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## General notes about the distributed intelligence system.

### General Section

The electric system for motorhomes designed by ArSilicii comprises a set of electronic modules which communicate with one another through a two-wire cable. These modules are known as Nodes and they all feature the following:

- They have a port with which to communicate with the rest of the system;
- They are autonomous, with their own operating logic (Intelligence) independent of the others.

Therefore, each Node is an independent item and can work autonomously also in the lack of communication with the other Nodes. In this case it acts in a pre-defined way which allows the vehicle to work just the same, forsaking only the most advanced features. The term distributed Intelligence refers exactly to the fact that there is no central control unit.

The Nodes are subdivided according to operating logic into the following categories:

- a) Energy management;
- b) Energy distribution;
- c) Acquisition from sensors;
- d) Presentation and Control.

Some nodes may have mixed functions.

### Energy Management

An energy management node has the characteristic of being able to switch and adjust the various sources of Energy available and to supply to the passenger compartment stable and safe power outputs.

In a motorhome, typically we have the following sources:

1. Engine battery/ies;
2. Services battery/ies;
3. Alternator;
4. Outside electric mains
5. Solar panels;
6. Electric generating set
7. Alternative sources (Wind generators, etc..)

For example, the base model of Energy management Node is called PowerNode300 and it is capable of

controlling automatically and alone the first five energy sources

### Energy distribution

The main task of an Energy Distribution Node is to protect the load or supply lines from failures isolating them from the effect. It carries out electronically what could have been done with a fuse or circuit breaker, but it offers additional functions, such as that of being able to adjust the power supplied to a load (Dimmer); accurate fault diagnostics, remote control of the single loads and above all it makes it possible to do all this in a decentralised way, i.e. it is no longer necessary to concentrate in the control element (the old control unit) all the wirings towards the loads and from the energy sources.

### Acquisition

An Acquisition Node (also called Sensor Node) manages detection of the data of sensors. In a motorhome, typically there are the following sensors:

1. The classical switches or buttons;
2. Level of fluids;
3. Temperature;
4. Gas;
5. Electrical ratings (Voltage, Current, etc..);
6. Various alarms ;
7. etc..

The status of the sensors is promptly sent to the whole system through the two-wire communication cable. This way, all the other nodes can learn the details from any sensor installed in the system.

### Presentation and Control

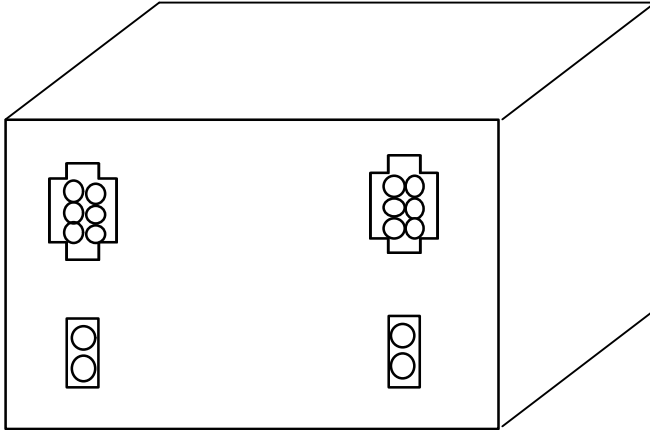
A presentation and control node makes it possible to display and set the various system parameters.

## ***NODES in PRODUCTION***

Currently three different models of nodes are produced:

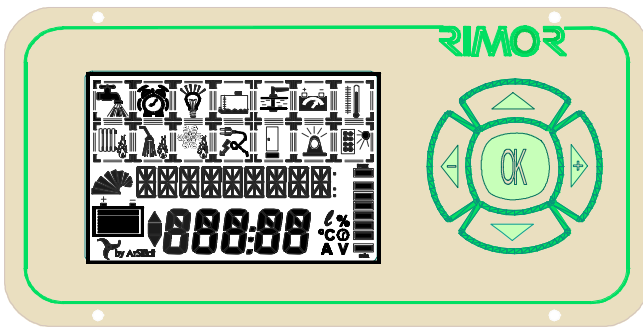
### **The PowerNode (or simply Battery Charger):**

This is a specialised node for controlling the energy and data acquisition (Voltages, currents etc.):



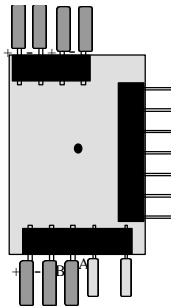
### **The LCD Node (or simply Control Unit):**

This is a specialised node for data presentation and control:



### **The Elementary Faston Node (or Simply Node):**

This node is not specialised and can be programmed to perform different functions:



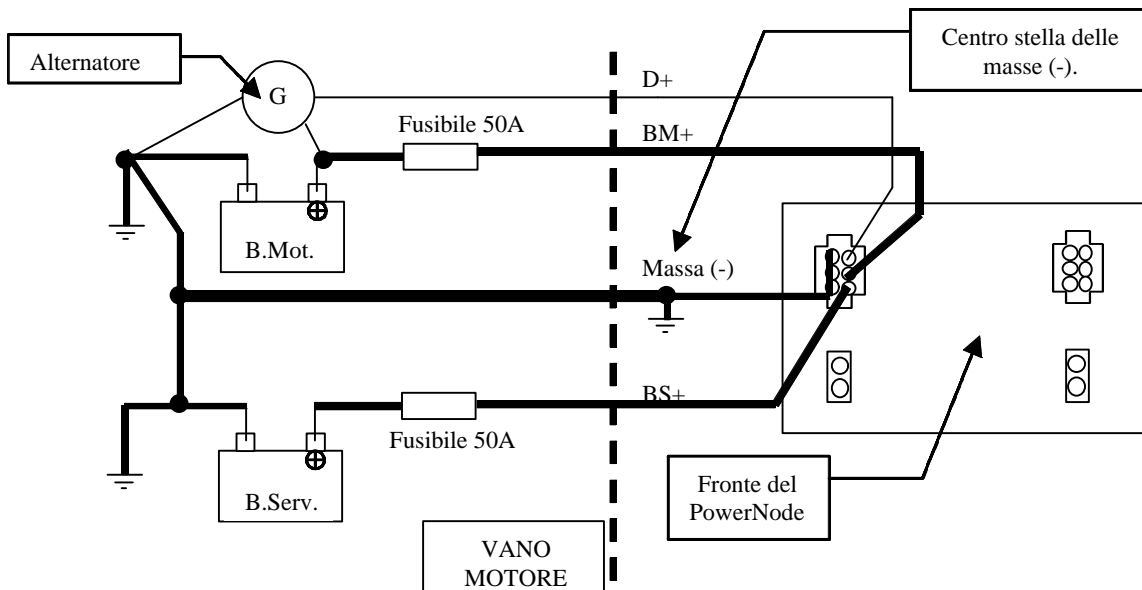
## Overall view of a typical system

Let us now see how to use the nodes introduced to make a complete system.

We are starting from control of the energy leading from the engine compartment.

### ENGINE COMPARTMENT

Typically in the engine compartment we have three items to be taken into account, the engine battery, the services battery and the generator (Alternator + standard Regulator with the mechanical unit), these must be connected to the



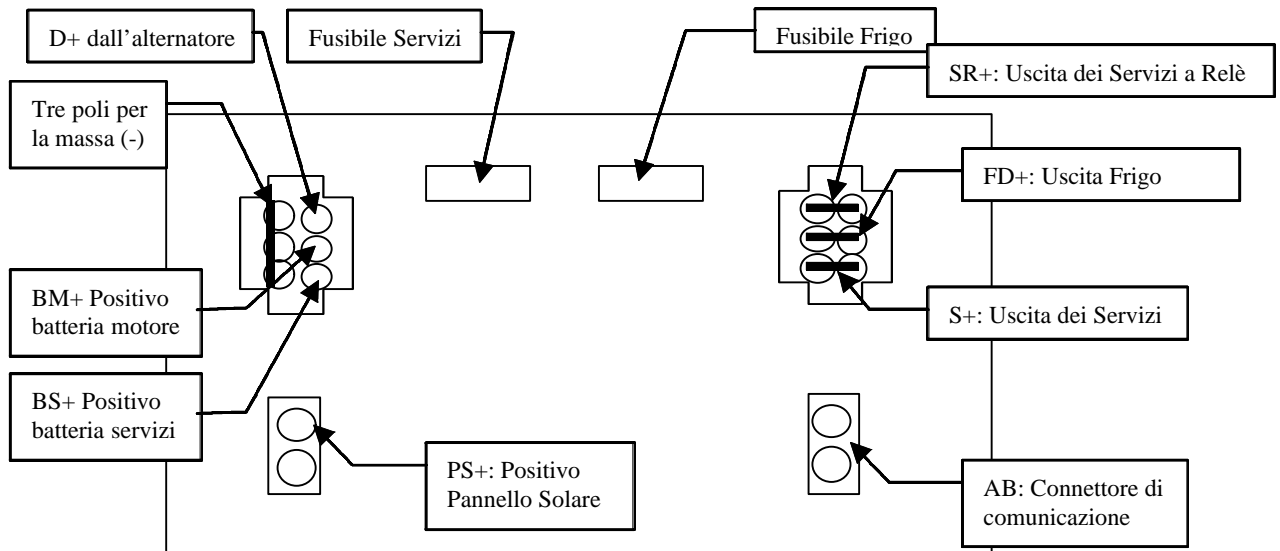
energy control node (PowerNode300) as follows:

Below are a few notes about the previous connections:

- The diameter of the wires in this part of the system is very important, they must be at least 6 sq.mm for the positive leads and 8 sq.mm for the shared earth.
- The PowerNode is fitted with a relay that can be used to put the Batteries in parallel. This function has been designed to allow the battery charger to also charge the Engine Battery, however, under certain hypotheses it may also be used to charge the Services Battery through the alternator. In this case, the diameter and length of the positive wires (BS+ and BM+) must be suitable to prevent excessive voltage drop between the batteries. The utmost care should also be given to any connections present. If all this cannot be guaranteed, it is wise to insert a 70 A relay next to the batteries controlled by the D+ signal which puts the batteries in parallel.

## Connections on the PowerNode

The PowerNode has the following connectors towards the outside:



On the rear there is a socket for the electric mains and a switch for choosing the mains voltage.

The powernode is fitted with a 12 A battery charger, and towards the outputs it has a rated capacity of 30 A, the fuses (30 A of course) serve to protect the powernode from overloads. It should be noted that these fuses do not in general guarantee the safety of the system downstream. To do this, suitable distribution systems should be installed.

Each output pole can deliver up to 15 A, therefore, some poles on the connectors are placed in parallel to make it possible to pick up higher currents. The negative pole should be connected to a star point made in the vicinity of the powernode itself, in this case only the battery charger current runs on this wire and therefore it can be connected to one pole only with a 4 mm<sup>2</sup> wire. The negative wires for the output supply lines lead from this star point.

The outputs available have the following functions:

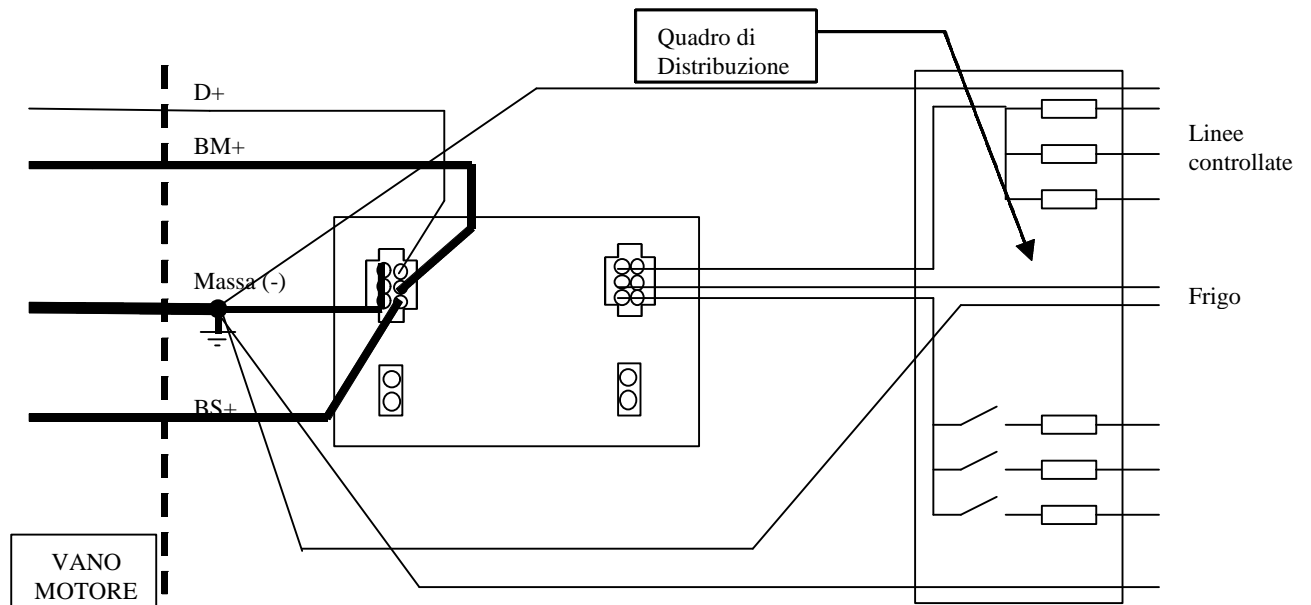
- S+ Output for services always powered, the powernode cannot section this line.
- SR+ Output for the sectioned service through Relay, on command the powernode can power this line.
- FD+ Output for Fridge, the powernode powers this line only when the engine is on, i.e. when D+ is powered.

## Energy Distribution at the PowerNode output:

The powernode outputs are then distributed on the various supply lines that we want to make. To do this, we can follow two approaches:

- Supply lines with Traditional wiring:

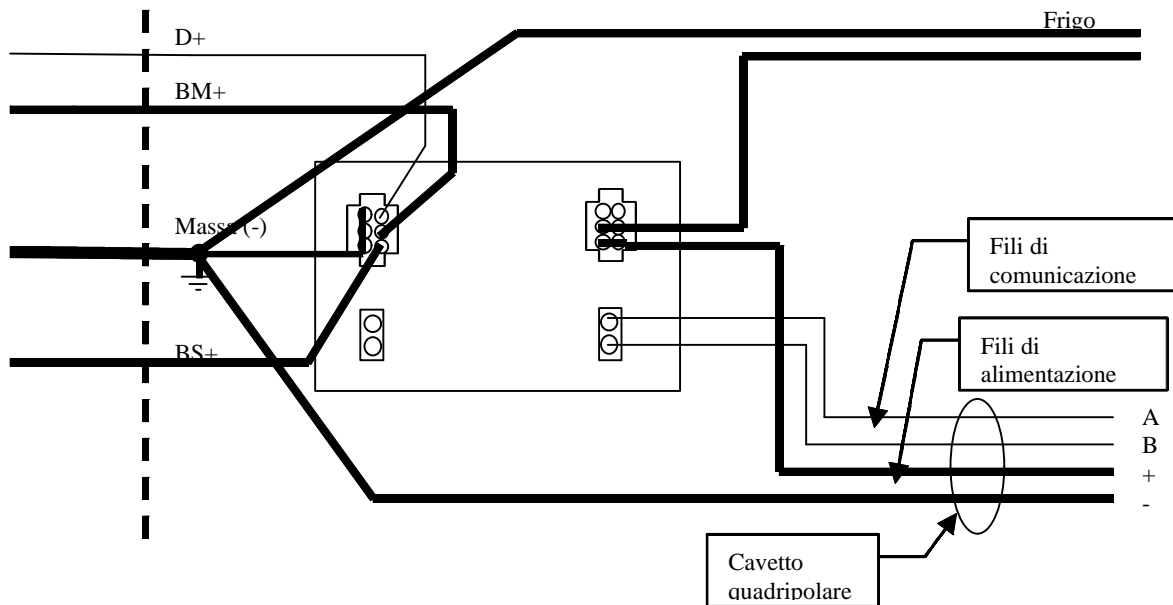
In this case, for each supply line we have to insert a fuse and a knife switch, if we distribute line SR+ we can avoid fitting the switch because the powernode has an internal Relay that controls it.



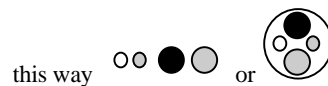
This way, we obtain traditional distribution at the output.

- Supply lines with distribution via nodes:

In this case the distribution component is no longer a fuse box with or without switches, but one or more distribution nodes:



A supply line is made at the powernode output formed of 4 leads, which, for convenience are often enclosed in a single sheath, or brought together in pairs. In other words :

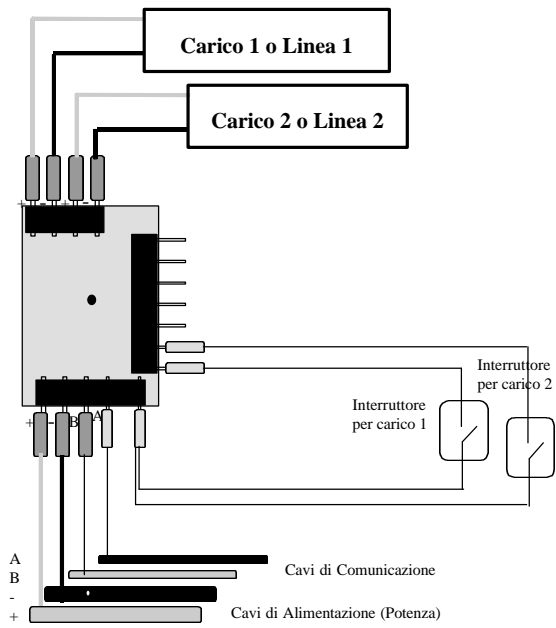


The various supply lines for the loads are then obtained placing them between the line and the line or lines to be created to form a distribution node.

Like all the other components of the system, the distribution nodes are connected to these four wires. The pair with the largest diameter (4 sq.mm ) is the one that carries the power that the node then distributes or sections, while the thinner wire is the one that allows the nodes to communicate. It is essential that both pairs be connected correctly, i.e. with the correct bias, to the node, so that it can deliver energy, and converse correctly with the other parts of the system. Conventionally the colours chosen for the wires are:

- RED            supply positive;
- BLACK        supply negative;
- Grey          communication A;
- Orange        communication B;

A wrong connection can damage the node.



Switch for load 2

Switch for load 1

Communication cables

Supply cables (Power)

It is important to underline that it is possible to adopt mixed solutions for distribution between traditional distribution and distribution by Nodes. In fact Rimor has currently adopted a hybrid system.