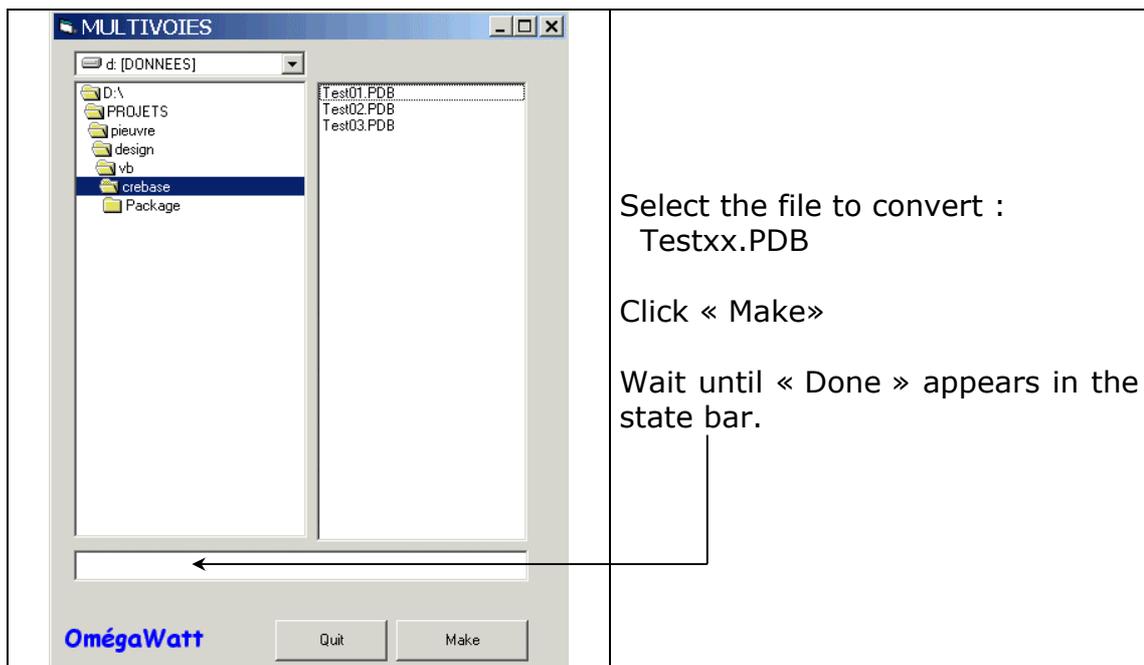
CREBASE1.EXE creates a text file named MV1.TXT (and overrides the previous one…). The file format is :

Test1D											
01000007	Volts	Volts	Volts	00000505	00000505	00000505	00000505	00000505	00000505	00000510	…
Multivoies1	Ph 1	Ph 2	Ph 3	Voie1	Voie2	Voie3	Voie4	Voie5	Voie6	Voie1	…
16/03/05 18:53:27	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	…
16/03/05 18:54:00	233,0	0,0	0,0	18,2	0,0	0,0	1407	0,0	0,0	0,0	…
16/03/05 18:55:00	233,0	0,0	0,0	17,8	0,0	0,0	1421	0,0	0,0	0,0	…
16/03/05 18:56:00	233,0	0,0	0,0	17,3	0,0	0,0	1437	0,0	0,0	0,0	…

Data are separated with tabulations. Importing this kind of files in a spreadsheet like Excel is straightforward.

First lines : File name, serial number and name of the concentrator.
1. Column 1 : Date time (end of the recording interval)
2. Columns 2,3,4 : voltages phases P1, P2, P3 (Volts)
3. Columns 5 à 10 : mean active power for sensor 1 to 6 of the module whose serial number is in second line of the file.
4. Columns 11 à 17 : mean active power of next module.
5. Columns 18 à 23 : …

During voltage sags, the concentrator adds a line (As a result, beware that all dates are not always following with a fixed interval - equal to the period of recording). In these voltage sags lines, all 3 phases voltage are zeroed.
When a time period is made of several lines, it is necessary to add the power of the modules to obtain the average power during the period.

7 <u>RECOMMENDATIONS</u>

- Recommended fuse or circuit breaker for the concentrator : 10A.
- Total length of the data bus : up to 5 meters. The shorter the better. Try to place these cables as far as possible from large current carrying wires.
- The radio module Bluetooth must be kept away from other modules or any other electronic device to improve communication range.
- During configuration, check that all the installed modules are seen by the concentrator (main menu on the PDA screen).
- The configuration phase and also double checking the measurements is of premium importance. An error in configuration (for instance wrong association between a current channel and the voltage phase) will impair the results. Use the "Start Config" button to make sure you configure each channel for each module.
- Before downloading the data, you must check that all modules in use were found in the main menu. If not, you will not receive the data corresponding to the missing modules. (The transmission menu now displays the total number of modules found – should correspond to the number of installed modules)
- Downloading lots of data is faster using infrared communication than radio;
- Avoid downloading the data when the recording period is very short (below 1 minute).
- For long measurement campaigns, it is strongly advised to download periodically the data. This can help detect problems as early as possible.

- The first active powers and voltages data line after a change in recording period is not valid and should be discarted.

Tips to use the PDA :
- On some PDA, infrared and radio communications must be activated first. Check the preference menu.
- Using radio or infrared communication drains a lot of power compared to standard use of these devices. Charge the battery whenever possible. The autonomy is normally sufficient for a full working day.
- Activate the auto shut down feature of the PDA (2 minutes). (It is momentary deactivated during data download)
- Backup regularly the data to a PC (hot synch). Most PDA have volatile memory (i.e. memory is lost when battery is fully discharged !)
- Cleanup the PDA memory before it is full. The use of fileZ is recommended.

Current sensors :
- Are intended to measure currents on *isolated wires*. Do NOT install around a bare conductor at a dangerous voltage.
- Output wires of the sensors are subject to interferences and should be placed as far as possible of magnetic fields (i.e. of large current carrying wires). Also these wires should be kept away from all metal parts at high voltage in the electric panel.
- Dimensions : see below

Technical characteristics :
Mesurement of voltages, currents, active and apparent powers in low voltage grids (230 Vac). Nominal frequency : 50 Hz +/-0.5%

Sensor type	Measurement range	Resolution	Min. power	Typical Accuracy	Hole diameter	Dimensions LxWxT (mm)
Concentrator	120-250Vac (per phase)	0.1V		1%		
Closed current transformers	0-45A (11kW)	1W	2.5 W	2%	9 mm	24x24x11
Miniature opening jaws (MC1)	0-60A	1W	5 W	2%	9 mm	32x20x7
Industrial Openable jaws 90A	0-90A	1W	5 W	2%	17mm	90x45x27
Industrial Openable jaws 180A	0-180A	2W	10 W	2%	17mm	90x45x27
Flexible Rogowski 180A (RC1)	0-180A	2W	10 W	2%	40 mm	coil Ø8 mm
Flexible Rogowski 540A	0-540A	6W	30 W	2%	65 mm	coil Ø8 mm
Flexible Rogowski 1000A	0-1000A	10W	50 W	2%	130 mm	coil Ø8 mm

Reference Conditions :
Ambiant temperature : +21°C +/-5°C
Relative humidity : < 80 %
Display : remote on a digital assistant (Palm os. compatible)
Display refresh rate : 0.5 to 1Hz
Recording period : 1 second to 1 hour
Supply : via any of the measurement phases.
Consumption : <1W (with 12 current sensors)

Electrical safety :
CAT III 250 V. Max overvoltage : 4 kVca
Electromagnetic compatibility : CE (CEI 61236-1, CEI 61236/A1)

Environnemental conditions :

Service temperature 0°C to +40°C
Storage temperature –10°C to +60°C (without battery)
Relative humidity 80 % maximum, not condensing
Altitude 2000 m maximum
Mecanical : IP 20

Dimensions :
Concentrator : DIN rail mounted – 35mm wide.
Modules : L x h x l : 84 mm x 25 mm x 50 mm. Weight 200g