MP2U
User Manual
Installation, Operation and Maintenance
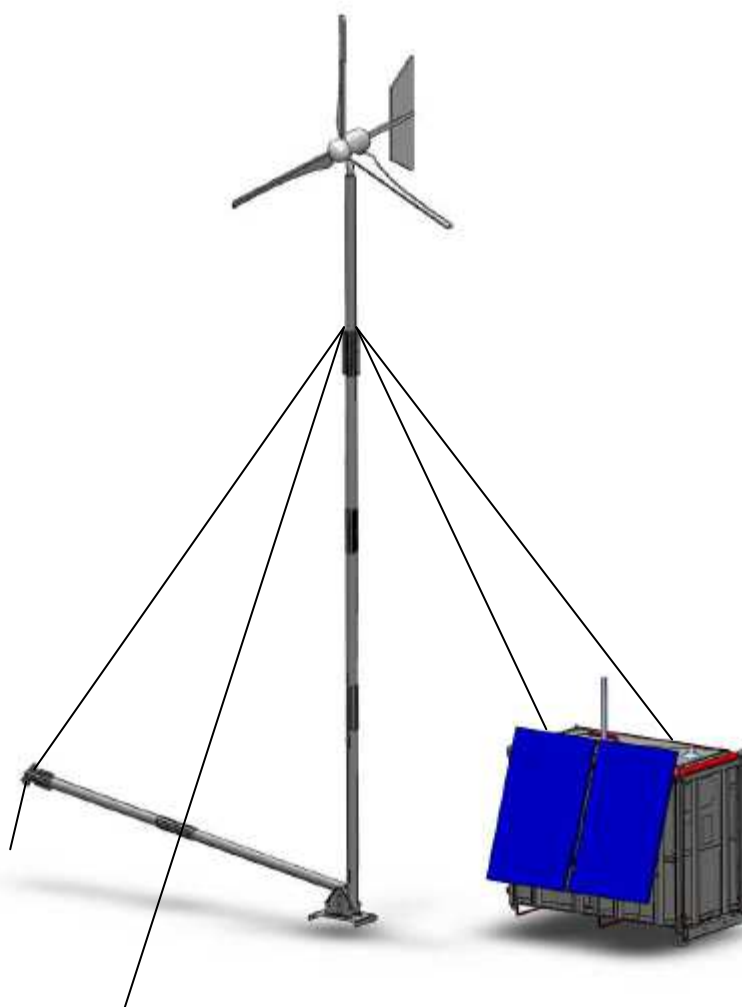
Version :	1.1
Mise à jour :	21/06/2012

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Safety First!

Warning!

Reading this manual and dutyfully following its prescriptions are compulsory in order to run properly and safely the MP2U.

Take your time to read it carefully and never go to the operation site without it.

Installation, operation, service and maintenance of a MP2U unit shall expose you to various risks. These risks are described below. They are marked in the manual with the corresponding icons. Be careful!

1. Electric shocks: Teh MP2U system is based on a nominal DC voltage of 24V. There are therfore limited risks of electrocution except the leads between the petrol generator and the battery charger. These leads are properly isolated.

    : This symbol will be used at the proper place in the manual to show when there might be an electric hazard.

2. Physical risks: The design of the MP2U involves heavy metal parts with hinges and lifting action. It can induce injuries if not handled properly. It is vital to follow this manual's instructions and to use the proper tools the proper way to avoid any problem. Individual safety equipment to be used will be adverted at the proper installation steps with the following icons :

    : Safety shoes compulsory

    : Gloves compulsory

    : Helmet compulsory

3. Environmental risks: The MP2U involves many components and some of them might induce some specific environmental risks. This risks are highlighted with the following icons:

    : Fire risk, inflammable material

: High temperature, risk of getting burned.

: Battery risks (high currents in case of short circuit, acid…)

4. Embedded signs in the MP2U: Signs on the MP2U placed at proper locations will highlight local risks. They should be carefully taken into account when using the MP2U. Take care that every people interacting with the MP2U has read this manual and has his safety equipment on him.

5. Operators of the MP2U: Only properly trained and qualified staff is allowed to interact with the MP2U. This system is complex and requires specific skills.

Important

ERM Automatismes has made all possible efforts to make sure that all information included in this manual are updated but ERM Automatismes shall not be responsible for any mistake or ommission. The users of this manual shall bear the entire responsibility of the use of their MP2U and of the corresponding risks. ERM Automatismes will not endorse any responsibility in case of any prescription of this manual not being met by the user and if the user's inconsequence is obvious.

This manual does not replace any of the manuals provided with the various manufactured equipment included in the MP2U.

Introduction

This manual includes all the information needed to run the MP2U dc 400/1/700-24

It relies to all MP2U dc systems.

These systems are designed to provide secured power to remote appliances using local renewable energy sources (sun, wind…).

They are built to last in the « Heavy Metal School » style and in accordance with Eurocode 1, NV65 and CM66 standards and can withstand winds up to 42 m/s.

The system's schematic is as follows:

Several energy providers (small wind turbine, PV, petrol genset) will charge a Li-ion battery bank. A DC load will be fed by this battery bank.

Operation

The wind turbine and the photovoltaïcs will charge the battery using the local available resources (sun and wind). These resources are fluctuant and consequently, the battery state of charge evolves with time.

Ressources | Convertisseurs | Stockage | Consommation
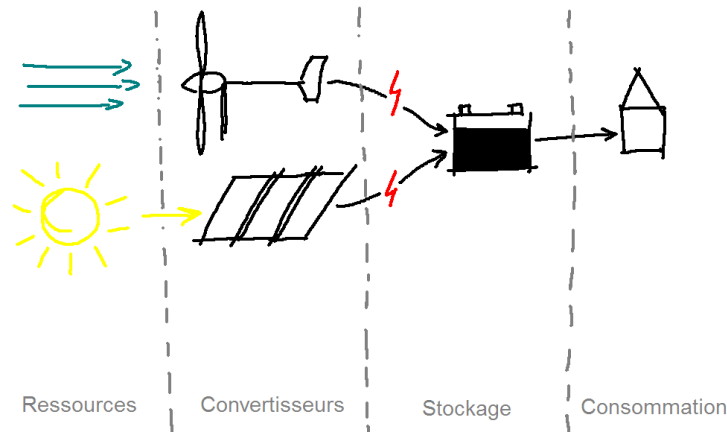
When the batteries are full, controllers will reduce the charging.

When the batteries are empty, the charger starts and allows the batteries to be charged by the petrol generator.

A PLC records the parameters of the system (currents, voltages, temperatures…) drives the various components.

This PLC also deals with the GSM/GPRS/3G/Ethernet communication and will automatically send alarm SMS to the people in charge. The phones numbers are set by the user at first installation.

It is also used as an anti-hijack system.
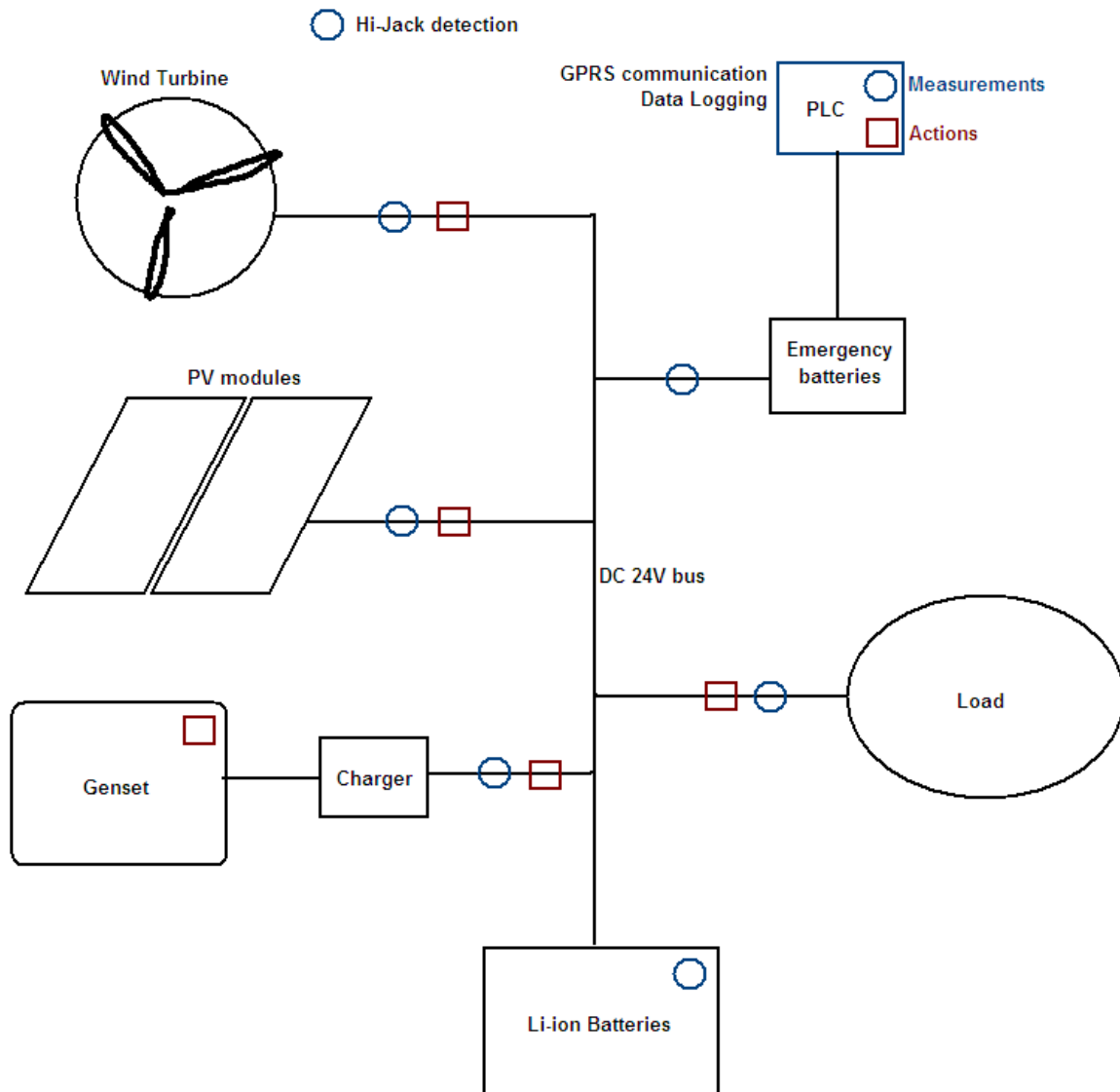
The MP2U relies on local natural resources. It was at first designed to be able to feed a 150W permanent load in the Highlands in Northern Scotland. Depending on the site, PV or wind shall have different contributions to the energy production. Tropical areas will most of the time depend mainly on sun but when latitude increases, wind will have a more important part to play.
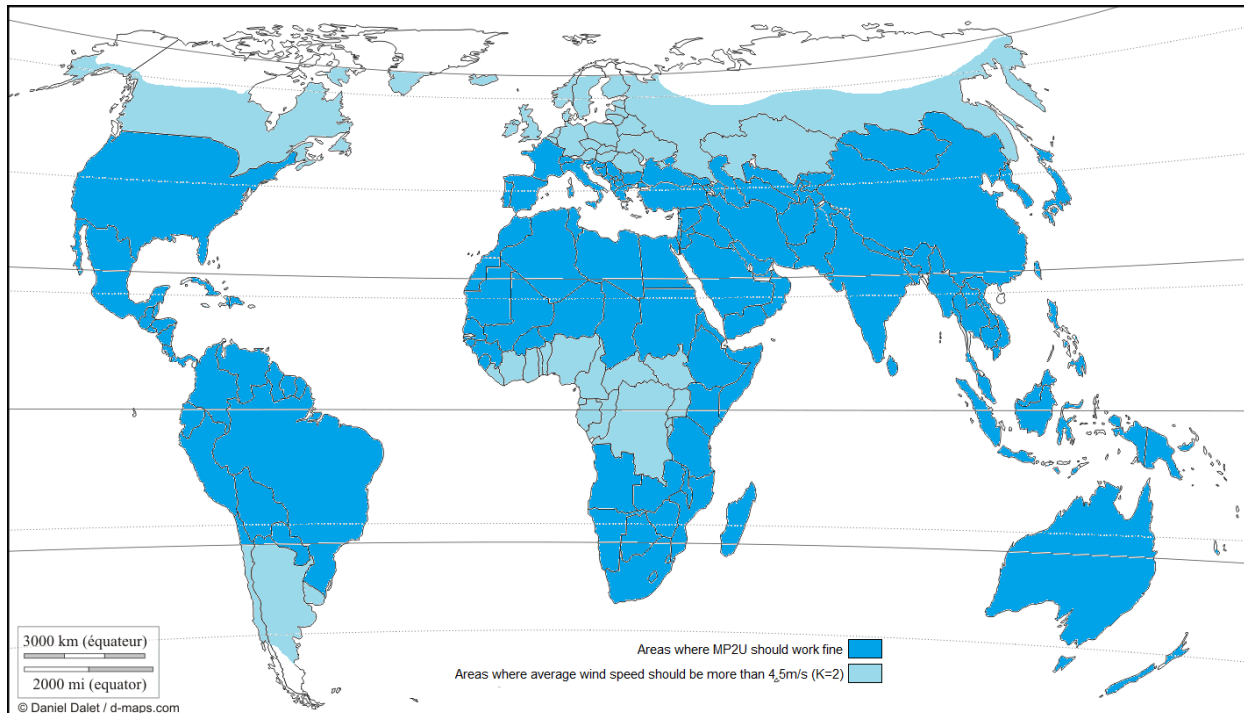
The map below indicates the areas where the MP2U should be suitable for you if you want to feed à 100W permanent load or less. Of course, local environment has to be considered and every site will have its own capacities. Please make sure that, when installing the MP2U, real care is taken to have the PV modules as exposed to sun as possible and at the right pitch angle, and that the wind turbine is properly set out of turbulences and at the windiest place possible.

Areas where MP2U should work fine
Areas where average wind speed should be more than 4,5m/s (K=2)

3000 km (équateur)
2000 mi (equator)
© Daniel Dalet / d-maps.com

Scope of delivery

The MP2U is delivered as one single closed unit. It can be delivered on request with the EasyLow© system and a trailer. Scope of delivery is as follows:

Item	Unit	Quantity
MP2U main enclosure		
Yingli 235Wc PV Module	U	2
E300 small wind turbine including	Ens	1
Blade set (3 blades)	U	3
Tail	U	1
Tail boom	U	1
Alternator + pitch control system	U	1
Nosecone	U	1
Screws and bolts	Lot	1
20m power cable	Ens	20ml
Battery li-ion 3,6V 700Ah	U	8
Battery charger Victron Centaur 1200VA	U	1
PLC including	Ens	1
Touchscreen box	U	1
Emergency stop box	U	1
Measurements box	U	1
Power box	U	1
Terminals box	U	1
PLC Back Up battery sealed 12V 40Ah	U	2
Genset 3300W Hyundai	U	1
Cable puller 1600kg	U	1
Cable for cable puller 20ml	U	1
Handle for cable puller	U	1
Sandows	U	2
GSM/GPRS external antenna	U	1
Enclosure adjustable feet	U	4

Item	Unit	Quantity
Pads	U	4
Tower tubes junctions	U	8
Keys	U	1
Compartment under the enclosure		
Tubular tower for wind turbine	Ens	1
Tube	U	6
Baseplate	U	1
Gin pole head	U	1
Tower head	U	1
Guy set	Lot	1
Anchors	U	8
Turnbuckles, shackles, cable-clips and accessories	Lot	1
Trailer + EasyLow©		
Stand gusset	U	2
Stand foot	U	4
Lockable steel box	Ens	1
Electrical plus to connect trailer to car	U	1
Trainer lockable steel box	Ens	1
	U	4
Chain hoists	U	4
Stand top carter	U	4
Adjustable straps	Lot	1
Bolts and nuts		

The overall weight of the MP2U is 1 041 kg including:

	en kg
Steel enclosure	320
Steel floor	24
E300 wind turbine	75
8m tower	150
Anchors	10
Power cable	10
PV modules	40
PV stand	7
Batteries	168
Genset	32
Supporting steel board for electronics	15
Victron Centaur charger	18
Controls	7
Fuse box	2
Tool box	67
Enclosure main gate	96
Total	1 041

This weight does not include the trailer.

List of needed tools

☐   Compass

☐   Spirit Level

☐   Torque wrench (20 to 60Nm)

☐   Open-end wrenches set (8 à 30mm)

☐   Ratchet and sockets (8 à 30 mm)

☐   Electric powered wrench

☐   Adjustable wrench 15" ou 18"

☐   Combination pliers

☐   Strong pliers

☐   Steel wire

☐   Heavy hammer 8kg

☐   Rope or line level

☐   Spray paint

☐   Standard electrician tool box

☐   Grommet for electric cables

☐   Voltmeter DC   ☐   Ampmeter DC

Installation

Unloading the trailer

Purpose of the step:
*The MP2U must be set in a place as flat and cleared as possible (maximum slope is 8%).
Take into consideration that you will have to install the MP2U but also the wind turbine and
that the wind turbine should not be shading the PV modules. Remember that the turbine has
to tilt up and down easilty (see step 4.2.1 Tower rising).*

Tools needed for this step*:
- Spirit Level, open end wrenches: 16-17-24, Ratchet and sockets: 16-17-24*

Step / Description	Picture
1/ Positioning the trailer: The trailer has to be oriented so that the PV modules will be facing South in the Northern hemisphere, and North in the Southern hemisphere. The main door will be facing the other way. Picture shows proper orientation for Northern hemisphere.	
2/ Preparing the EasyLow© system: Fit the stand feet in the stand gusset, taking care to have the feet's plates horizontal. Secure with an M16 bolt.	
3/ Unloading stand tubes: Open the steel hood and pull out the two tubes having fixing lugs.	

4/ Finalizing the stands:
-Prepare the stand feet by having them on both sides of the trailer.
-Put a tube on the two stands taking care to have the fixing lugs downwards.
-once properly adjusted, secure with the top carter and four bolts.

5/ stand adjustment :

-Make sure the stand is stable
-Mov the stand in order to make sure that the trailer will be able to move both ways.
-Stand tube should be about 20cm far from the MP2U enclosure.
-Adjust horizontality using a spirit level and modifying the feet length using the optional holes.

This should be done at both ends of the MP2U.

6/ Installing the hoists

-Attach the hoists to the fixing lugs on the tube and to the corresponding fixing lugs on the MP2U. The hoist should stay close to the tube while using the hoist (use the chain hook to connect to the MP2U).

7/ Removing the trailer
-Use the hoists to lift the MP2U a few cm above the trailer floor.
-pull the trailer out <u>manually</u>.

8/ Bringing the MP2U down:
-Use the hoists to bring the MP2U down slowly.

⚠ Be careful to keep the MP2U horizontal during the process to prevent any dangerous swing.

Once the MP2U is about 30m above the ground,

-adjust horizontality using the hoists,

-put the pads in place beneath the MP2U feet,

-unlock the feet (they have to slip down to the pads),

-fit the small bent bar into the nearest holes under the MP2U. Do not use the holes they were already fitted in for transport.

The MP2U is now on the ground. Release the hoists and dismount the stands. Open the MP2U and find next components inside.	

Installation of the PV generator

Purpose of the step:
The PV modules will be put in place in a way nobody can dismount them once the MP2U is closed. Be careful to be two to carry the modules, especially when wind is blowing.

Needed tools for this step:
Open end wrench: 16-17
Ratchet and sockets: 16-17

Step / Description	Picture
1/ Electric cables: -open the eyelet by rotating it and push the cables through. -close the eyelet.	

2/ Installing the modules

-put the two modules in place slipping the lugs in the slots. They should be hanging without being held.

3/ locking the top fixation:

-insert the 12mm stainless steel bar through the top of the MP2U passing through the modules' lugs.
-check from inside the MP2U that the bar is properly put in place. It has to be fully inside the enclosure (not protruding end).
-lock with the safety pin.

4/ Installing the down fixation:

-Insert the Ø 21.3mm bar in the bottom lugs of the modules.
The two modules are now assembled.
-Fit the plastic caps at both ends of the bar.
-hang the offset arms to the bar, in front of the slots in the MP2U wall. There are two offset arms sets: one for 60° module slope and another for 45°. Chose the angle nearest to the latitude of the site plus 10°.

5/ locking of the PV generator

-Swing the modules up slowly. Lift the offset arms and slip them through the slots in the MP2U wall.

- Secure the offset arms from the inside using the M10 bolts.

The PV generator is now installed and secured.	

Installation of the wind turbine

Tower Assembly

Purpose of this step:
The tower is made of 4 tubes linked together by steel bolt shells. Be careful in siting the anchors properly. This will ease any later servicing a lot.

Needed tools for this step:
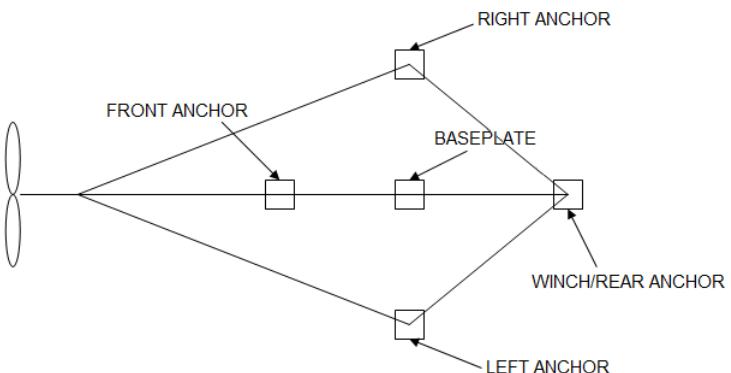*Flat spanner, open end wrenches 10-13-16-17*
Sockets 10-13-16-17
*Hand held screwing machine*
Adjustable pliers
Strong pliers
Steel wire

Step / Description	Picture
1/ Overview: -4 anchors for guys. The Winch Anchor is the one considered as the operating point. -A baseplate on which the tower rests.	

2/ Siting:

-Nail the baseplate to the ground using the steel rods provided.

-Draw two lines at right angle meeting in their middles.

-Place the right and left anchors 15cm ahead of the moving towards the front anchor.

-Mark on the ground the places of the anchors.

Tilt side

8400

8400

150
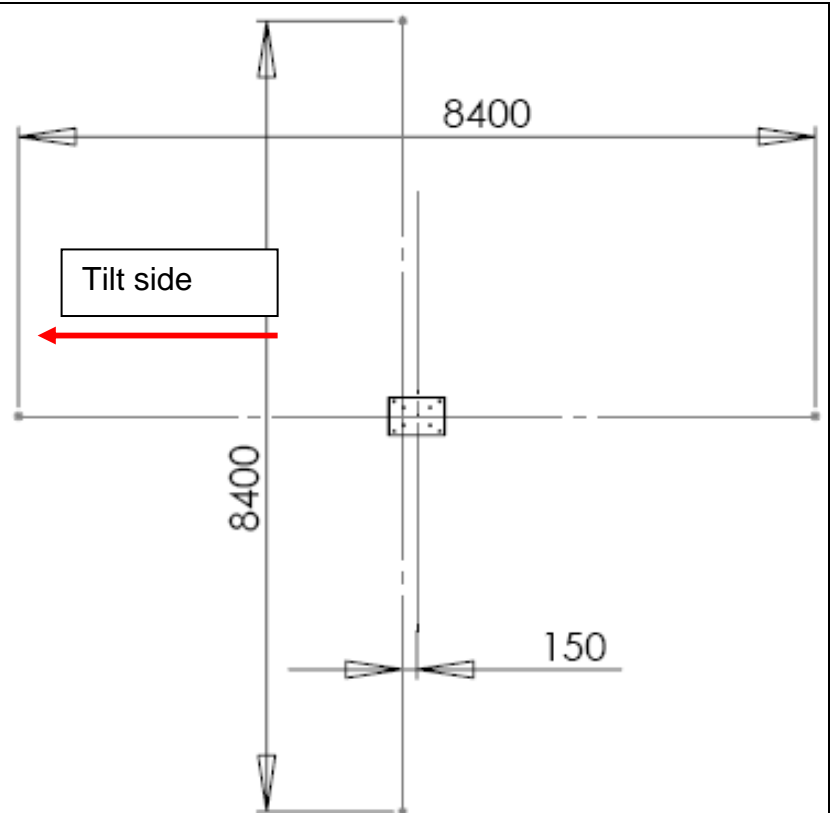
3/ Anchors

For the right, the left and the front anchor: nail 2 galvanized steel posts one behind the other at 50° $_{+-10°}$ and 50 $_{+-10}$ cm apart on the marks made previously.

(The post the closest to the baseplate is the reference. It has to be nailed on the mark. The second one is placed behind and will be used to support the front one. The fixing rings must be facing towards the baseplate. Thelowest ring has to be not more than 10cm above the ground).

- The winch anchor is made of two reference posts (one for the cable puller and one for the guy) and a third securing post placed behind.

- Put the steel slings in place between the two posts....

Notice: This anchoring method is the most versatile one ERM Automatismes could design but still, it might not be adequate for specific grounds (sand, wet area, rocky sites…) and it is the installer's responsibility to choose another way to make the anchors when needed.

Maximum load in the guy, if the installation has been done as prescribed in this manual, is 575 DaN. This value is correct for both tilting and extreme winds.

4/ Positioning the tubes
-The tubes are marked. Align them on the ground starting from the baseplate in the correct order 1, 2, 3 and 4.

- Fit the tube 1 into the baseplate. Use the M20 bolt as a shaft to attach the tube to the holes closest to the front anchor.

5/ Tower assembly:

-Put together two shells using 8 M10 bolts kept loose. Fit an M10 bolt in the middle hole and tighten it. It will be used as an end stop.
-Fit the shell assembly over the tube 1 up to the end stop.
-Slip tube 2 into the shell assembly. Make sure the tubes are aligned and are both pushed in up to the stop.
-Tighten all bolts progressively.
-Proceed the same way for tubes 2 and 3 and 4.
-Fit the two smaller shells (used to hold the guy plate at teh right height on the tower) oveer the 4th tube. They should be placed so that they are 1,50m far from the tower top.
-Slip the guy plate over the fourthe tube until it rests on the small shell assembly.

Guys are attached here
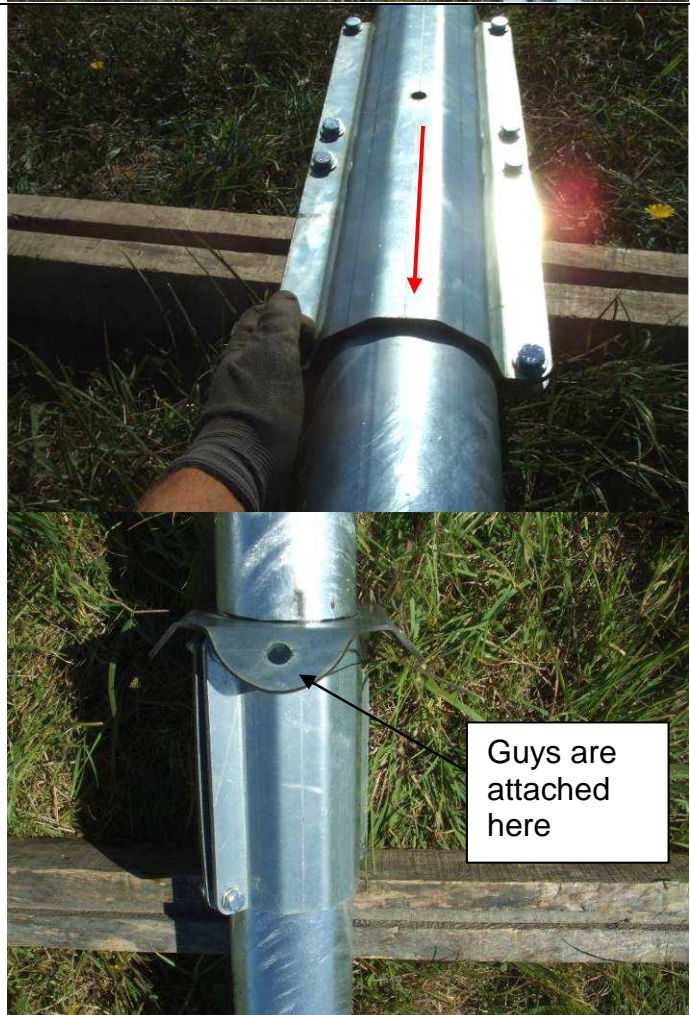
5/ Assembling the ginpole:

-Fit the ginpole together as you did for the tower. It comes on the upper holes in the baseplate.
- Fit the ginpole head on top of the second tube, insert the M20 treaded bar in the holes protruding and through the fixing plate and secure with the two red rings.

Ginpole head
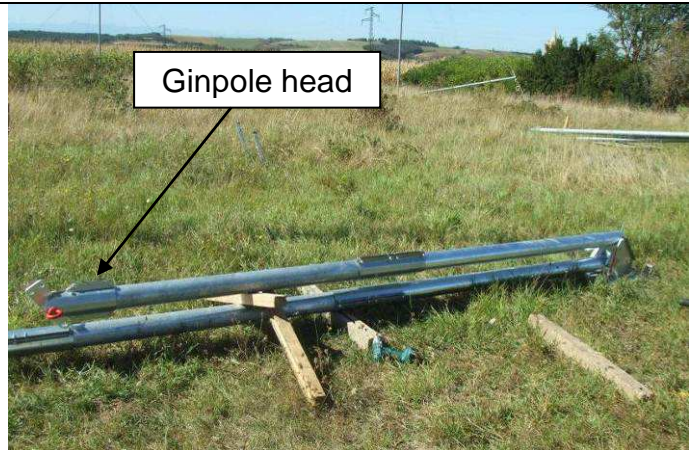
6/ Guys:

Basic rules for guys buckles:
-A cable clamp has to be put in a specific way. The wide part has to be on the active string and the U part on the dead end. "Never put a saddle on a dead horse" is the rule.
**-The spacing between two cable clamps is 10 times the diameter of the cable e.g. for this 10mm cable, the minimum spacing is 10cm.**

-Attach the front guy to the guy plate under the tower with a shackle and the other end of the guy to the front anchor.
- For each lateral guy, follow the same process, inserting a shackle between the guy and the turnbuckle.
-Attach the winch guy to the top hole of the guy plate and the other end to the ginpole head, on the one holed side of the plate.
Secure all the shackles with iron wire to prevent them from unscrewing.

U part

Saddle
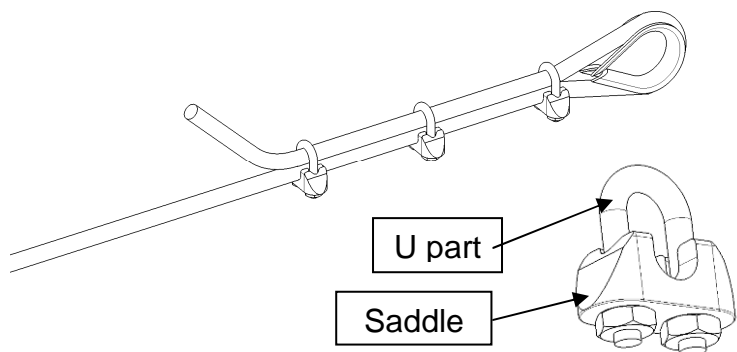
| **7/ Ginpole guys:**
-Attache the ginpole guys to the red rings on the ginpole head and to the shackles on the lateral anchors. | |
| **8/ Installing the cable-puller:**
-Attach the cable puller to the winch anchor with two 1,5t shackles.
-Attach the hook to the ginpole head using a 1,5t shackle in one of the two available holes of the plate. Slip the cable inside the cable-puller. | |

Raising the tower

Needed tools for this step:
-Spirit level
-Adjustable wrench 16" ou 18" (to adjust turnbuckles)

Caution: tilting up the tower must be completed in proper weather conditions. Wind should be below 6 m/s and there should not be any chance of lightning strikes.

In case of equipment failure or human mistake, consecuencies are immediate and cannot be anticipated. It is therefore compulsory to tilt the tower with as little people as possible in the danger area (anywhere the tower might fall). Nobody should be standing within the square made by the anchors. The staff dealing with the process of tilting the tower must wear individual safety equipments as requested by the law and must have been properly trained. If it is a public site, a danger zone area should be fenced using red tape.

Common rules:

- Never use force when it is not supposed to be used. Is something gets stuck, try to understand why.

- The tower and the ginpole must be under control in all the directions during all the process. They should not be allowed to move anywhere without being allowed to.

- During the process avoid having people changing places.

- The operator in charge of the cable-puller is the one in charge of the tilting process. He has to monitor and follow up what his colleagues are doing and should give orders when needed.

- At least two people are needed to tilt the tower up / down. The cable-puller operator and the one in charge of checking the lateral guys' tension. When the latter moves from one lateral anchor to the other, he should always pass behind the cable-puller operator in order to keep out of the danger area.

- Only approved and trained technicians should be in the area. Please ask anybody else to move apart.

- The operating staff must have their tools with them and should not have to move around to look for them during the process.

- The site must be cleared.

**If a problem arises during the tilting process, the tower has to be put back down in a safety position before the problem gets solved and rised again. Never try to solve a problem working under a partially tilted tower.**

Before starting the tilting procedure, chek thoroughly all the guys, shackles, turnbuckles, anchors to be sure that everything has been fitted / tightened properly.

ALWAYS RAISE THE TOWER WITHOUT THE TURBINE FIRST

1/ Things to check:	
-Front guy in place. -Cable-puller properly attached and easy to operate. -Guys are free to move their ways, nothing is in their way. -Guys do not cross each other.	
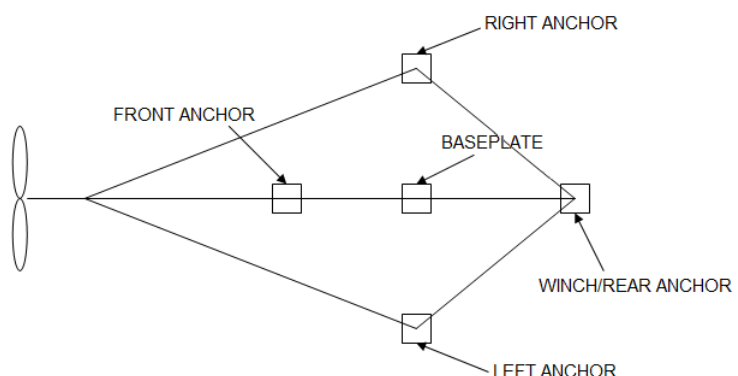
2/ Raising the ginpole

-One person will lift the ginpole carrying it at its head to ease the use of the cable-puller at starting.
-The ginpole has to be kept straight and should not bend to the right or left. Adjust the ginpole guys accordingly.

3/ Installing the holding rope:

When the tower is about to be vertical, the weight of the ginpole will pull the tower towards the cable-puller operator. To keep this phase under control, a rope is attached to the front guy with a shackle and kept tensioned by a staff member.

4/ tower raising:

-The cable-puller is operated and the tower slowly tilts up. Keep the ginpole vertical and the tower head aligned with the base plate and the winch anchor.
-Tensions of the lateral guys have to be checked permanently.

5/ Adjusting the guys:

-The ginpole guys usually get tense when raising the tower. They have to be loosened progressively.

-The tower guys will also get tense and will have to be adjusted at the first rising. Once this has been done once, they should not have to be adjusted anymore. Yet they have to be checked at every operation on the tower.
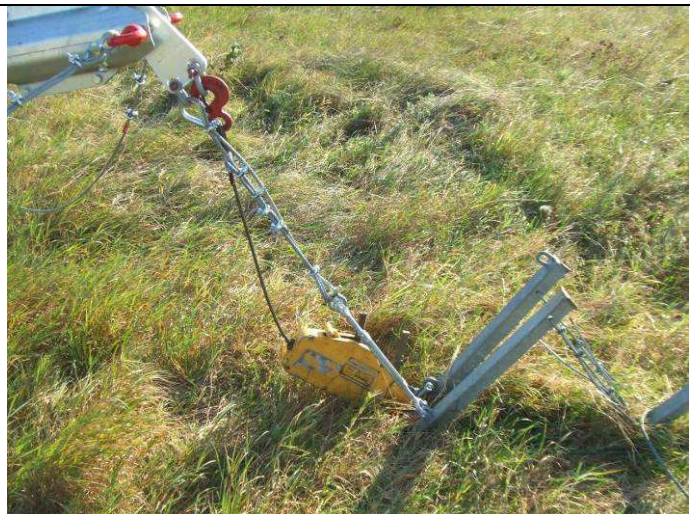

6/ Holding the tower:

At the end of the tilting process, the weight of the ginpole will pull the tower up. To keep the tower under control, an operator bends the front guy with the holding rope and will release slowly the rope to make the tower come to its final position slowly.
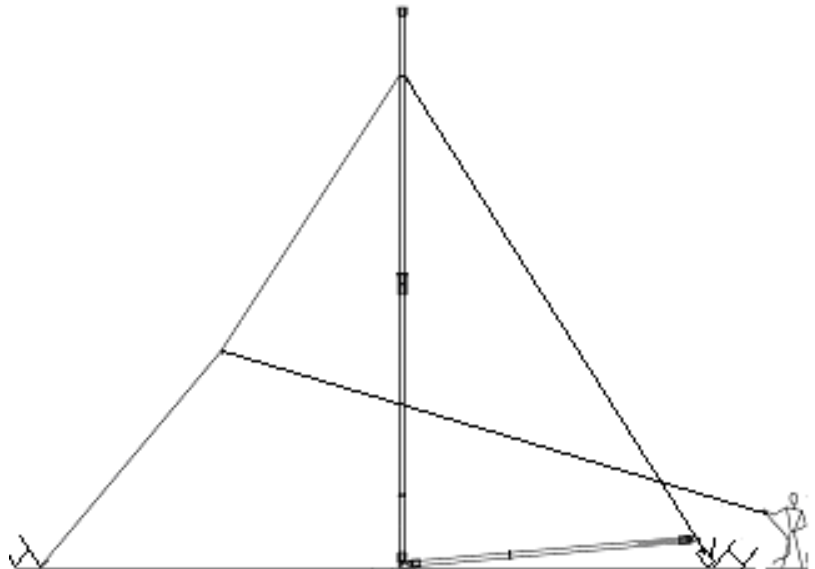
7/ Removing the cable-puller:

Once the tower is raised, put in place the sling between the anchor and the last hole of the plate.
Tension it using the turnbuckle until the cable puller can be safely removed.
The ginpole can also be removed if needed.

8/ Verticality:

-Adjust the guys in order to have the tower perfectly vertical and straight from bottom to top.

-Once it has been done, secure the turnbuckles slipping the dead end of the guys throught them and through the shackles. This will prevent the turnbuckles from unscrewing themselves because of vibrations.

The guys must be holding the tower but not pulling it down. Do not tighten too much the turnbuckle. The guy must be loose enough to "wave" when you shake it.

9/ Tilting down:

-Install the cable-puller
-Pull the tower with the holding rope
-Remowe the sling
Carry on the reverse process.

Installing the wind turbine

Things to know:
This step is described in the wind turbine manual
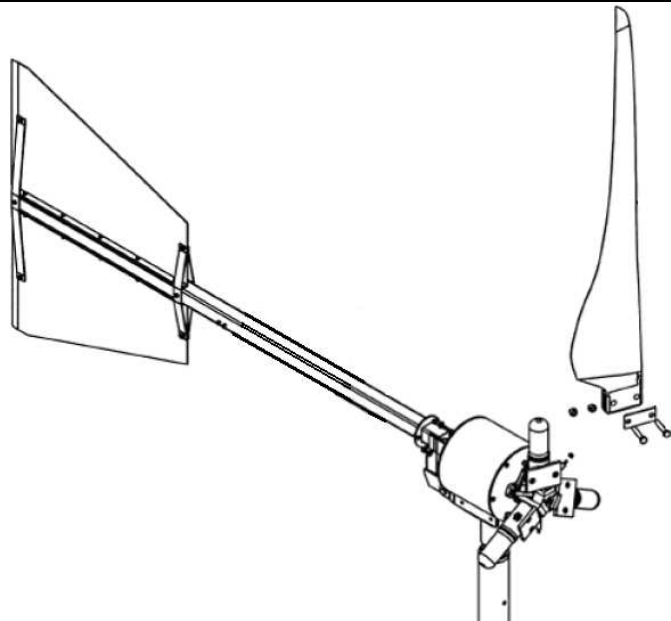Needed tools for this step:
Open end wrenches: 10-13-19
Sockets: 10-13-19
Torque wrench

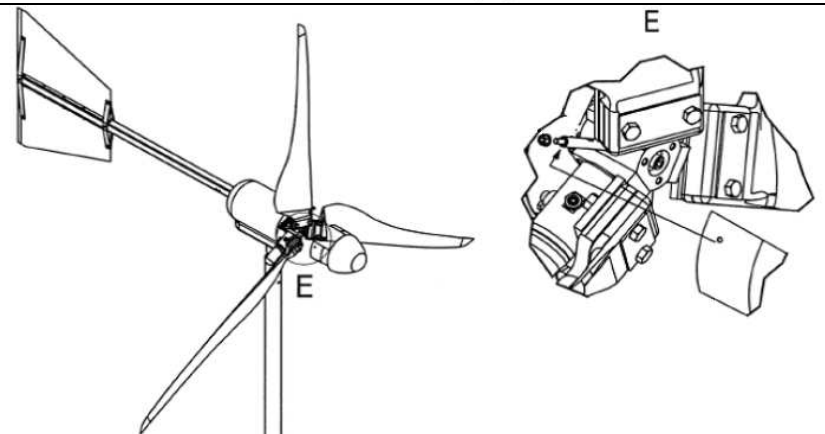| Step / Description	Picture
1/ Power cable: -Slip the power cable connected to the turbine inside the tower.	
2/ Pivot flange: -Insert the cable protecting tube inside the tower. -Remove the holding screws and detach the tube from the turbine. -Bolt the flanges together with the M8 screws with the torque wrench at 35Nm (25.8lb.ft)	
3/ Fitting the tail -fit the tail to the tail boom using the M6 bolts tightened at 20Nm (15lb ft) Note that the GFP carter is not used. This differs from the turbine manual.	

4/ Assembling blades -Fit the blades to the hub as specified in the turbine manual. -Tighten the M12 bolts at 50Nm (37lb ft)	
5/ Fitting the nose cone: -Slip the nose cone over the protruding studs. -Tighten cautiously the M6 nuts at 4Nm (3lb ft)	
6/ Final tilt up: -Follow previous steps from "Raising the tower" page 21.	

Installation of the load

To install the load, e.g. your Lidar, please refer to the manufacturer's manual.

Commissioning

Before proceeding to the starting procedure, check the following points:
- PV is properly oriented.
- Tower is straight and guys secured.
- Easy opening of the doors. If the MP2U is not resting evenly on its 4 legs, it might get slightly bent and make the doors opening difficult.

Mise en service

Connecting the PV modules and the wind turbine

All the connections are made in the terminal box. PV cables are already in place with MC4 terminals and can be connected to the modules. Please follow the color code.
Wind turbine cable has to be connected to the two biggest terminals in the box.
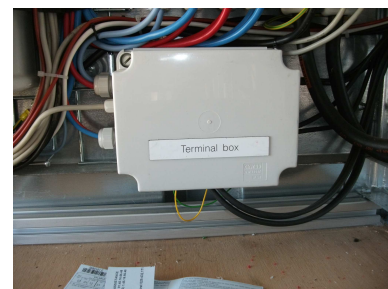
Grounding

All the appliances in the MP2U are grounded via the steel enclosure. The enclosure itself has to be grounded using the post provided.
The wind turbine tower is also linked to the MP2U common earthing using the specific cable provided.

Turning on the MP2U

Upon starting, the main door is open. All switches are on the OFF position.

Power up the PLC by pushing in the F7 fuse (See page **Erreur ! Signet non défini.** *"Erreur ! Source du renvoi introuvable."*). The PLC starts and puts itself in STANDBY mode. In this mode, the wind turbine is shorted, the PV is off, the Genset is off.

Once the system has been commissioned, the power up is done using the red switches:

There are four of them:
- An emergency push button to disconnect the main batteries (« Batteries »),
- A rotating switch that shorts the wind turbine and therefore stops it in low and medium winds (« WT Brake »). See "**Erreur ! Source du renvoi introuvable.**" page **Erreur ! Signet non défini.**.
- A rotating switch interrupting all RE sources, PV and wind (« RE Power »)
- A rotating switch opening the Genset/charger DC circuit.
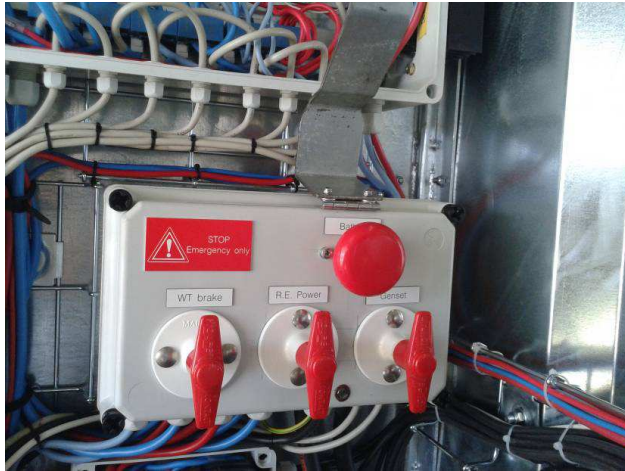
Initial position: everything is stopped.

A steel carter forces a sequence. All rotating handles should be put upwards before the push button is activated. This carter should always be down in its normal position when running the system.

On the touch screen, a keyboard appears for the input of the code. If the code is valid (Default code is 1873), The START screen comes up. By cliking on START, the user starts the system and goes to mode RUN. The STOP button comes up.

If the user closes the door of the enclosure, he can still open it within 5 minutes without using the code. If he delays more than 5 minutes, he will have to input the access code again otherwise the anti-hijack alarm will get active.

Remark:

During services, the user opens the door and has a 2 minute delay to input the access code until the alarm comes up. He can then access the STOP button. He can either stop the system (and put it back in STANDBY mode by pushing the STOP button) or he can access the various screens of the software (Wind Turbine, PV, GE, Load…). If he manually stops a component, the mode will turn to DEGRADED. The user must leave the DEGRADED mode to get back to RUN mode manually by putting everything back into operation.

Modes

As specified previously, there re 3 modes:

The STANDBY mode

This is the mode which is active before starting the system, when the PLC has just been turned on.
The system is also put in this mode when the STOP button is pushed.

The RUN mode

It is the normal operating mode. It is active as soon as the user pushes the START button. In this mode, the PLC is in charge of everything and drives the RE sources according to the various inputs measured.

The DEGRADED mode

This is the maintenance mode. The user automatically switches to it when he manually forces the system to do the following actions:

1 – Braking the wind turbine

When the BRAKE button is pushed, the DEGRADED mode turns on. The BRAKE has to be released for the mode to return to RUN.

2 – Stopping the PV

When the "Turn PV off" button is pushed, the mode is set to DEGRADED. When it is released, it comes back to RUN.

### 3 – Starting / stopping the Genset

The mode does not automatically switches to DEGRADED for the Genset as it can be started manually anytime. The user has to push the AUTO/MAN button to change modes and can only START/STOP the genset using the appropriate button when in mode MAN (=DEGRADED).

4 – Start / stop Load

Exemple given here is for the ZephIR Lidar but works for any appliance. When the "Stop the ZephIR" button is pushed, the mode switches to DEGRADED and comes back to RUN when released.

Man-Machine Interface

When the PLC is powered up, a keybord screen appears for the access code. Once the code is input, the starting screen comes up.
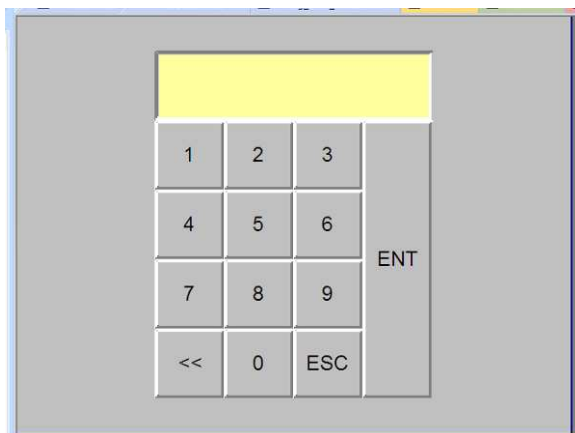
Access code keyboard. Factory set code is 1873.
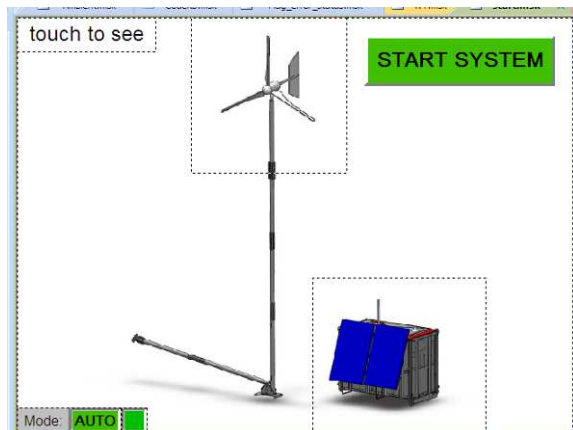
Starting screen

Press the START button to run the MP2U.

The buttons in the left bottom corner of thescreen (Mode: AUTO/MANU and the small flag next to it) show in which state the system is. To be in the RUN mode, the AUTO label has to be on. As long as it is on MANU, the PLC is in DEGRADED mode and this means a forced action is on. Check all the screens to release the relevant buttons.

The small square flag turns red when an alarm message is active. You can access the last message generated by clicking on it.
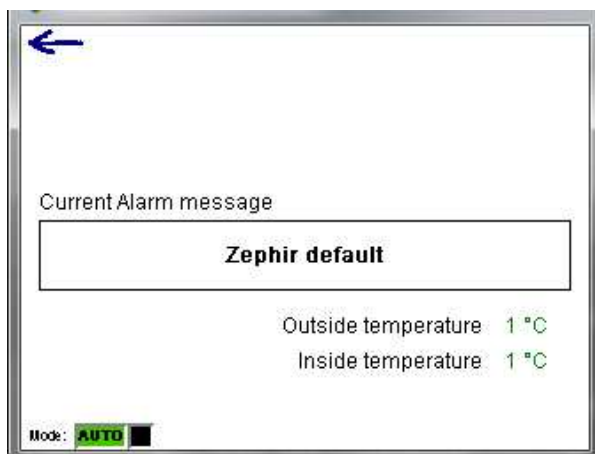
Alarm screen

All components of the system can be accessed by touching them. Touch the wind turbine to go to the wind turbine screen.
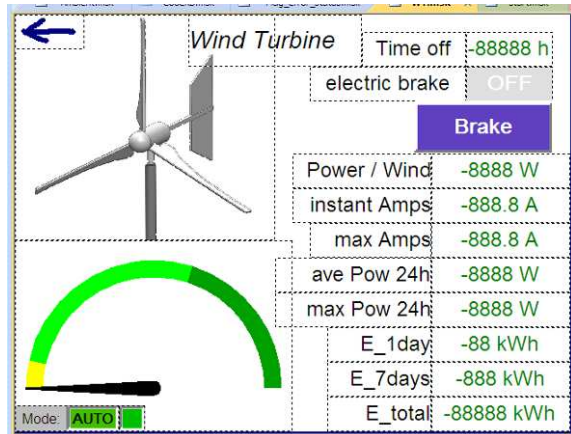
Wind Turbine screen

Going back to previous screen is done pushing the blue arrow on the top left of the screen. This is true for all screens.

This screen, as for other energy sources, gives a lot of indications about the output of the turbine. It also includes a brake button. If this button is pushed, the turbine will be directly connected to the dump load and will therefore slowly come to a stop. It might not stop quickly depending on how strong the winds are but i twill not feed the batteries anymore and is in a safe position. It can be let this way for days if needed.

Spread values are the following:
Time off: number of times since the turbine has been producing power.
Electric Brake: this flag indicates if the turbine is fully connected to the dump load or not.
Power/Wind: instant usable power fed to the batteries by the wind turbine (power sent to the dump load is not measured).
Instant Amps: Instant amps sent to the batteries. As a reminder, the battery bank is in 28.8V.
Max Amps: Maximum current measured sinc the system has been started.
Ave Pow 24h: Average power for the last 24 hours. This value is set to 0 when starting the system and up to 24 hours after.
Max Pow 24h: Maximum power recorded within the last 24 hours. This value is set to 0 when starting the system and up to 24 hours after.
E_1day: last day energy output. Reset to 0 when the system is started.
E_7days: last week energy output. Reset to 0 when the system is started.
E_total: Total energy produced by the wind turbine since the system has been started.

If the MP2U enclosure is touched on the staring screen, the Enclosure screen is reached:
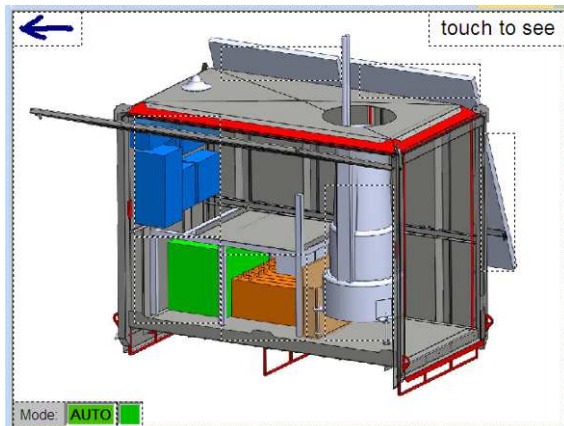
Enclosure screen

The blue components are the Controls. The green one is the Genset, The orange ones are the batteries and the Lidar and the PV modules can also be accessed by touching them.
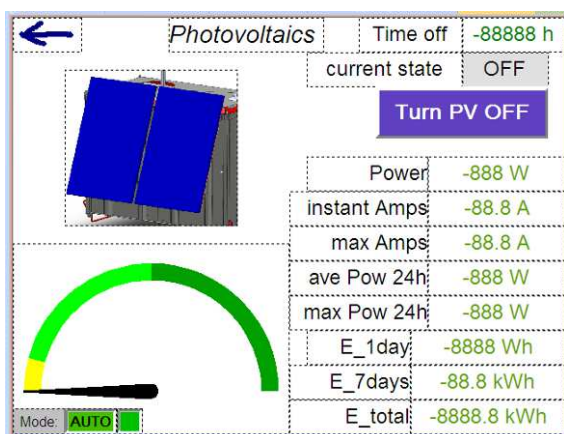
PV Screen

The PV screen displays the same kind of parameters as what is read on the wind turbine screen. The "Turn PV OFF" button stops the production.

Genset screen

The Genset screen allows to manually start/stop the Genset.

Notice: the Genset can only be started if its key is switched to the ON position allowing the starter to be fed by the Genset battery. This allows to keep the Genset stopped during maintenance and to prevent any unwished starting. The Genset battery is kept charged by the MP2U.

The flag at the top right angle shows the charging state of the Genset. It is reading « Genset ON » when the Victron Centaur c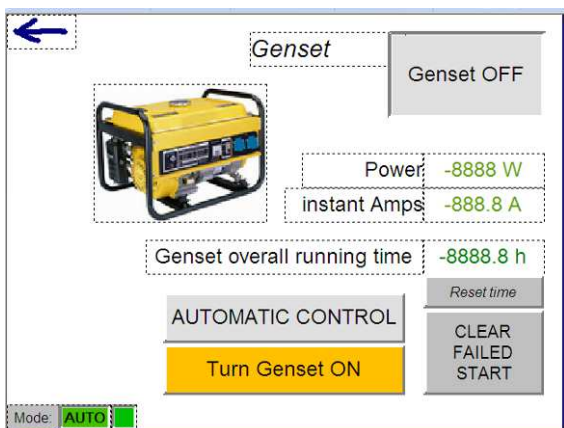harger is actually charging the batteries. If the Genset is disconnected from the charger, it might be running but not charging the batteries. In this case, the flag reads "Genset OFF".

The Genset beng the less reliable device of the MP2U, it has a specific management program. When batteries are low and the outputs of the wind turbine and the PV generator are too low to feed the load, the Genset is automatically started. If the starting fails (lack of oil, lack of petrol, any other reason…), the PLC tries to restart the Genset three times. If all these attempts fail, it sends an alarm SMS.
If the Genset failed 4 times, the PLC will not try to start it until the "Clear Failed Starts" button has been manually pushed by the maintenance staff.
It is possible that the MP2U is delivered with another Genset than the one illustrated on the screen. In any case, please refer to the Genset manual for operation and maintenance.

There is no petrol level indicator in the Genset tank. But there is a counter indicating the numbers of times it has been running. We suggest the user to reset this counter each time the tank is filled. This counter is not taken into account in the management system so it can be forgotten without any consecuencies.

The load also has a specific screen:
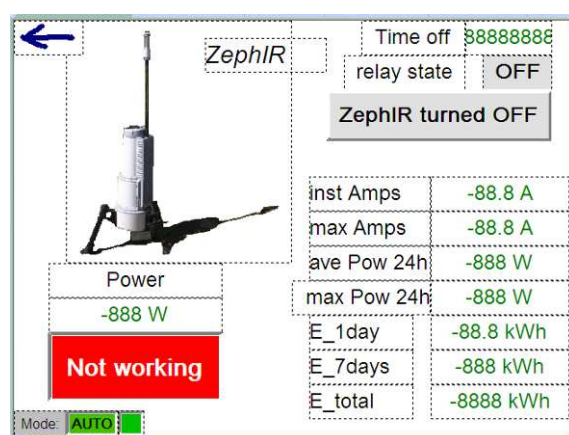
Load Screen

It is possible to stop feeding the load by pushing the « Turn ZEPHIR OFF » button. When the load is not working (because it has been switched off or because it is not drawing power), a "Not working" flag appears.

Controls can be accessed by touching the blue components on the enclosure screen.
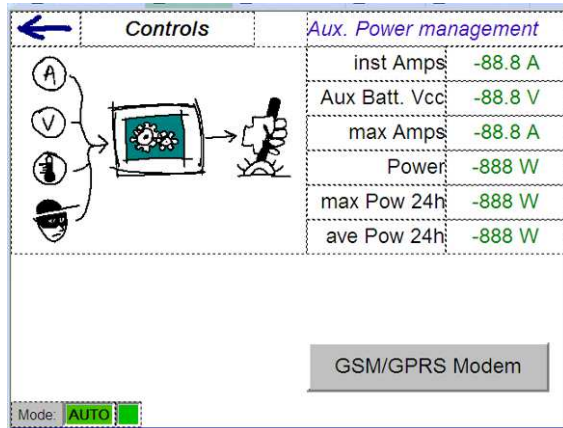
Controls screen

This screen gives information about the working state of the Controls but does not allow any action. Apart for transportation / long storage reasons, the PLC has to be functional permanently to protect the components of the system.

A GSM/GPRS button allows reaching the Modem screen:
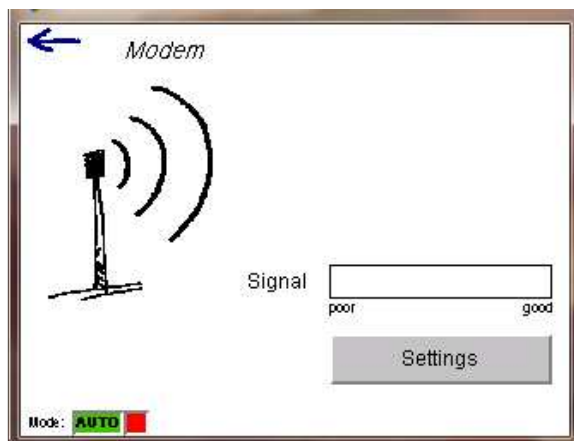
Modem screen

This screen allows checking the quality of the GSM/GPRS signal. Pushing the Settings button leads to the setting of phone numbers to dial for the SMS alarms.
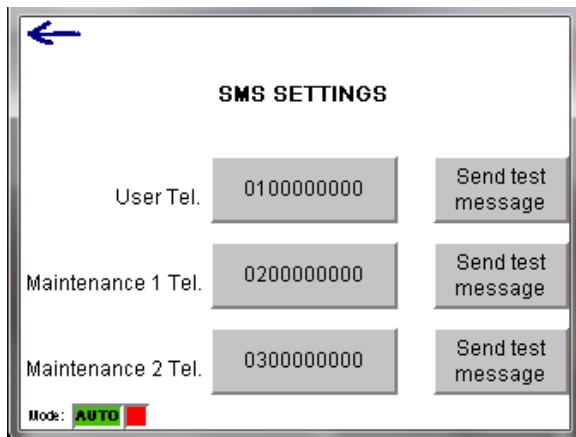
The phone numbers can be changed by pushing the appropriate button. A keyboard pops up and the number can be dialed.

Once the phone number has been set, a test message can be sent using the button next to the target number. It is therefore possible for the phone owner to be sure that he will receive the alarm SMS.

The User will only receive major alarms. The Maintenance 1 and 2 will receive every alarm. See page **Erreur ! Signet non défini.** "**Erreur ! Source du renvoi introuvable.**"
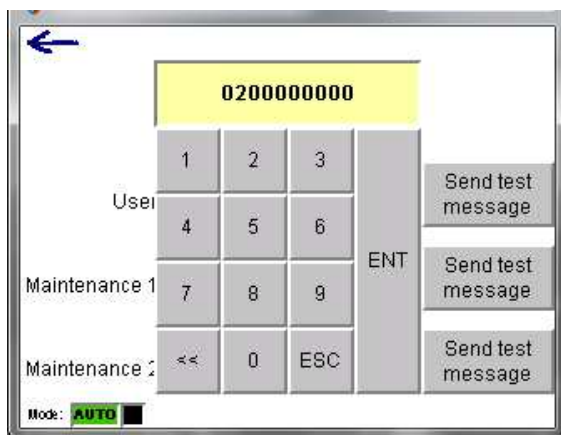
Phone numbers keyboard

Next screen can be reached by touching the orange components on the Enclosure screen.
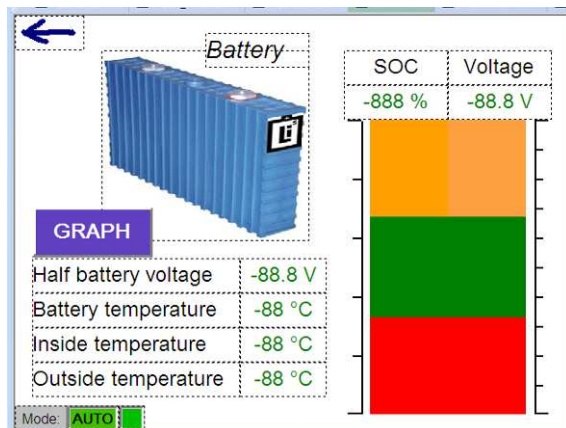
Battery screen

Batteries should never be put out of order but for emergency reasons using the manual red push button. This screen is only giving information which is:

SOC: *State Of Charge* indicating the energy available in the batteries. A 100% value means the batteries are full. <u>Warning</u>: this value is not perfectly exact. There is an uncertainty of +/- 5% approx as it is calculated dynamically but this uncertainty will remain constant in time, which is not the case of most available SOC calculators.

Voltage: main battery bank voltage.

Half battery voltage: This voltage is used to compare the voltage of 4 batteries out of 8 in the bank. It allows knowing if one battery in the bank is having a defect. If this is the case, the system is immediately stopped and an alarm SMS is sent. Defect in batteries can lead to fire with Li-ion batteries and have to be taken into account as soon as they arise.

Battery temperature: a temperature probe is measuring the battery temperature. If the temperature gest too high (more than 60°C), the system is stopped until the temperature comes down to 40°C.

Inside temperature: enclosure inside temperature

Outside temperature: a probe is fitted outside the enclosure to compare the outside and inside temperatures.

The GRAPH button allows reaching the following screen:
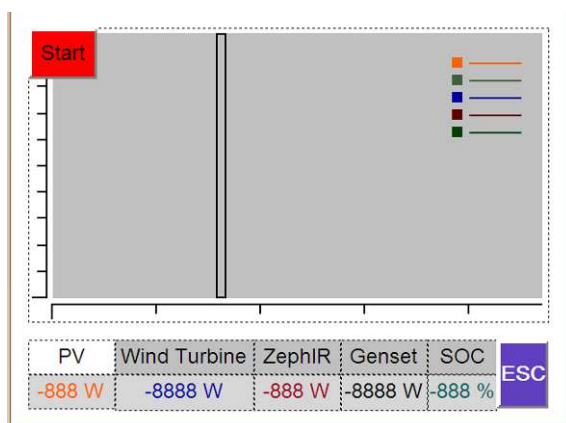
GRAPH screen

The GRAPH screen displays the main power values of the system every second. The graph function can be started / stopped. To go back to previous screen, push the ESC button.

Alarms

The PLS sends various alarm SMS. All the SMS come with the date, time and SOC (State Of Charge).
The SMS are only sent once when the problem arises.

The table below lists down all the alarms:

P	MESSAGE	CONDITION ACTION
0	MESSAGE (Date + time + 'Possible intrusion' + SoC)	The anti-hijack lead (PV, Turbine and Door) has been opened. Automatic action : none Manual action : find reason of the opening
1	MESSAGE (Date + time + 'Problem in battery unit' + SoC)	A battery cell is deffective Automatic action : system stopped Manual action : battery control
2	MESSAGE (Date + time + 'Zephir default' + SoC)	Load current is zero (<IZEP_MIN) Automatic action : none Manual action : check the load
3	MESSAGE (Date + time + 'Low battery, power supply default' + SoC)	Battery voltage is too low (<=UBAT_MIN2) Automatic action : system stopped Manual action : check availability of power sources (PV, Turbine, Genset)
4	MESSAGE (Date + time + 'High battery temperature' + SoC)	High battery temperature (>=TBAT_MAX) Automatic action : power sources stopped Manual action : battery control
5	MESSAGE (Date + time + 'Hot temperature inside power supply system' + SoC)	High temperature inside encllosure (>=TINT_MAX) Automatic action : none Manual action : check enclosure fan
6	MESSAGE (Date + time + 'Modem battery default' + SoC)	Back up battery voltage low (<=UBAUX_MIN) Automatic action : none Manual action : check that back up battery are properly charged by system
7	MESSAGE (Date + time + 'Low battery, petrol generator on' + SoC)	Battery voltage is low (<=UBAT_MIN1) and the power sources do not produce enough to cover the load Automatic action : Genset starting Manual action : none
8	MESSAGE (Date + time + 'Low gasoline' + SoC)	Time of use of Genset > TGE_MAX Automatic action : none Manual action : fill up Genset petrol tank
9	MESSAGE (Date + time + 'Solar panel default' + SoC)	Current out of the PV generator is zero during TPV_KO Automatic action : none Manual action : check the PV generator
10	MESSAGE (Date + time + 'Wind turbine default' + SoC)	Current ouot of the wind turbine is zero during TEOL_KO Automatic action : none Manual action : check the wind turbine
11	MESSAGE (Date + time + 'Parafoudre default' + SoC)	Digital input 1 is 1 Automatic action : none Manual action : replace faulty surge arrestor
12	MESSAGE (Date + time + 'Relai statique PV KO' + SoC)	Call ERM Automatismes

P	MESSAGE	CONDITION ACTION
13	MESSAGE (Date + time + ' Relai statique débordement KO ' + SoC)	Call ERM Automatismes
14	MESSAGE (Date + time + 'Chargeur Victron KO ou panne d'essence' + SoC)	Charger not charging. Automatic action : none Manual action : check Genset
15	MESSAGE (Date + time + 'Passage en mode Run')	System in RUN mode
16	MESSAGE (Date + time + 'Passage en mode Standby'+ SoC)	System in MANUAL mode
17	MESSAGE (Date + time + 'Passage en mode dégradé'+ SoC)	System in DEGRADED mode

An SMS is sent when an alarm arises. As long as the alarm is still active, no further SMS is sent. The alarm has to be cleared and to rise again for a new SMS to be sent.

There are 3 users with a linked priority:
P1, highest level, only major alarms – Labeled « User » on screen
P2, medium level, all alarms, most of the time, this number is kept for ERM Automatismes – Labeled « Maintenance1 » on screen
P3, local level, for field satff, all alarms – Labeled « Maintenance2 » on screen

Variables

Inputs

The PLC measures and records the following parameters.

INPUT	TYPE	TAG	DESIGNATION
1_AI1	ANALOGIC INPUT	U_2BAT	TENSION 1/2 BATT
1_AI3	ANALOGIC INPUT	U_BAT	TENSION BATTERIE
1_AI5	ANALOGIC INPUT	U_BAUX	TENSION BATT AUX
1_AI7	ANALOGIC INPUT	I_BAT	COURANT BATTERIE
1_AI9	ANALOGIC INPUT	I_PV	COURANT PV
1_AI11	ANALOGIC INPUT	I_EOL	COURANT EOLIENNE
1_AI13	ANALOGIC INPUT	I_GE	COURANT CHARGEUR GE
1_AI15	ANALOGIC INPUT	I_CONS	COURANT 28V
2_AI1	ANALOGIC INPUT	I_COMM	COURANT AUX
2_AI3	ANALOGIC INPUT	I_DEBOR	COURANT DEBORDEMENT
2_AI5678	ANALOGIC INPUT	T_BAT	TEMP BATT
2_AI9101112	ANALOGIC INPUT	T_INT	TEMP INT
2_AI13141516	ANALOGIC INPUT	T_EXT	TEMP EXT
DI1	DIGITAL INPUT	E_PAR	FUSION PF
DI2	DIGITAL INPUT	E_INT	INTRUSION

Ouputs

The PLC drives the following outputs:

OUTPUT	TYPE	TAG	DESIGNATION
DO1	DIGITAL OUTPUT	SSR1	RELAI STATIQUE PV
DO2	DIGITAL OUTPUT	SSR2	RELAI STATIQUE EOLIENNE PWM
DO3	DIGITAL OUTPUT	K1	RELAI COMMANDE K2 RELAI DEBORDEMENT
DO4	DIGITAL OUTPUT	SSR3	RELAI STATIQUE DEBORDEMENT PWM
DO5	DIGITAL OUTPUT	SSR4	RELAI STATIQUE ALIM LIDAR
DO6	DIGITAL OUTPUT	K3	VALIDATION GE
DO7	DIGITAL OUTPUT	K4	MARCHE GE

Data Logging

Every second, data is stored in a buffer. Every 10 min, the average of these 600 values is calculated and stored on the SD card as a csv file. The SD card can be removed at any time to read the data. As soon as it is in its slot, the PLC is logging. When no SD card is in the slot, no logging is done.

Last check before going

Once the system has been put into operation, spend a few minutes having a look at each screen and check the various parameters. If something seems unusual, do not hesitate to call ERM Autmatismes +33 (0) 490 600 568 for explanations.

GSM/GPRS Test

It is useful to check that SMS are properly sent. On very remote sites, the networks might be weak and might need a bigger external antenna that can be fitted on the turbine tower. Call ERM Automatismes for details.

Service and Maintenance

Preventive maintenance

The preventive maintenance should be performed at each deployment, as well as at alarm induced intervention. If no alarm is received, preventive maintenance should be performed once a year.

Electrical maintenance

Before any action on the system, measurements have to be done:

Measurements

Check U voltages for:
- The wind turbine (0 < U < 150VDC) in the terminal box
- PV Generator (0 < U < 36VDC) in the terminal box
- Battery bank (22 < U < 32VDC) on the battery lugs
- Back up batteries (18 < U < 28.8VDC) on the battery lugs
- Charger (22 < U < 32VDC) on the DC output lugs at the bottom of the charger

Putting the installation out of service

Turn everything of before working on the electrical components:
- Switch all red rotating handles in a vertical position.
- Wait for the turbine to stop
- Push the red battery button

Reminder: **Despite these actions, DC voltages are still present in some parts of the system (batteries, PV modules).**

Battery bank

Reminder: **The opposite terminals of a battery bank (+ and -) should never be short circuited. Consecuencies will always lead to heavy damages and might cause serious injuries.**
- Clean the battery bank with a dry cloth
- Check corrosion on the battery lugs
- Check the proper tightening of the screws
- Measure voltage « U » for each battery (2.8 < U < 4Vcc)
- Measure voltage « U » for the whole bank (22 < U < 32Vcc)
- Look for any physical defect: leaks, swollen battery, damages of any kind.

Warning: **Li-ion batteries fires must be extinguished with the proper fire extinguisher provided. If not available, use water.**

PV Generator

Reminder: **PV produces voltage as soon as exposed to light.**
- Measure open circuit voltage « Uoc » out of the PV generator (0 < U < 36Vcc depending on sunlight)
- Clean PV modules with a clean cloth. Water and glass soap can be used.
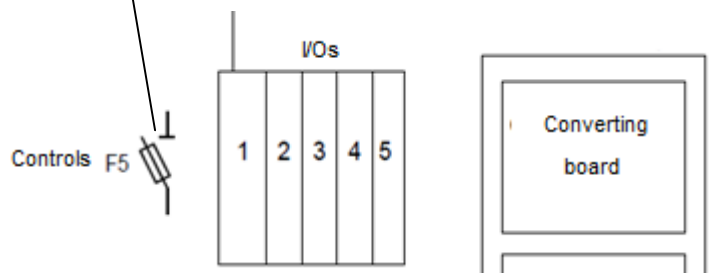
Controls

Reminder: **The PLC is fed by back up batteries and therefore, DC voltages are still present in the boxes.**
- Clean the insides of the boxes with a dry clean cloth. Check for insects or rodents.
- Check for evidences of overheating (smell, dark traces…)
- Check the tightening of every terminal

Fuse replacement

Pictue below shows the power fuses in their enclosure.
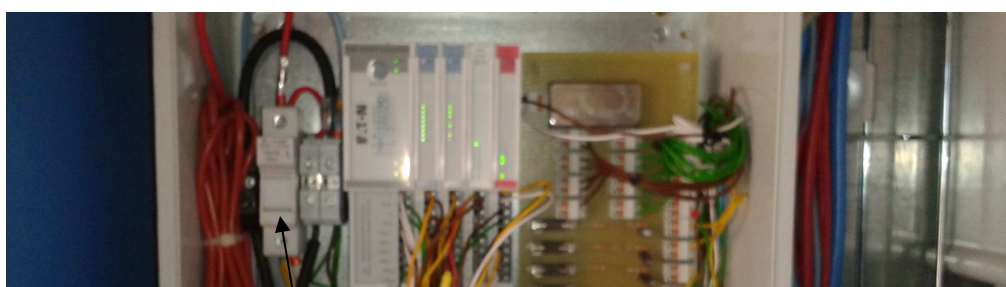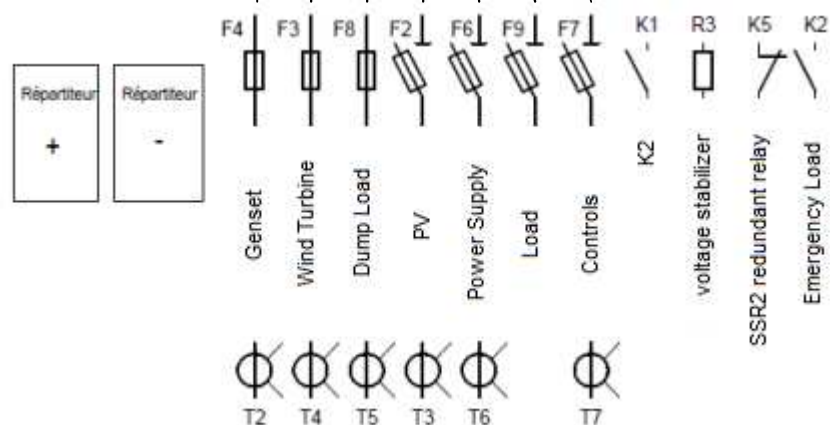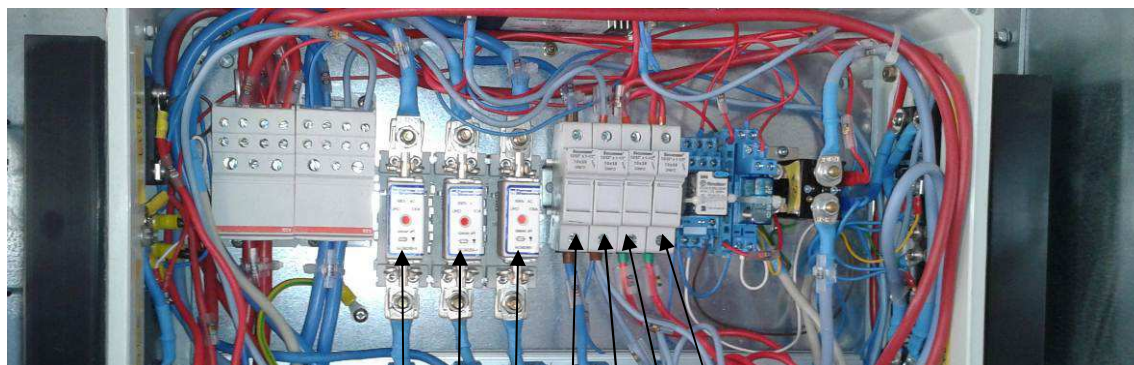
Wind turbine Specifications

Design	3 bladed upwind rotor	
Speed control	Centrifugal pitch control	
Nominal power	1	kW
Diameter	3	m
Swept Area	7	m²
Starting wind speed	2.5	m/s
Cut in wind speed	3	m/s
Nominal wind speed	12	m/s
Blade material	GFRP	
Rotating speed	0 to 800	RPM
Alternator	Permanent magnet, direct drive	
Voltage output	24	VDC
Number of poles	12	
Tower top weight	75	kg
Max Lateral thrust	200	DaN

System description
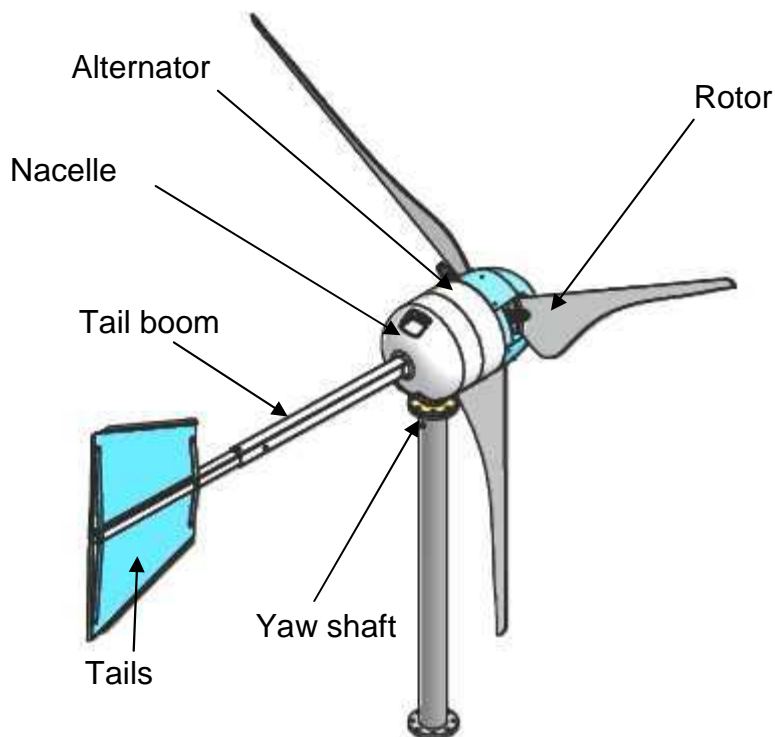
The e300iii is a unique wind turbine that incorporates superior technology. The heart of the machine comprises of a unique twin axial flux permanent magnet brushless alternator. The alternator contains no less than 96 poles and 52 magnets. The polyphase high frequency output is internally rectified to give a dc output with extremely low ripple content. The generated power is transferred to the output cables via heavy duty bronze slip rings and twin copper composite electrical brushes. The prime mover on the e300iii is a 3.0m (9.85') diameter three blade wind rotor fitted with quiet running high efficiency blades. The blade hub incorporates passive pitch control. The e300iii pitch control changes the operating angle of the blades to achieve speed control in high wind. The tail vane assembly is static and simply aligns the machine with the prevailing wind.

All steel components are electro-galvanised and passivated for extra protection. The standard finish consists of the application of an etching marine primer and an intermediate protective coat followed by polyurethane two pack finishing coats.

Inspection and maintenance

As a standard rule, the pitch control system should never be modified. It has been set in factory with specific tools and any modification would void the warranty.

Frequency	Item	Duty	Comments
As often as you can	Wind Turbine	Check for abnormal noises or vibrations.	If so, check the whole turbine and look for the cause.
Every six months of operation	Tower	Check that the guys are properly tensioned and in good state.	Only for ERM Towers. If you use your own tower, rely on the manufacturer's recomandations.
	Wind Turbine Eolienne	Check for corrosion and losened bolts	Use galvanised and color car paint for corrosion. Tighten loose bolts. Call ERM Automatismes is blades are damaged.
		Visual inspection of the blades.	
Once a year	Wind Turbine	Check for loosened bearings in the alternator or in the yaw shaft	This needs the tower to be tilted down. Replace faulty spares and correct other problems as previously.
		Look for rust on the nacelle or on the alternator	
		Check the slip ring assembly. Check the wear of the pitch control system.	
	Tower	Check all the cable clamps, shackles and turnbuckles.	Only for ERM Towers. If you use your own tower, rely on the manufacturer's recomandations.
		Check the top of the tower and all the bolts involved.	

Failure analysis

Failure identification on MP2U

Most of the problems are delat with by the PLC. It is most of the time possible to understand a problem thanks to the screens. Other possible failures are listed below:

Problem	Possible reasons	Remedy
Load is not powered anymore	Load fuse out of order	Replace F9 fuse. See "Fuse replacement" page 42.
	Batteries are too low	Check the Genset tank
	Batteries are at risk (high temperature or faulty cell)	Check every battery cell and find the overheating source.
	PLC is out of order	Replace F7 fuse. Call ERM Automatismes if problem remains.
PV Generator does not produce	PV Fuse out of order	replace F2 fuse. See "Fuse replacement" page 42
	Batteries are full	Normal operation
	Not enough light. Moduleq are in the shade. Modules are dirty. Modules are not facing the sun.	No breakdown. Correct problem.
	No voltage in the terminal box	One of the modules'cable has been damaged or cut. One of the MC4 connectors is loose or disconnected. Check electric circuit.
Battery voltage rises too much (more than 36V)	Static relays out of order	Check SSR2 and SSR3 relay. See Electrical drawings.
PLC reports hijack all the time	Alarm lead cut.	Check the continuity of the alarm lead in the terminal box. Look for a discontinuity.
	Poor door contact	Check door contacts.

Failure identification on wind turbine

Problem	Possible Reasons	Remedy
Wind turbine is not spinning at all, even in high winds	Mechanical problem on the turbine. Broken alternator, faulty bearing, foreign object interfering.	Call ERM Automatismes

Problem	Possible Reasons	Remedy
Wind turbine spins very slowly, even in high winds	Short circuit on the turbine leads	Find the short circuit. Check the relays, the diodes and the cable.
	Worn bearings	Replace bearings.
	Surge arrestor out of order and grounding a turbine lead	Replace surge arrestor
Low output	Low wind	Poor turbine siting. Change siting or increase tower height (Call ERMAutomatismes for optional higher towers)
Wind turbine vibrates	Rotor unbalanced	Check the blades and the pitch control system. Blades should be 120° apart and all have the same weight and same gravity center.
Wind turbine does not face wind	Tower is not vertical	Correct verticality
	Yaw shaft bearing worn out	Replace yaw shaft bearing.
Wind turbine spins very fast but does not produce	Cables disconnected	Check cables
	Slip ring assembly broken	Check slip ring assembly.

MP2U Technical Specifications

Device	Specifications
Main Batteries	Type : LYP700 Li-Yttrium Capacity : 700Ah – cell voltage : 3.2Vdc 8 cells = bank voltage 25.6Vdc Max voltage allowed : 32Vdc Min voltage allowed : 22,4Vdc Dim : 627 x 67 x 306 mm – Weight : 21kg + /- 300g per unit
Emergency Batteries	Type : SGP12-40 Powerline Capacity : 40Ah C20 – cell voltage : 12Vdc 2 cells = bank voltage 24Vdc Max voltage allowed : 28.8Vcc Min voltage allowed : 18V Dim : 250 x 180 x 190 mm – Weight : 7,2kg per unit
Wind Turbine	Type : Kestrel e300 – Diam. 3m 1000W@12m/s

Device	Specifications
	Rated RPM : 650 Max voltage : 150Vdc open circuit full speed MPPT voltage : 30Vdc Axial flux permanent magnet alternator Pitch control – 3 blades Weight : 40kg IP55 – IEC61400-2 Tower : Guyed tubular tower tiltable 8m – galvanised steel
PV Modules	Type : YL 235 P-29b-1 Power output : 235.0 W +/- 3% Efficiency : 14.4% Voltage at Pmax (MPPT) : 29.5Vdc Current at Pmax (MPPT) : 7.97A Open Circuit Voltage : 37.0V Short Circuit Current : 8.54A NOCT : 46 +/- 2 °C – T° coeff. Gamma of P : -0.0045/K Dim : 1650 x 990 x 50 – Weight : 19.8kg IP65 – MC4 connectors IP67 Design Wind Load : 2.4KPa
Genset	Gasoline generator Type DFD3000H Output voltage : 230V 50Hz Nominal Power : 2.5kW – Max Power – 2.8kW 4 stroke engine 6.5HP 3600RPM 196cm3 Air Cooling Fuel tank capacity : 15 litres (approx 5 times at full load) Noise level : 69dB(A) Fitted in skid – Weight : 46kg CE marked
Charger	Type : Centaur Victron 24/80 Input Voltage Range : 90 – 265Vac or 90-400Vdc Frequency : 45 – 65Hz - cos Phi = 1 Absorption Voltage : 28.5Vdc Float Voltage : 27Vdc – 3 outputs Charge current : 80A – Analogical Ammeter 3 steps charging – internal temperature sensor Fan cooling – short circuit protection included Working temperature : -20°C to 60°C Ignition Protected – IP21 Dim : 505 x 255 x 230mm – Weight : 16kg EN60335-1, EN60335-2-29, UL1236, EN55014-1, EN61000-3-2, EN55014-2, EN61000-3-3
PLC	Type : XV102 Eaton Moeller Screen Diagonal/Type : 3.5'' TFT-LCD Color QVGA 320x240 LED Backlight Processor : RISC, 32-bit, 400MHz DRAM 64Mby – NVRAM 32Kby – SD Memory card slot

Device	Specifications
	Ethernet – CANOPEN Webserver Power supply : max 5W – 24Vdc
KPS Enclosure	Hot dip Galvanised Steel fully lockable Dim. : Weight : 1250kg

For any other information: Call ERM Automatismes.

Your comments:

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