PREDATE POWER SYSTEM MANUAL

Manual Version: 1.0 Last Modified: 15/05/2023

Contents

0. Introduction

This document is a short user manual for the proper operation of the prototypes designed and fabricated under the framework of the PREDATE project. The system consists of the following components:

- Ground Power Station (GPS)
- UAV Power Station (UAVPS)
- Tether Cable

The complete abstract schematic of the system is presented in Fig. 1.

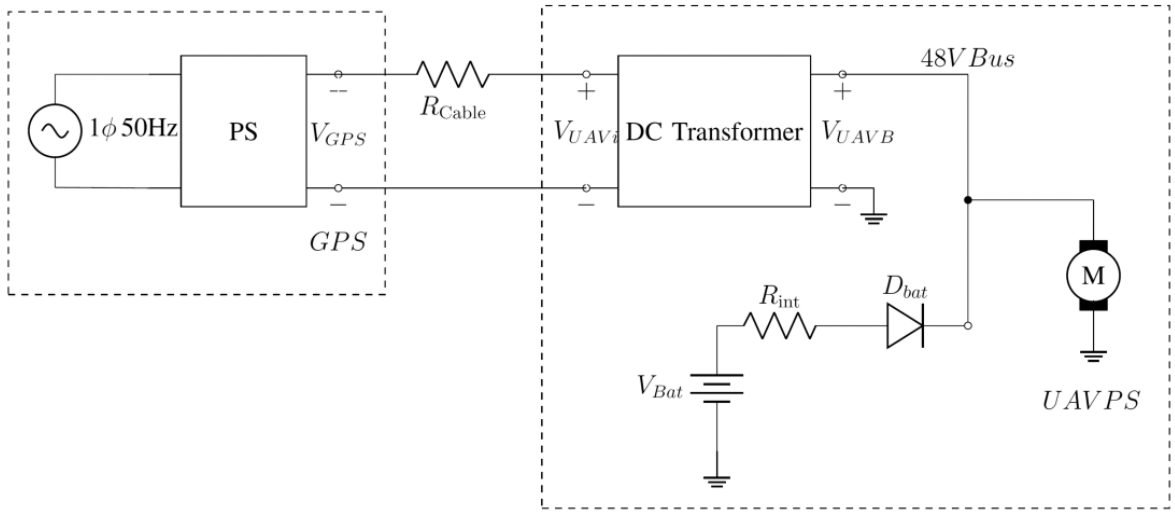


Figure 1: System Power Architecture

In the following sections, a general description is provided for each component, along with a detailed analysis of specific aspects, when required.

1. Ground Power Station

1.1. General Description

The GPS consists of the *BK Precision - PVS10005* [1] programmable Power Supply (PS) used for powering the UAVPS through the tether and of the PREDATE Ground Station PCBA used for controlling the PS and communicating with the UAVPS and the PC Flight Data Logger.

1.2. GPS and UAVPS Communication

Fiber communication is set up to transfer data between the UAV and Ground Power Stations. Currently, data transmission is unidirectional as measurements are sent from the UAVPS to the GPS. No data (command or measurement) is transferred from the GPS to the UAVPS. The fiber communication hardware implementation is demonstrated in Fig. 2.

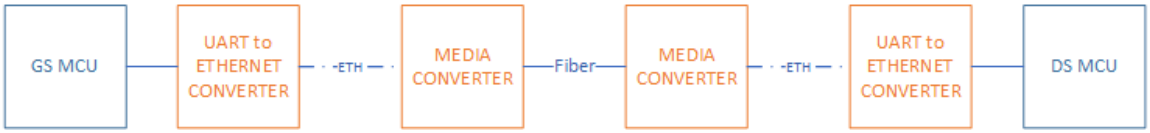


Figure 2: GPS and UAVPS communication system

The UART to ETHERNET converter used is the *Waveshare 2-CH UART To Ethernet Converter* [2]. Any newly purchased converters cannot be used out of the box, as they must be configured as client and host (depending on whether they will be used in the GPS or the UAVPS) and have their IPs and baud rates changed. To perform this procedure, please follow the steps below:

1. Open the NetModuleConfig.exe that you can find under *PREDATE_Deliverable\UART to ETHERNET CONVERTER Files.*
2. Connect the converter to your PC through Ethernet.
3. Click *Search* and after a few seconds your converter should be displayed in the application.
4. Click the *name* of the converter to select it.
5. If you want to configure a converter for the DS, load, through the application, the corresponding configuration file, which is *drone_config.cfg*. The details of the configuration are shown in Fig. 3.
6. If you want to configure a converter for the DS, load, through the application, the corresponding configuration file, which is *gnd_config.cfg*. The details of the configuration are shown in Fig. 4.
7. Click *Set ALL*. The configuration is downloaded in the converter and after a few seconds a message is displayed in the application, indicating the end of the procedure.
8. The converter is ready to be used.

The media converter used is TP-Link MC220L [3]. Both media converters (GPS and UAVPS) are mounted on the PCBAs without their casing. The converters are powered by the PCBAs and they do not need any external power supply. Please connect the power jack of the media converter to the corresponding pin headers on the PCBA, as shown in Fig. 5 and Fig. 6 for the different PCBA versions.

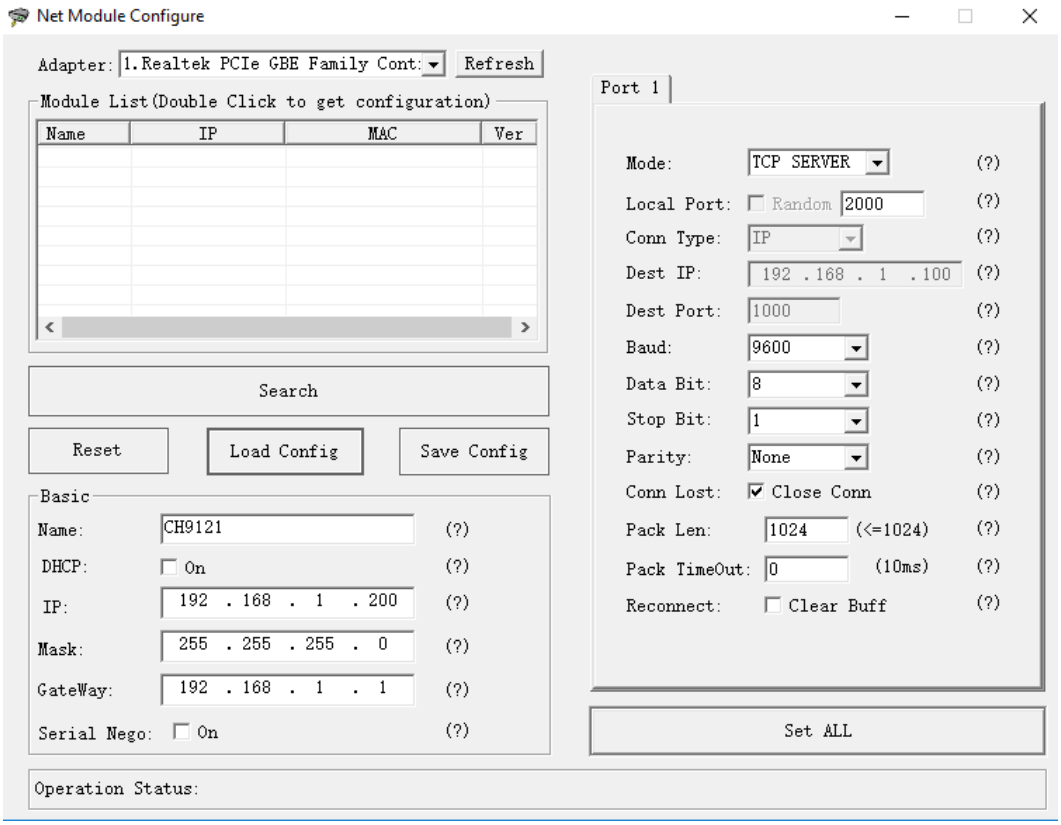


Figure 3: Converter configuration parameters for UAVPS (drone_config.cfg)

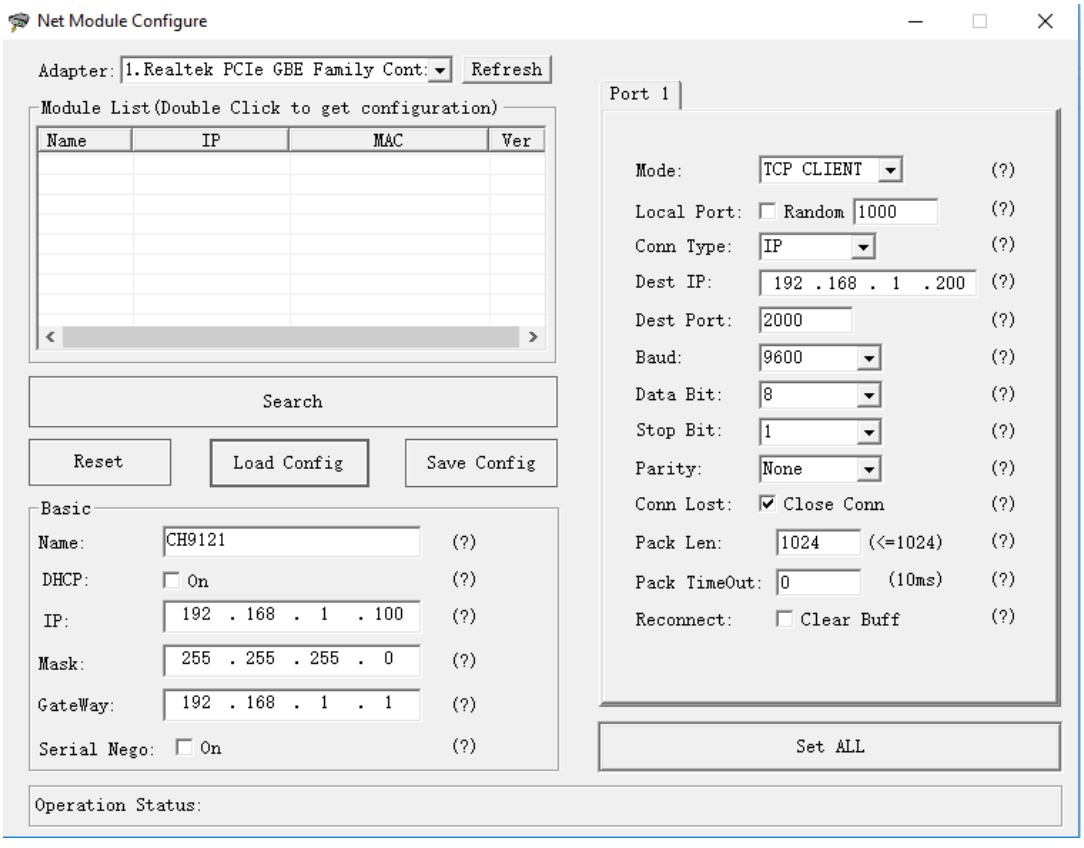
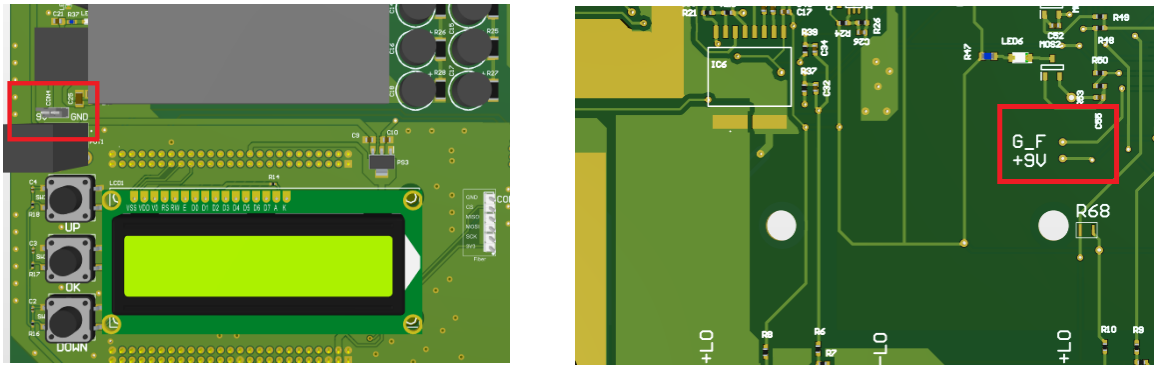
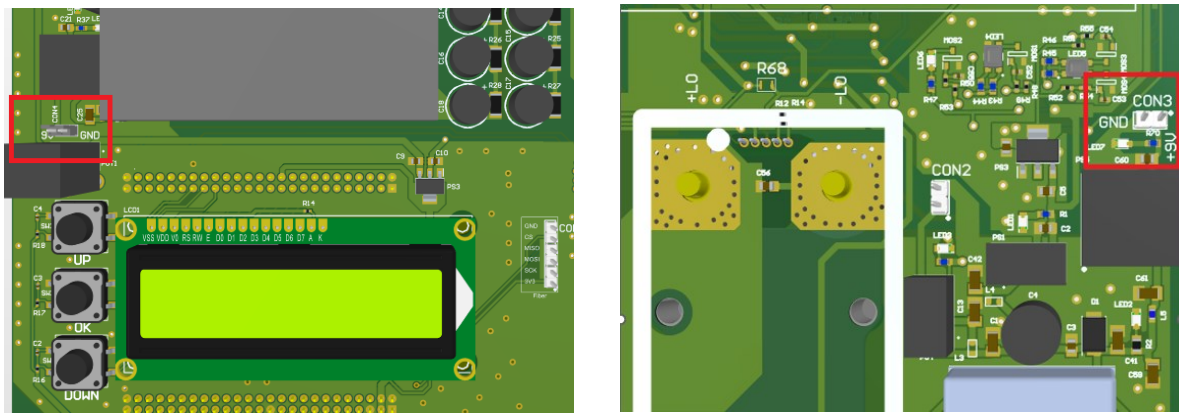


Figure 4: Converter configuration parameters for GPS (gnd_config.cfg)



a) b)

Figure 5: a) Media converter supply on GPS V1.2, b) Media converter supply on UAVPS V1



a) b)

Figure 6: a) Media converter supply on GPS V1.3, b) Media converter supply on UAVPS V2

1.3. LCD Screen

The LCD screen of the GPS consists of a 16x02 LCD Module. There are 3 different display screens available:

1. UAVPS Input Screen (Fig. 7): In this display the input voltage, current and power of the UAVPS are displayed.

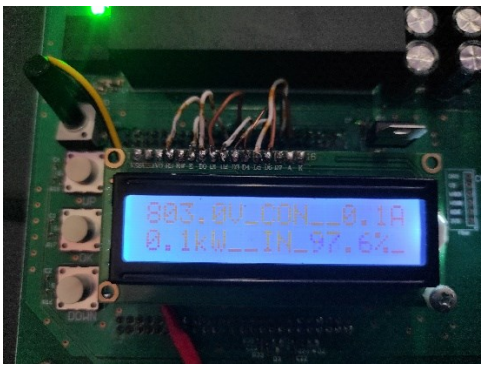


Figure 7: UAVPS Input Screen

2. DC Transformer Output Screen (Fig. 8): In this display the output voltage, current and power of the DC Transformer array are displayed along with the internal temperature of the BCM modules.

Figure 8: DC Transformer Output Screen

3. Battery Screen (Fig. 9): In this display, the battery voltage and current are displayed.

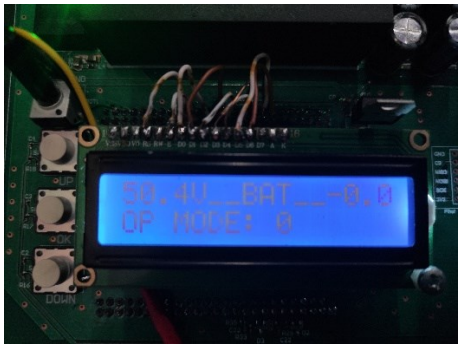


Figure 9: Battery Screen

1.4. PC Data Logger

A Data Logger was designed to save all flight data to any personal computer. The data transfer from the GPS MCU to the PC is realized with a MicroUSB to USB cable. The application program was developed in Python 3. To be able to run the application, Python 3 and all used packages must be installed on the computer. When executed, the program starts listening to COM Port 11 (by default) and saves all received data to a buffer. The used Com Port number may be changed by changing the source code. To stop data recording, the user must press “Ctrl+C”. Then, the data of the buffer are stored in a CSV file in the folder where the source code file is located. The name of the csv file includes the date and time of the executed flight.

2. Tether Cable

2.1. General Description

The LINDEN-SPE-7155 tether cable was used for the application. It consists of two 20AWG conductors and one fiber optic cable.

3. UAV Power Station

3.1. General Description

The UAVPS consists of a DC Transformer implemented by using an array of three BCM4414BH0E5035M10 modules and of a battery stack (Tattu Plus 22000mAh 6S1P Lipo Smart Battery Pack) which is interfaced to the UAVPS output through an array of four Schottky Diodes.

3.2. Power Sources and Load Connections

The tether and battery power sources along with the UAVPS output should be connected as shown in Fig. 10.

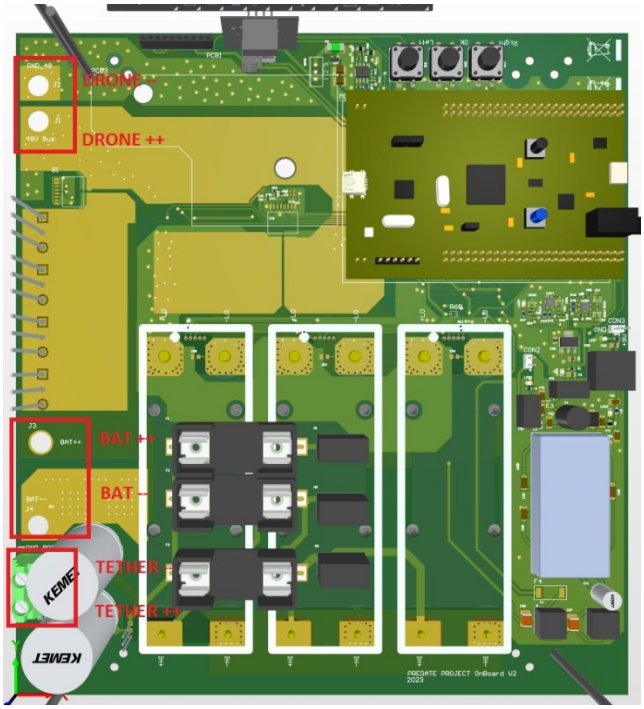


Figure 10: UAVPS Power Sources and Load Connections

4. System Initialization

The initialization procedure of the system is the following:

1) The tether cable is connected to the GPS and to the UAVPS.

2) The voltage of the Power Supply is set to 800V and the current limit to 3.1A. The GPS is powered on.

3) The battery stack is connected to the UAVPS.

4) The ESC power distribution board is connected to the UAVPS.

After this sequence the operator may initialize the flight. To power off the system, the inverse procedure must be followed.

5. References

[1] PVS10005 Manual

[2] Waveshare 2-CH UART To Ethernet Converter Wiki

[3] TP-Link MC220L Information