CONFIGURABLE POWER SOLUTIONS FOR CURRENT OPERATIONS SUPPORT

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***Abstract*—Current Army operations include a variety of sensor systems and other applications employed in a dismounted mode at a variety of sites. These sites may be very austere, with no commercial or tactical power available, or they may be in more developed locations with access to commercial and/or generator power. The Army Research Laboratory has developed a configurable power solution that permits a particular sensor suite (UTAMS) to operate continuously from solar, vehicular battery, generator, or commercial power. This design provides soldiers maximum flexibility in deploying the sensor suite and is readily adaptable to similar applications.**

I. Introduction

A system designed to maintain 12VDC power to the UTAMS system was requested for immediate deployment in OIF. This power solution was designed to accept power from a variety of sources and consists of a power interface box designed for battery charging dc power. Any current operations support hardware such as UTAMS could be used with this system. For the present application however, the peak and average output power drawn by the load are 30W and 16.5W respectively.

A key feature of this solution is that it is automatically reconfigurable. The battery charge regulators are designed such that the system can be connected to any combination of inputs, and the system will combine the output current to provide power to the load while charging the load battery.

As shown in Fig. 1, the power inputs include a connection to solar array panels, a NATO slave cable input for vehicular power input, and connections for 230 or 110 V AC power from a generator or commercial power source. Each of these inputs is conditioned by power converter modules to provide charging power to a 12 V DC bus. This can be connected directly to the sensor system but the preferred mode of operation is to use the system to keep a 12 V DC lead acid gel cell battery charged; the battery is sized to meet the application load demand and ensures continuous power to the sensor suite for up to 48 hours in the event of continuous loss of all input power options.

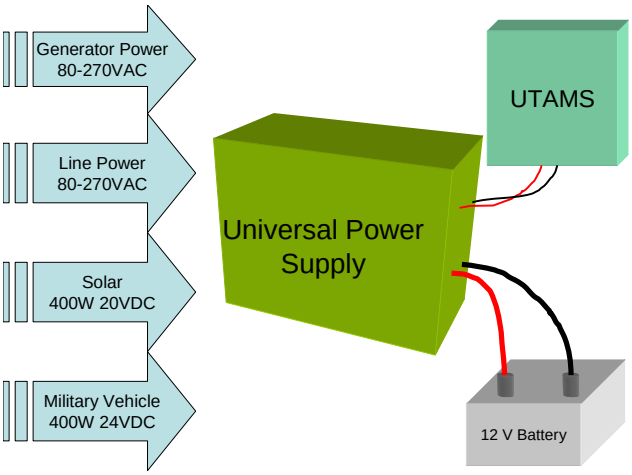

Fig. 1. UTAMS power supply input configuration.

II. System Design

The goal of this power supply is to provide flexible DC battery charging power in the most austere environmental conditions. For this reason a sealed, lightweight enclosure was chosen to both contain and cool the components used to convert input power into 12V output power.

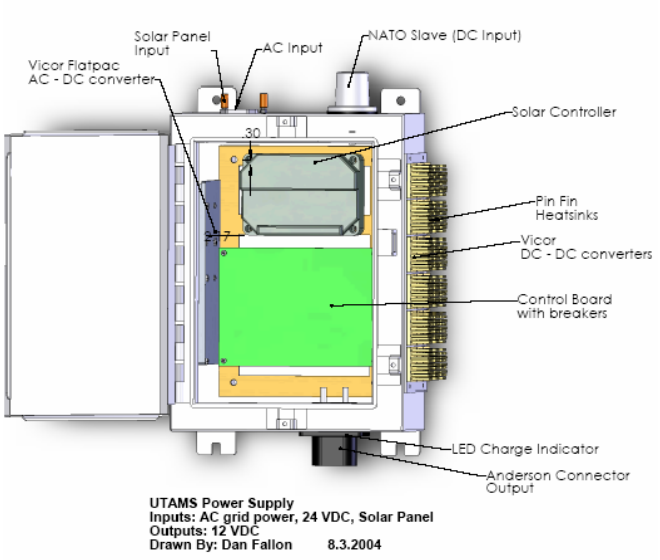

Fig. 2. UTAMS power supply box, interior view.

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The enclosure is a polished aluminum box that measures 24” by 12” by 12”. It is naturally convected by ambient air using two sets of pin-fin heatsink arrays that are sized to keep the box cool at full sun conditions on a hot day at full power.

Self contained AC-DC converters were chosen to provide universal input AC power capability and to provide electrical isolation from the AC grid in order to avoid electrical shock. Additional DC-DC converters were also provided to allow 24V military vehicles with the capability to charge the 12 battery. Each power converter is mounted to the wall of the enclosure with a heatsink mounted on the opposing side. Finally a self-contained solar power charge controller is also mounted in the box, due to its low power dissipation, it is not considered as a heat source in our experiments.

Temperature rise experiments of the box with the universal generator input active at full power were done to eliminate problems in the field. As the graph in Fig. 3 shows the internal temperature rise is limited so that the power converter electronics still operate within a margin of safety below their 80ºC limit. Due to this testing a number of heatsink configurations were evaluated until the final pin-fin design was considered a success.

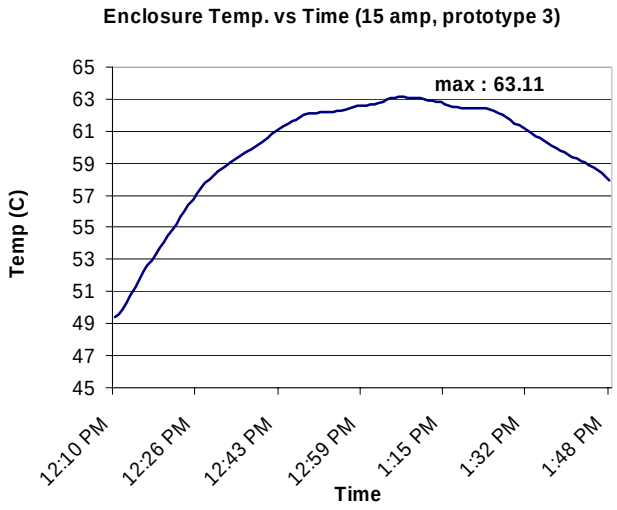

Fig. 3. Temperature rise of enclosure at near full power in full sun, 90F ambient.

III. Generator and AC Line Input

The AC interface provides insulated spring-loaded terminals for an AC cord pigtail connection. A 400W AC/DC converter provides a universal input voltage range of 80 to 260 VAC at 50/60Hz. It is built with its own battery charge regulator that can charge a single 12V battery up to 26A continuously.

IV. Solar Power Option

The solar power option was designed using three 42W solar panels together with a solar controller/converter. Selection of the panels was based on tests conducted to determine the amount of daily energy necessary to ensure overnight operation of the UTAMS. Power, current, and voltage data was collected using different solar panel configurations and battery configurations. This data was analyzed and used to determine the most effective combination of solar cells and battery capacity.

V. Vehicle Power Option

The vehicular power option includes a NATO slave cable connector for connection to military vehicles with a 24 to 12V DC/DC power converter module. The NATO interface requires that the tactical vehicle be run periodically to ensure that the vehicle batteries remain within an acceptable state of charge for vehicle system operation, however the power converter will shutdown if the vehicle battery reaches 18V. This charger system is rated at 400W and has built in protection and controls including over-temperature, short circuit, and voltage transients.

VI. User Interface

User interface for this power system includes a single flashing/steady status indicator that indicates battery state of charge. A low 12V battery at the correct charging voltage with indicate a flashing signal, a charged battery at correct voltage will indicate a steady light. This status light is activated by pushbutton so that the light will not draw attention to the box.

VII. Conclusions

This configurable power system provides a configurable battery charger access to commercial, solar, or generator power. The Army Research Laboratory has developed a configurable power solution that permits a particular sensor suite (UTAMS) to operate continuously. This design provides soldiers maximum flexibility in deploying the sensor suite and is readily adaptable to other 12V systems. Data collection on solar power and thermal experiments in a variety of weather conditions has demonstrated this system’s reliability and availability for applications requiring uninterruptible 12V power.

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