



Vertical Power

Electronic Circuit Breaker System

VP-200 Series

VP-200

VP-200 Duo

Installation Manual

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1 Important Notice

This manual contains important information that may affect the safety of your aircraft. Do not fly the aircraft until you fully understand the installation and operating instructions, and all of the pre-flight checks have been successfully completed.

Read the Warranty / Agreement below. There is information in the Warranty / Agreement that may alter your decision to install this product. **If you do not accept the terms of the Warranty / Agreement, do not install this product.** The product may be returned for a refund if you do not accept the terms of the Limited Warranty / Agreement.

Vertical Power Inc. is not liable or responsible for a pilot's action or any situation that results in personal injury, property damage, missed commitments, lack of use of an aircraft or any expenses incurred due to: product failure, inaccuracy in displayed data or text files, display or display format issues, software bugs or problems, upgrade or customization issues, misinterpretation of the display, warning and/or limit settings, calibration problems, installation issues (leaks, mis-wiring, obstructions, damage to aircraft or components, incorrect installation of any parts, wrong parts, parts that don't fit, etc.) or any other issues related to the installation or operation of this product. All of the above are solely the pilot's and/or installer's responsibility. The pilot must understand the operation of this product before flying the aircraft. The pilot will not allow anyone to operate the aircraft that does not know the operation of this product. The pilot will keep the VP-200 Operating Instructions in the aircraft at all times.

By installing this product, the aircraft owner/pilot and installer agree to hold Vertical Power Inc. harmless and in no way responsible for monetary compensation, including punitive damages for any incident, harm and/or damage associated with this product (including but not limited to the ones listed above). If you do not agree to the above, **DO NOT INSTALL THIS PRODUCT.** The pilot, owner and/or installer may want to obtain an appropriate insurance policy before installing this product. If you do not have the skills, knowledge, tools, equipment or facility, to perform and determine the installation of this product is safe, reliable and accurate and to determine this product is operating properly after installation, **DO NOT INSTALL THIS PRODUCT.** If the owner/pilot and/or installer are unwilling to take the responsibility for the installation and operation of this product, **DO NOT INSTALL THIS PRODUCT.** This product may be returned for a refund by contacting Vertical Power Inc.

The pilot must understand the operation of this product before flying the aircraft. Do not allow anyone to operate the aircraft that does not know the operation of this product. Keep the Operating Instructions in the aircraft at all times. The ability for this product to correctly control electronic components and detect a problem is directly related to the pilot's ability to properly install the system, program proper configurations and limits, and the pilot's interpretation and observation skills.

This manual does not make any recommendations as to specific methods by which to lean your engine. Check the airframe and/or engine manufacturer's recommendations to properly lean your engine. It is the pilot's responsibility to lean the engine properly.

It is possible for any system to fail thereby disabling electronic components or displaying inaccurate high, low or jumpy readings. Therefore, you must be able to recognize a system failure and you must

be proficient in operating your aircraft safely in spite of a system failure. **IT IS THE BUILDER AND/OR PILOT'S RESPONSIBILITY TO DETERMINE THE APPROPRIATE LEVEL OF BACKUP AND REDUNDANT SYSTEMS NEEDED FOR SAFE OPERATION OF THE AIRCRAFT.** If you do not have this knowledge or skill, contact the FAA, a certified aircraft mechanic, or a local flight instructor for training prior to building or flying the aircraft with this system.

Do not allow anyone who is not qualified to modify the calibration or configuration data. If setup or calibration data is inadvertently or improperly changed, you could get inaccurate readings that may lead to improper operation of the aircraft, flaps, trim, starter, landing gear, or engine. This could result in an unsafe configuration of the control surfaces, engine damage and/or an emergency situation.

Before flying the aircraft verify the instrument markings displayed on the system are accurate with your POH for every function displayed. Verify the horsepower displayed on the system is accurate with your aircraft's POH and/or engine data. Verify that each electrical device is configured correctly and behaves appropriately. The system allows the pilot to enter checklists, configuration data, backups and other information through the USB port. These data must be verified by the pilot before it is used.

The system displays engine and fuel data as received from an external system. The accuracy of each function displayed is dependent on the external system, and you should verify that this information is calibrated on the external system and should be verified before the aircraft is released for normal flight. Verify the accuracy of both the external system information as well as how those data are displayed on the VP-200. The external system and/or the VP-200 must be calibrated to the aircraft fuel system and the system's accuracy must be verified before flying the aircraft. Be sure to read and understand the fuel level accuracy limitations of the external system.

Before starting the installation, make sure that your planned installation will not interfere with the proper operation of any controls. The installer should use current aircraft standards and practices to install this product. Refer to AC 43.13-2A, Acceptable Methods, Techniques, and Practices - Aircraft Alterations and AC 43.13-1B, Acceptable Methods, Techniques, and Practices--Aircraft Inspection and Repair.

The VP-200 is an experimental system limited to use in experimental aircraft. Not approved for use in aircraft with FAA or foreign type certificates.

LIMITED WARRANTY / AGREEMENT

Vertical Power Inc. (“VP”) warrants its aircraft monitoring and electrical control system and system components to be free from defects in materials and workmanship for a period of three years after the retail invoice date. VP will repair or replace any system components under the terms of this Warranty provided the item is returned to VP prepaid. This Warranty shall not apply to any unit or component that has been repaired or altered by any person other than VP, or that has been subjected to misuse, abuse, accident, incorrect wiring, or improper or unprofessional installation by any person. **THIS WARRANTY DOES NOT COVER ANY REIMBURSEMENT FOR ANYONE'S TIME FOR INSTALLATION, REMOVAL, ASSEMBLY OR REPAIR.** VP reserves the right to determine the reason or cause for warranty repair.

1. This Warranty does not extend to any engine, machine, aircraft, boat, vehicle or any other device to which the VP system may be connected, attached, or used with in any way.
2. **THE REMEDIES AVAILABLE TO THE PURCHASER ARE LIMITED TO REPAIR, REPLACEMENT, OR REFUND OF THE PURCHASE PRICE OF THE PRODUCT, AT THE SOLE DISCRETION OF VP. CONSEQUENTIAL DAMAGES, SUCH AS DAMAGE TO THE ENGINE OR AIRCRAFT, ARE NOT COVERED, AND ARE EXCLUDED. DAMAGES FOR PHYSICAL INJURY TO PERSON OR PROPERTY ARE NOT COVERED, AND ARE EXCLUDED.**
3. VP is not liable for expenses incurred by the purchaser or installer due to VP updates, modifications, improvements, upgrades, changes, notices or alterations to the product.
4. The pilot must understand the operation of this product before flying the aircraft. Do not allow anyone to operate the aircraft that does not understand the operation of the system. Keep the operating manual in the aircraft at all times.
5. VP is not responsible for shipping charges or damages incurred during Shipment, except for situations where the system fails away from the aircraft’s home base and the pilot is unable to safely fly the aircraft, at which time VP shall, at VP’s sole discretion, pay only one-way shipping charges to the purchaser (US 48 states only).
6. No one is authorized to assume any other or additional liability for VP in connection with the sale of VP products.
7. **IF YOU DO NOT AGREE TO ACCEPT THE TERMS OF THIS WARRANTY, YOU MAY RETURN THE PRODUCT FOR A FULL REFUND. IF YOU DO NOT AGREE TO ACCEPT THE TERMS OF THIS WARRANTY, DO NOT INSTALL THE PRODUCT.**
8. This warranty is made only to the original purchaser and is not transferable. **THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES OR OBLIGATIONS, EXPRESS OR IMPLIED, ORAL OR WRITTEN. VP EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THE PURCHASER AGREES THAT IN NO EVENT SHALL VP BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING DAMAGES TO THE ENGINE OR AIRCRAFT, LOST PROFITS, LOSS OF USE, OR OTHER ECONOMIC LOSS. EXCEPT AS EXPRESSLY PROVIDED HEREIN, VP DISCLAIMS ALL OTHER LIABILITY TO THE PURCHASER OR ANY OTHER PERSON IN CONNECTION WITH THE USE OR PERFORMANCE OF VP' PRODUCTS, INCLUDING BUT NOT LIMITED TO STRICT PRODUCTS LIABILITY IN TORT.**

2 Change Log

Change date	Change
11-24-07	Updated contactor diagrams to show more detail.
12-3-07	Added instructions for connecting audio ground. Updated external annunciator input section. Added note about wiring both Control Units to the battery contactor for Config 3.
12-14-07	Added information on dual battery, single bus setup Added troubleshooting section
12-18-07	Updated troubleshooting section
1-8-08	Added diagram to flap section, added more light dimming considerations
1-25-08	Added Garmin G900X wiring interface details to <i>data connections</i> in Section 4. Added starter annunciator detail.
2-25-08	Changed air data input from Chelton GADAHRS
3-6-08	Added landing gear wiring information
3-15-08	Added new setup screens for v14 software
5-13-08	Removed annunciator integration with Gretz Aero pitot tube (support is now via an adapter)
6-30-08	Added picture on engine configuration section. Added new General Setup info for v16. Added additional troubleshooting sections. Added JPI EDM-950 to supported engine monitors. Added starter safety circuit.
8-20-08	Change 'Config 3 considerations' to reflect both CUs controlling battery contactor.
9-4-08	Added/changed engine and air data interfaces with Garmin G900.
9-15-08	Added more information about dual-speed boost pumps. Added mag switch OFF check while engine running. Added information and screens to show new features in version 17 software: annunciators, new alarms, appendix for annunciators, backup switch feedback. Added more detail on connecting the p-lead wires. Added input pin verification step.
1-9-08	Added note about backup circuits on alternators.
2-23-09	Added inverted logic on annunciators, climate control, and data logging.
2-24-09	Added new feature to enable power on a pin when co-pilot trim disconnected.
3-16-09	Added backup method C.
4-2-09	Added information on isolation contactor for hydraulic pumps and non-VP air conditioning systems.
4-3-09	Updated serial data and engine menu portions of setup menu
7-1-09	Added v20 features. See release notes on web site, software page. Changed timing on p-bus failure detection. Added clarification on flap up switch settings. Added power connector install/removal instructions
12-16-09	Added SkyView information to data section. Added to trim disconnect section.
1-5-11	Added instructions to integrate with Garmin G3X.
2-4-11	Updated Garmin G3X serial connection instructions.
5-11-11	Added new features for version 22 software. See release notes for details.

3 Introduction

3.1 Welcome to Vertical Power!

The VP-200 series is a new and innovative way to intelligently control the electrical devices on your aircraft.

While the VP-200 series makes life a lot easier for the builder, it's not simply a plug-and-play solution. The builder must still run wires to electrically-powered components and this wiring takes some careful planning. Please take the time to read and understand this manual before proceeding.

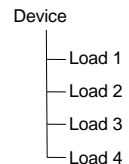
This manual describes the installation steps and techniques necessary to install the VP-200 series. It is also intended to provide the information you need to know to capably wire your electrical system. Because many of the features are controlled using the setup menus rather than with hard-wired components, you can easily change things in the future.

This manual is constantly updated, so check the Vertical Power web site for updates during your build.

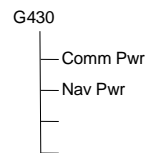
If you follow each of the five steps outlined in this manual, you will have a safe and full-featured electrical system.

3.2 Vertical Power Terms

Mode	At all times, the VP-200 series is in one of ten Modes. The Mode determines what information to display to you and what devices to automatically turn on or off. The Modes are defined as Pre-flight, Before-Start, Start, After-Start, Taxi, Run-up, Takeoff/Climb, Cruise, Landing, and Maneuver.
Load	A user of electrical power. It may be a light, radio, GPS receiver, contactor, or EFIS, just to name a few. A load is wired to a power pin on the Control Unit.
Device	Vertical Power uses the notion of a device to organize the electrical loads on the aircraft. A device is a grouping of one to four electrical loads. For example, a device named <i>Landing Lt</i> can be defined as a single load on a single pin, or as four loads each attached to its own power pin.



A device named *G430* could have two pins, one for Comm power and one for Nav power. A *Device List* is displayed to you on the right-hand side of the display screen and shows if a device is on, off, or faulted. It also shows the current drawn by each device and highlighting the a device on the list allows you to manually control power to it. A device can also be a contactor, flap or trim motor.



Pin	A pin refers to a physical pin on one of the Control Unit connectors that provides power to a load. Special-purpose pins are provided for flaps, trim, starter, and the battery contactor(s). Most pins, however, are generic and can be configured to match the type of load it is powering. Each pin has a maximum current rating of either 5 amps, 10 amps, or 18 amps @ 14 volts. Certain pins simply turn loads on and off. Other pins provide variable voltage, and can be configured for soft start or light dimming in addition to on/off operation.
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State	There are three states: on, off, or faulted. Faulted is equivalent of a tripped circuit breaker.
Automatic	Devices are by default in an Automatic state, and may be switched on and off automatically when modes change.
Manual	You may override automatic state and manually control device state using the Device List or an external switch. A device in the Manual state always overrides the automatic setting.
Connector	Two types of connectors are used throughout the system. D-sub connectors are smaller and provide signal and low power (less than 2 amps) connections. Vertical Power uses high quality, gold plated, machined-barrel connectors. High-quality, Molex gold-plated connectors are used to provide power (up to 18 amps) to high current devices.
AWG	American Wire Gauge – a standard that describes the size of the wire.
Circuit breaker	While the VP-200 series does not use conventional circuit breakers or fuses, the term is very common and herein is used to mean the maximum current a circuit will draw before faulting.
Fault	The VP-200 series protects each circuit from short circuits as well as over-current conditions. When a fault occurs, the VP-200 series turns the faulted device on the device list to red, displays a message, and plays an audio tone in your headset. You can then press the “Clear Fault” soft key to reset the fault, similar to resetting a circuit breaker. The System will reset the circuit to normal operation if the reason for the fault has cleared.
Backup circuit	A backup circuit allows you to power a load directly from the battery through an external switch (separate from the VP-200 series). When the external switch is turned on, fused power is provided directly from the battery to the device regardless of whether or not the battery contactor is closed or the VP-200 is turned on. Wiring these circuits is optional.
B-lead	This is the large wire that goes from the alternator to the main electrical bus. It provides current from the alternator to the battery and electrical bus.
p-lead	This is the wire that goes from the mag switch to the magneto. There is a p-lead for each magneto form the switch.

3.3 Other Reference Documents

Vertical Power provides other documents that should be used in conjunction with this manual to help you thoroughly plan a safe and effective electrical system for the type of mission you fly. The following documents are available on the Documentation page of the Vertical Power web site (www.VerticalPower.com), and should be reviewed in conjunction with planning your electrical system.

<u>Document</u>	<u>Description</u>
Load Planning Worksheet	This Excel spreadsheet guides you through planning and configuring the data and power pins on the VP-200 series. It allows you to document and plan various parts of the required setup.
Device Amps	This document lists the electrical current draw of many popular radios, GPS moving maps, EFIS displays, lights, and other avionics. It is maintained by Vertical Power, but contributions come from builders.

Config 1, 2, 3, 4	These documents show wiring detail for the different electrical configurations supported by Vertical Power.
Flap-Trim Wiring	Flap and trim wiring detail.
Canopy Seal	Wiring the automatic canopy seal pump on a Lancair.
Gear Wiring	Landing gear wiring detail.
Alternator Wiring	How to wire an internal or externally regulated alternator or B&C SD-8.
Connector Service Manual	Step by step instruction how to work with Molex, d-sub, insulated crimp and other connectors.
Contactors Wiring	Overview of the different types of contactors used in experimental aircraft, and step by step instructions how to wire them properly.

Additional documentation may also be available on the web site.

4 Electrical System Basics

This manual and the accompanying documentation on the Vertical Power web site are intended to provide enough detail to understand overall concepts and safely wire your aircraft. Should you want more information, additional resources can be found in a variety of books and texts, a few of which are shown here:

- FAA Advisory Circular AC 43.13, *Acceptable Methods, Techniques, and Practices - Aircraft Inspection and Repair* available from www.faa.gov
- FAA Advisory Circular AC 23.1311, *Installation of Electronic Display in Part 23 Airplanes*, available from www.faa.gov
- Aeroelectric Connection book, available from www.aeroelectric.com
- <http://www.sportair.com/articles/Electrical%20Systems%20Simplified.html>
- Movies: http://www.heli-chair.com/videos_public/wiring_videos/2007_wiring/

An aircraft electrical system can be divided into three parts:

1. “Backbone” components: aircraft battery, alternator, voltage regulator, contactors and associated wiring. Contactors are just high-capacity relays that are energized by low power signals but allow large amounts of power to pass through.
2. Busses, switches, and circuit protection (fuses and/or circuit breakers)
3. Users of power and the wiring to and from those users. Users may be lights, instruments, avionics, pumps, etc. The term *device* or *load* is used in this manual to generically describe all the users.

More on electrical system basics:

- The aircraft **battery** and **alternator** provide power to all electrically-dependent systems. Normally, the battery powers systems before and during starts and then the alternator takes over charging the battery and providing power to the electrical devices. A **battery contactor**, connects (or disconnects) the high-current wires between the battery and the main power distribution bus.
- Power typically runs from the battery/alternator to **electrical busses** behind the panel where power is split and sent to individual devices through **circuit protection devices** (fuses and circuit breakers) and switches. The VP-200 series assumes the role of busses, circuit protection, and most switches. During construction, using the VP-200 series greatly simplifies the task of wiring your aircraft.

- **Wire** sizes vary and the size of the wire to each device is determined by the current load (amps) of that device as well as the distance the current must travel. If a wire is too small for the load or distance, it will heat up and possibly fail. If the wire is too big, it will certainly carry the load but at the expense of added weight.
- To complete the electrical path, devices must have a ground. This means connecting a ground wire to the metal aircraft structure (aircraft ground) or running a ground wire from the device to a central location such as a firewall grounding point.

4.1 Alternator Operation

The alternator provides power to devices and also charges the aircraft battery. The **voltage regulator** continuously monitors the bus voltage and adjusts the output of the alternator. The regulator only works when it is powered from a bus through a wire called the **field wire**. Some alternators are internally regulated (the regulator is built in), and others have external regulators (a separate box located outside the alternator). In either case, the regulator must be powered and the VP-200 series supports both configurations.

Today's experimental aircraft are powered by either 14 volt or 28 volts systems. Often you may hear 12 volt or 24 volt systems. Why the difference? The reason is because the batteries are rated at either 12 or 24 volts. When the engine is running and the alternator is turned on, the alternator generates 14 volts or 28 volts, slightly higher than the battery voltage so it will keep the battery charged.

If you have a primary alternator and a secondary (backup) alternator, like in config 2 & 3, only one alternator should be powered on (in other words, the field wire is powered) at a time. Therefore, we refer to one alternator as the primary (Field Pri) and the other as the secondary (Field Sec). If both are on simultaneously, they do not equally "contribute" to powering the loads. The one whose voltage regulator is set to the highest voltage will draw all the current (sometimes called current hogging), possibly overloading the alternator.

If each alternator is powering an independent bus, like in config 4, then both alternators should be powered simultaneously. Since each bus is independent, there is no chance that loads from one bus will draw power from the other bus. Therefore, we refer to the larger capacity alternator as bus A (Field A) and the lesser capacity alternator as bus B (Field B). The alternator mounted on the accessory case (rear) of the engine typically has a smaller capacity than the front-mounted alternator, and loads must be planned accordingly. Usually, a cross-tie contactor is installed in this configuration which ties the two busses together, allowing one alternator to power both busses if a failure occurs.

Turning power on and off to the field wire is the most benign way to turn the alternator on or off. You should check with your alternator manufacturer about whether it is advisable to turn the field on and off while the alternator is under load.

When planning your electrical system, assume the alternator provides 80% of its rated output (in amperes), and therefore your total continuous load (don't worry about trim or flaps or other transient loads) should not exceed 80% of rated alternator capacity.

4.2 Wire Sizes and Circuit Protection

A table below shows wires sizes versus loads for a typical homebuilt-size airplane. **The wire size can be larger than necessary but should not be smaller.**

Circuit breakers (and fuses) protect the wiring, not the device. If the breaker is too large, then the wire may overheat and fail. If too small, then the device may fault (breaker trips) because it draws too much current.

Most kit aircraft companies and avionics companies provide recommendations for sizing wires and breakers. You can use these recommendations. Or, you can borrow or purchase an ammeter (typically under \$50 at Radio Shack, etc.) measure the current draw of each electrical device and then determine the sizes yourself.

When you know the current draw for each device, use the chart below to size wires from the VP-200 series to devices. For simplicity, the wiring harnesses available from Vertical Power use the four wire sizes in the table.

Up to (amps)	Use wire size (AWG)
5A	20
10A	18
18A	14
Data signal	22

4.3 Magneto Wiring

The traditional aircraft ignition system is separate from the aircraft electrical system in that an engine-operated magneto supplies timed ignition pulses to the spark plugs without help from the aircraft battery or alternator. To control whether or not the magneto provides pulses, the traditional magneto typically has P-lead lug attached to a wire that runs to panel-mounted magneto switches or a combination magneto-start switch. To prevent unwanted and unexpected ignition, the switches ground the P-lead. Many newer electronic ignitions have a P-lead –type wire that performs the same function.

During a mag check, the switch grounds the P-lead to disable that specific mag. The engine then runs only on the other mag. Grounding each mag in this manner checks that the other mag is operating properly. When the mag switch is on L (or left) position, it is checking the operation of the left mag by grounding the right mag and vice versa on the right position.

If you wire the RPM input (to your engine monitor) from a magneto or Lightspeed ignition, the RPM will go to zero when disabling that mag. E/P-mags continue to provide RPM when the p-lead is grounded. We recommend wiring your tach input so that the RPM does not go to zero when shorting the p-lead (typically during a run-up check). This allows the VP-200 to properly calculate the RPM drop and delta during a mag check (future feature). This can be done in one of several ways:

- use a hall-effect sensor that is installed in the vent port on the magneto.
- use a sensor on the tach drive port on the engine
- use the E/P-mag as the RPM source

Check with your engine monitor manufacturer for specifics related to their product.

4.4 Grounding

Many people think that the power, or positive, wire is the most important wire to provide electricity to a device. The electrical ground is just as important as electricity must flow the entire path from the power source to the device and back to the source. The ground wire must be the same wire gauge or a larger diameter (smaller gauge number) as the wire that provides power to the device.

A *ground loop* is when electricity can take two different paths, and each path has a different resistance. Ground loops are most noticeable in aircraft audio equipment, and can produce a variety of problems, most notably unwanted noise.

Grounding is as much of an art as it is a science. With that in mind, several options for grounding your system are provided below. Choose the one that best fits your needs. Keep in mind that more wiring means more weight (although likely negligible). Also, note that in all the examples below the avionics grounds are kept together.

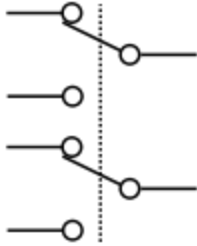
- Option 1: Run a ground wire from each and every electrical device back to a common grounding point, typically a ground bus on the firewall.
- Option 2: Run ground wires from all the avionics to an intermediate grounding point, then run a larger wire from the local ground bus to the firewall ground. Run wires from all the other devices to the firewall ground.
- Option 3: Run the ground wires from the avionics to the firewall ground, and run the other ground wires to a local ground (a metal part of the airframe located near the device).

Don't forget about the audio ground wire, too! (Pin 18 on the DU connector)

4.5 Switch Nomenclature

There are many types of switches available for use in aircraft, and this manual will show the basic types that you may need to use with the VP-200 series. The chart below shows the most common switch types. A parenthesis () around a switch position indicates it is a momentary, spring-loaded position.

Switch Type	Abbreviation	Symbol	Mechanism
Single Pole, Single Throw	SPST		OFF-ON OFF-(ON)
			OFF-(ON)
Single Pole, Double Throw	SPDT		ON-NONE-ON ON-OFF-ON (ON)-OFF-(ON)
Double Pole, Single Throw	DPST		OFF-ON OFF-(ON)

Double Pole, Double Throw	DPDT		ON-NONE-ON ON-OFF-ON (ON)-OFF-(ON)
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4.6 Alternator Current Sensing

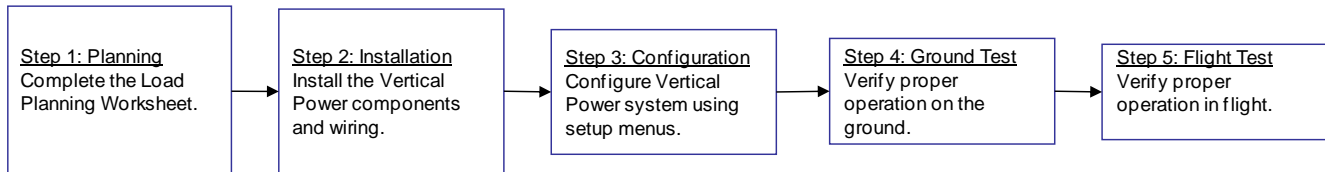
When planning your aircraft electrical wiring you must consider whether to wire an ammeter on the wire connecting the alternator(s) to the main bus. The ammeter will indicate the amount of current the alternator is providing.

Our recommendation is that an ammeter is not necessary when installing the VP-200 series because the functionality built into the VP-200 precludes the need for this. However, if you prefer to install one, the VP-200 series will display the readings. The current sensors (shunts or hall effect sensors) are part of your engine monitor package and are connected to the engine monitor. Currently the Grand Rapids EIS and AFS EFIS (Chelton output) can provide these data.

5 Vertical Power Overview

5.1 Installation

The installation of the VP-200 is accomplished in five main steps, and the amount of work for each step is shown by the relative size of the boxes:



Following these steps will increase the likelihood of a trouble-free electrical system. Each step is described in detail later in this manual. You can optionally swap steps 2 and 3 and set everything up on the bench first.

We recommend that you read through all five steps so that you better understand the system prior to beginning the planning step.

Taking the time up front to carefully plan your electrical system will pay big dividends later on.

5.2 Components

Vertical Power provides the following components for the VP-200:

Display Unit This unit mounts in the instrument panel and is your primary interface. It has five pushbutton soft keys and a rotary knob. The high-resolution color screen is daylight readable and dimmable. Data from an external engine data source and GPS are fed

into the Display Unit. The unit performs high-level functions such as mode determination, audio alerts, and display of device states (on, off, or faulted) and electrical system and engine status. The unit accepts up to eight inputs from external switches each of which can be used to indicate the status of the canopy or baggage door; or act as a remote starter switch or manual override switch for a device. Six serial I/O ports are included as well as an audio output.



Control Unit

This unit mounts behind the instrument panel or in some other location in the cockpit away from water and extreme heat. It has eight connectors that are used to exchange data with other VP-200 series components as well as provide power to electrical devices in the aircraft. A large lug accepts power from the battery (via the battery contactor). The unit can provide 60 amps continuous power to aircraft devices. It handles low-level functions like flap and trim operation, trim speed control, light dimming, soft-start capability, power switching, and circuit protection (over-current, over-voltage, and short-circuit). It checks the status of the aircraft electrical system 50 times per second. There are eight external switch inputs which can be used for flap and trim inputs as well as other external switch functions.



Switch Panel

This unit mounts in the instrument panel and has switches for system power. Three other switches can be configured (via set-up menus) to control any devices, and stick-on labels are included to label the switches. Each switch has a built in LED light to provide status and/or alert information to you. An ambient light level sensor is recessed in the bezel.



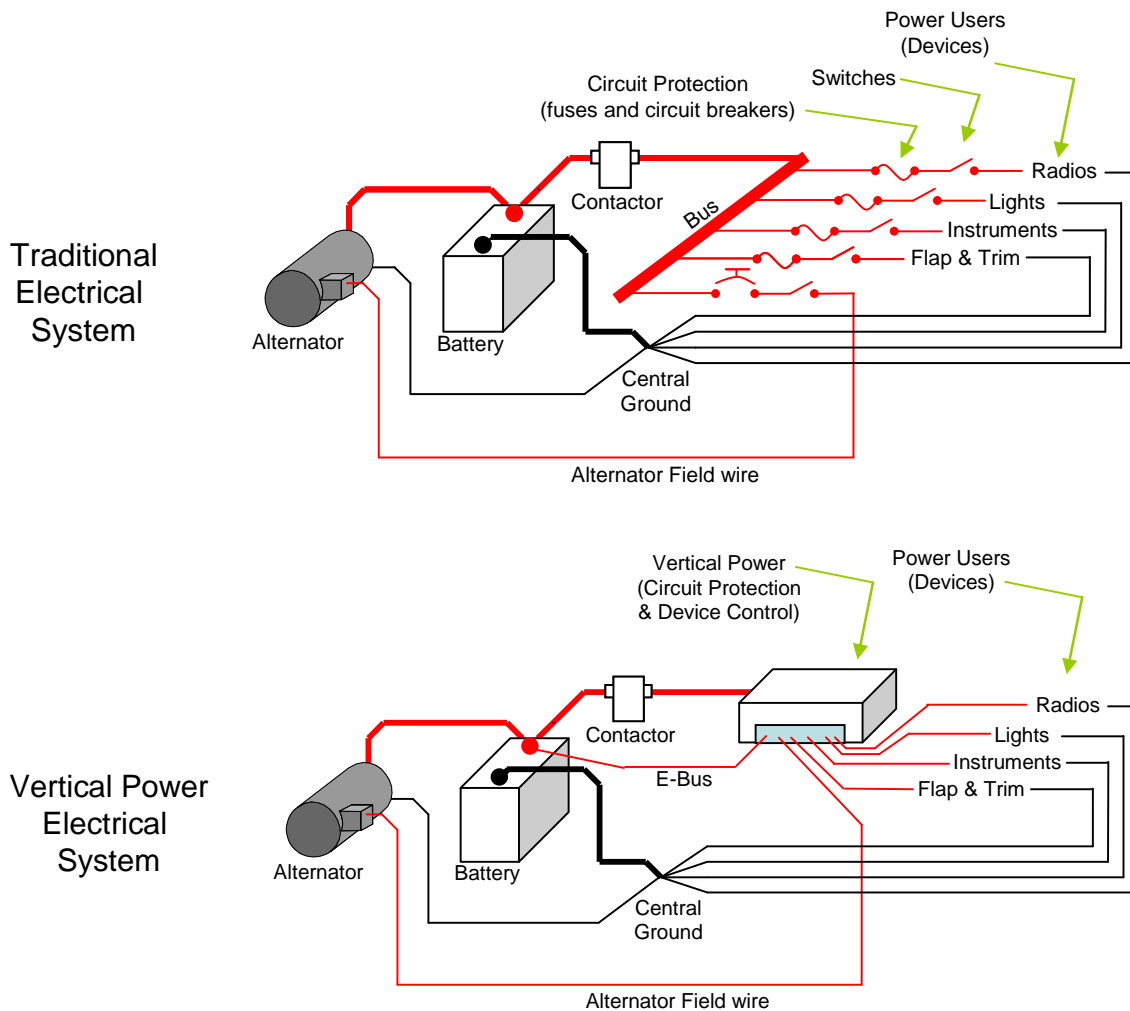
Remote Control

This small hand-held device is similar to a key fob that comes with modern automobiles. It has five buttons. One button turns the VP-200 series on and off, and the other four can be set up to control individual devices in the aircraft.



5-3 System Overview

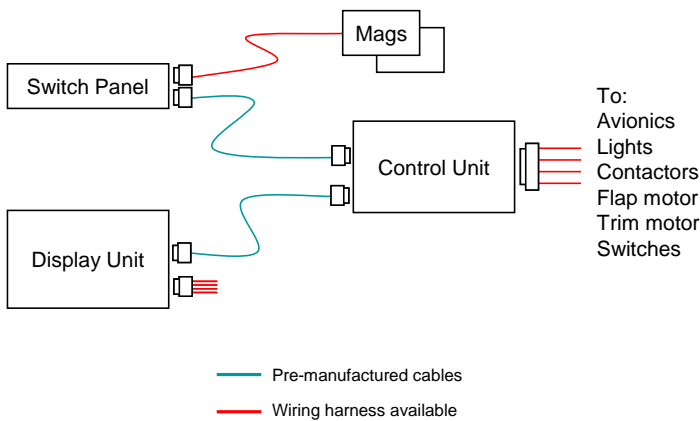
The architecture of the VP-200 series builds upon time-tested methods, yet incorporates modern switching and circuit protection technology. The diagrams below show a basic traditional electrical system compared with a Vertical Power electrical system.



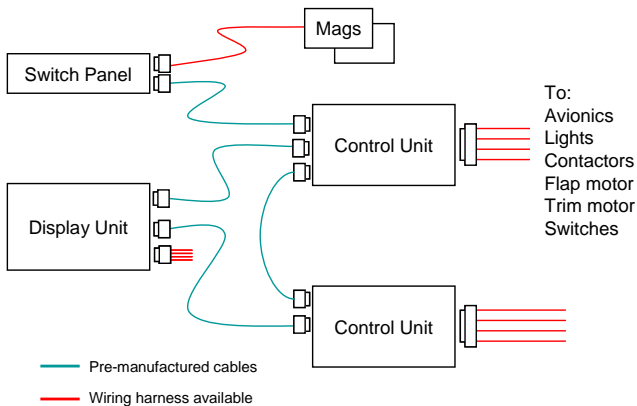
Note from these diagrams that the Vertical Power Control Unit provides both switching and circuit protection, making the task of wiring considerably easier (remember, though, that wiring an aircraft takes careful planning and installation – it should not be trivialized). An Endurance Bus (E-Bus) is “built-in” to the Control Unit, and requires running a single wire from the Control Unit directly to the battery. Although wiring for an internally regulated alternator is shown here, the VP-200 series supports both internally and externally regulated alternators.

These diagrams are simplified to introduce the overall architecture. Detailed wiring diagrams are available on the Vertical Power web site (www.VerticalPower.com). Detailed procedures are shown later in this manual under Section 6.22.

Now let's discuss how the various VP-200 series boxes are connected together. The diagram below shows a single Control Unit system.



This diagram below shows a dual Control Unit system.



The VP-200 series components connect together with pre-manufactured cables which are included with the system. These cables carry data signals and low-current power. You do not need to make any cables to connect the system components together. The connections to the rest of the aircraft are summarized as follows:

1. Connect wires from the Control Unit to the devices, including the main power cable
2. Connect data and optional external switch inputs to the Display Unit
3. Connect optional external switch inputs to Control Unit
4. Connect wires from the Switch Panel to the P-leads on each magneto

5.4 Supported "Backbone" Wiring Configurations

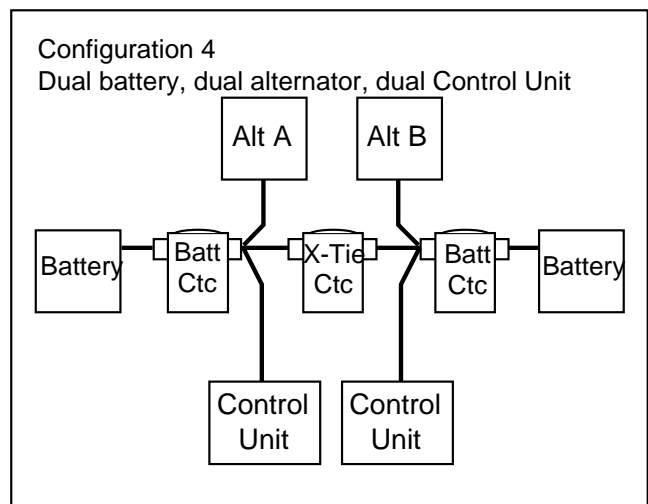
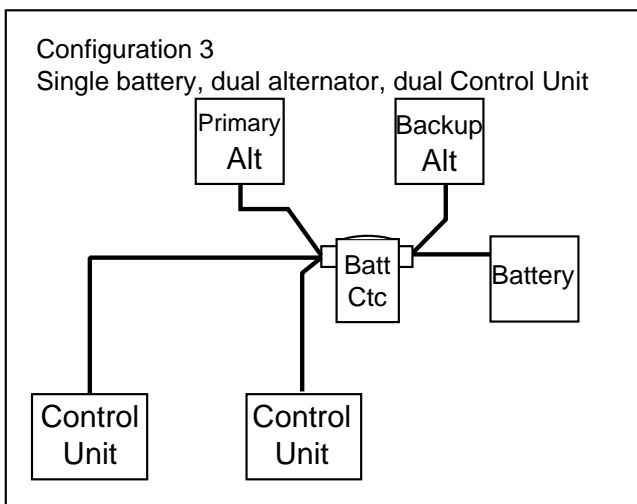
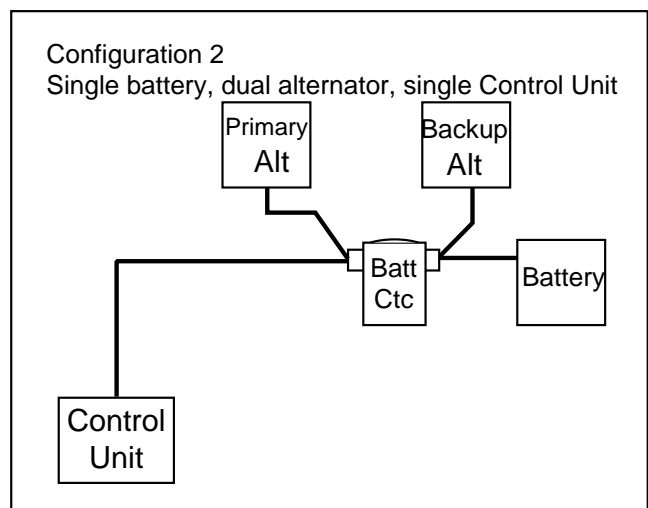
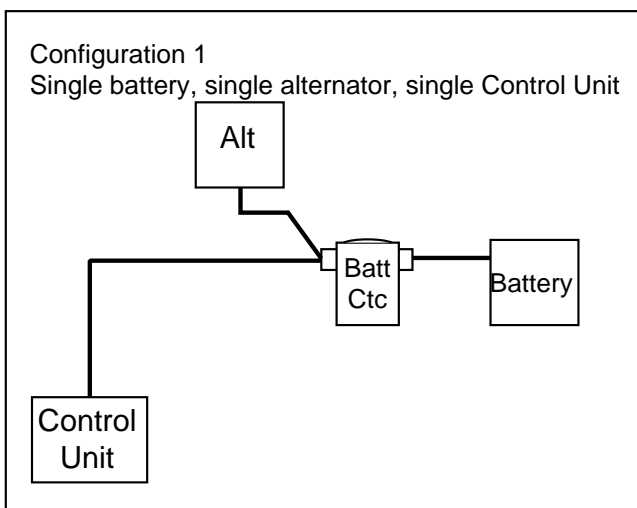
The VP-200 series supports four different backbone configurations, and the setup menus will require that you specify one of them. **The system requires that you wire the electrical system exactly as specified, otherwise failures or unknown behavior may occur.** Take special care to note where each alternator connects to the battery contactor.

Each configuration has considerable flexibility in choosing the type of alternator(s) you want to install. An alternator can be an internally regulated (typical automotive alternator), externally regulated (such as the B&C SD-20, L-40, or L-60), or a permanent-magnet alternator (such as the B&C SD-8).

- Configuration 1:** Single battery, single alternator, single Control Unit
- Configuration 2:** Single battery, dual alternator, single Control Unit
- Configuration 3:** Single battery, dual alternator, dual Control Unit
- Configuration 4:** Dual battery, dual alternator, dual Control Unit, dual independent bus

Vertical Power can support a second battery installed with the Config 1, 2, or 3 systems. If you're installing a second battery for use with a Subaru engine or Lightspeed ignition, reference the respective documents located on the web site under Support -> Documentation. If you're installing a second battery just to have additional backup electrical power, see the "Second Battery" wiring diagram in the same section on the web site.

The diagrams below show the high-level wiring and power interconnections for each configuration. Detailed wiring diagrams are located on the web site.



You may change the configuration in the future as your needs change. For example, if you initially start with single alternator and then later decide to add a backup alternator, you can simply install the new alternator, change the setup menu to configuration 2, and add the wiring to control the new alternator.

6 Step 1: Planning

It is a good idea to spend time on the planning stage whether you are installing a simple or a complex aircraft electrical system. This section discusses many items and considerations that should be incorporated into your planning. At the end of the section, you will be asked to complete the Load Planning Worksheet which documents the design of your electrical system.

Note about feature implementation. Many features described in this manual were available with first product release in 2007. Features that were not in the first release will be added in subsequent releases as part of no-charge future software upgrades. The later features are included herein to help you plan your system and wire for them now. Please contact us directly if you have any questions about a specific feature that you require for your aircraft.

6.1 Wiring Harnesses

Wiring harnesses to connect the Control Unit(s), Display Unit, and Switch Panel to each other are included with the system. These harnesses are complete with dedicated connectors and have no user-accessible functions. Each connector is unique, and therefore it is very difficult to mix up the connectors.

For the harnesses that run from the Control Unit to the devices, you can use a pre-cut and labeled wiring harness from Vertical Power, or you can use a basic connector kit as the basis to make your own harness. The basic connector kit includes special connector housings and pins so that you can build your own wiring harness.

- The pre-cut wiring harness comes with enough individual wires for the average aircraft leaving extra pins available for future use. Each wire has a unique marking making it easy to identify the wire at its far end. You are not locked into the wiring configuration provided, and you may move wires around from pin to pin to suit your needs. The power connectors allow you to very simply remove a wire from its connector and install it in another pin with just a small screwdriver and pin-removal tools. The smaller, d-sub connectors also require an inexpensive special tool to remove the pins. If you require additional wires with pre-crimped connectors, Vertical Power can provide them.
- If you decide to make your own wiring harnesses, please note that pins for the power connectors and d-sub connectors require special crimp tools which are available for rent or purchase from Vertical Power. Do not use generic crimp tools as doing so may result in a poor mechanical connection.

The photos below show the different connectors used in the VP-200 series, the big, higher-amperage power connector on the left and the smaller, low-amperage d-sub connector on the right.



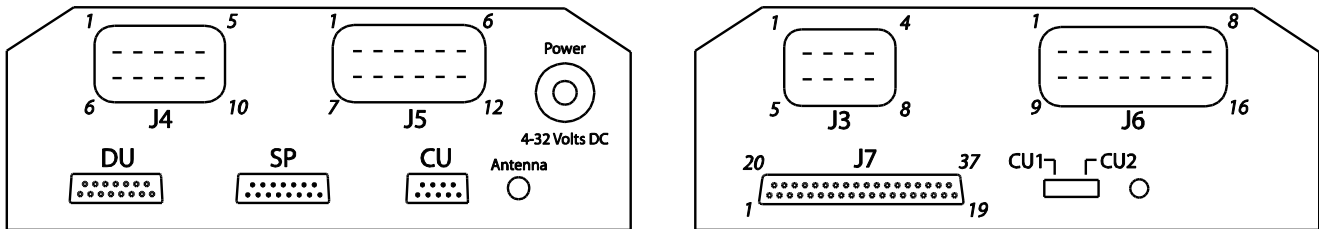
Power Connector



D-sub Connector

6.2 Control Unit Connectors

There are eight connectors on each control unit, five of which connect the VP-200 series to the outside world. The other three are used to connect the system components to each other and have no user-accessible pins. Four of these connectors, identified as J3 through J6, carry high-current loads. The fifth connector, J7, is a D-sub connector used for low-current purposes such as trim motor operation and position feedback. The CU connectors are shown in the diagram below:



Now, refer to the Excel worksheet tab for Control Unit 1.

- The purpose of each pin on the five connectors (J3 – J7) is listed in column B. Most pins can be configured uniquely to support a wide range of loads. However, a few pins (in magenta) have specific purposes such as the flap motor and starter solenoid.
- For connectors J3, J4, J5, and J6 column C shows the maximum current capacity of each pin.
- Connector J7 is for low-power uses (less than 2 amps on a pin). Note that pins for two trim axes and flap control are grouped by color. Ray Allen trim motors have built-in position sensors, and have five wires (three for position and two for the motor power). The wire colors in Column I matches those for Ray Allen trim servos. Use only Ray Allen trim servos. Please contact us if you are considering using a different type of trim motor. Though wiring for flap position runs through Connector J7, the flap motor is driven from Connector J3 (2 wires).

Note that DU and SP connectors are both db15 connectors, but of different gender. When installing the CU to DU and CU to SP cables, please note the gender when “laying in” in the cables.

In a dual CU system, the SP connects to Control Unit 1 only. The SP connector on CU2 is unused.

6.3 Installing and Removing Power Connector Terminals

The large (black) power connectors allow you to easily install and remove the wire/terminal assembly.

6.3a Installing terminals

Step 1: Insert a small screwdriver (max width= 1/8 inch, about 3.0 mm) into either pry point

Step 2: Using the housing as a pivot point gently pry out on the white insert, until it reaches pre-lock position (5.0 mm travel)

Insert screwdriver



Gently pop up white section



Before



After



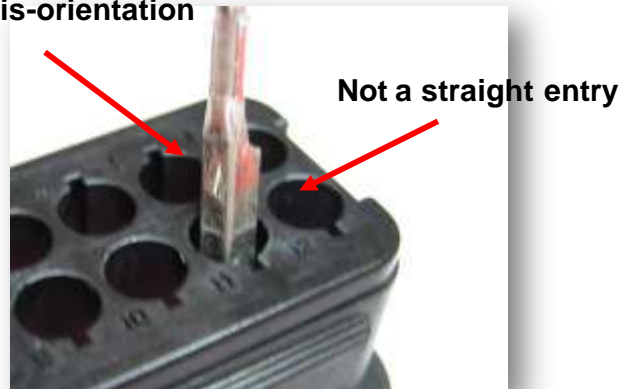
**The white insert should never be removed!
If it is removed, discard the entire connector. Do not attempt to re-assemble.**

Step 3: With the white insert still in the 'out' position, align the terminal to rear of connector. Align the orientation feature as shown and insert through appropriate opening. If resistance is encountered, retract the terminal and adjust the angle of insertion. Continue inserting the terminal until it stops with an audible click. Give the wire a slight tug to make sure it is seated properly. It should not come back out.



Orientation feature aligned with index

90° mis-orientation



Troubleshooting:

The terminal should insert smoothly into the connector housing. If it does not, the following are the most likely causes:

- The terminal is rotating while you are inserting it. The terminal must remain aligned until it is fully inserted.
- The tangs on the insulation crimp may not be fully closed. Gently squeeze the tangs closed around the insulation with a pair of pliers.
- The white insert may have closed. Open the insert.

Step 4: With the terminals fully installed, the white insert can be seated into its final lock position by applying an even force to both ends until it comes to a stop, with an audible click. The white insert should move a distance of 5.0 mm (about ¼”).

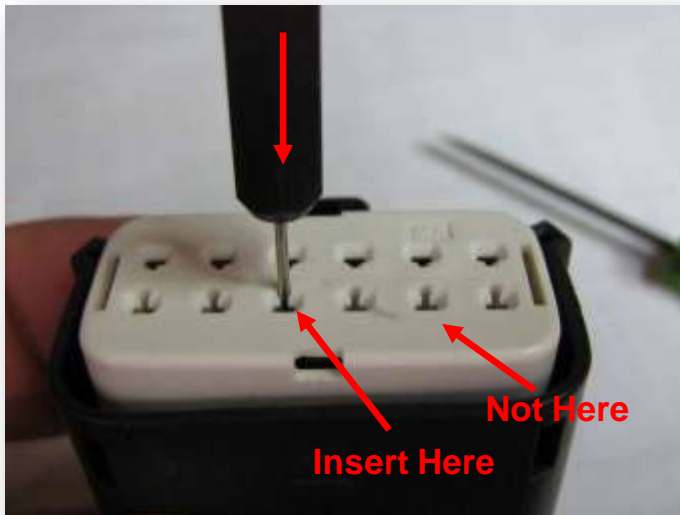
6.3b Removing terminals

Steps 1 & 2: Follow these steps as shown above to raise the white part of the connector.

Step 3: Using the pin removal tool, insert the tip into the terminal service hole adjacent to the terminal to be serviced.

Step 4: Push down gently to release locking finger. You will hear a gently click. **Do not apply any lateral force, as this may damage the connector or the terminal!**

Step 5: With the white insert still in the ‘out’ position, gently pull on the wire to release the terminal. If the terminal resists, the service tool may not be fully engaged. Remove the tool and re-try. Push the service tool further into the service opening to ensure that it has fully disengaged the locking finger.



Do not insert the tool into the terminal opening!

Do not use excessive force, excessive force can damage the connector!

Step 6: The white insert can be seated into its final lock position by applying an even force to both ends until it comes to a stop, with an audible click. The white insert should move a distance of 5.0 mm (about ¼”).

6.4 Display Unit Connectors

The Display Unit has three d-sub connectors on the back, as well as a USB connector. J1 and J2 are used to connect the Display Unit to the Control Unit(s) with the cables provided. J3 is for external connections as described below:

- J3 is a 37-pin d-sub connector that connects to serial devices, external switches, and external audio systems.
- The RS-232 serial lines are in pairs labeled RX (receive) and TX (transmit). A receive pin on the Display Unit is wired to a transmit pin on the other device. Serial lines are used to exchange data with the Engine Data Unit, GPS receivers, EFIS units, and other devices with serial interfaces. To exchange data between two boxes, a minimum of two wires are needed. One signal and one ground wire. The TX and RX wires are signal. The ground from the other box (GPS, EFIS, etc.) must be grounded to the same place as the Control Unit grounds.
- The Display Unit provides amplified and line (non-amplified) audio outputs. Typically, the amplified output is wired to the un-switched audio input of an audio panel. Do not wire any of these outputs to a music input connection on an audio panel. The un-amplified output is used with some intercom systems. Check with your intercom or audio panel manufacturer for specific details.

6.5 General Wiring Considerations

The following considerations should be followed when designing your electrical system:

- Place all landing and taxi lights on 18A pin, regardless of their actual current draw and wire size. Only one landing or taxi light should be wired to a pin. HID can be placed on a 10A too.
- Interior lights should be on a dimmable circuit, unless you want to add an external dimmer knob, in which case any power pin will provide bus voltage to the dimmer.
- The eight external switch inputs on the CU or DU can be used for trim and flap actuation switches, flap limit switches, canopy or baggage door position switches, or other inputs described later in this manual. Any device can be switched on and off using a switch wired to these inputs. These inputs are active when grounded. Simply wire one side of the switch to ground and the other to a pin. Use the setup menu to configure the function of the pin. See 6.8 *External Switch Wiring Considerations* for more details.
- Flap motor, starter, cross-tie contactor and battery contactor **must** be wired to the pins shown in the worksheet. They are highlighted in magenta.
- There are three ground wires (highlighted in black) for each Control Unit. EACH ONE must be connected to the firewall ground bus.
- J4 Pin 1 (highlighted in red) on a Control Unit should be connected to a 20A slow-blow fuse (included) and then directly to the aircraft battery. Replace this fuse only with a Bussman MDA-20 fuse.

6.5a VP-200 Duo (Dual Control Unit) Wiring Considerations

When installing VP-200 Duo system, the following points should be considered:

- If an avionics component has dual redundant power inputs (such as the Grand Rapids Technologies EFIS or Dynon EFIS), each power input should be wired to a different CU. When setting up that device in the setup menus, each power input pin should be assigned to the same device so they are turned on and off together. For simplicity (but not required), use the same pin on each CU.

- Some avionics equipment have two power inputs but each is for a distinct function. Do not split these power inputs between two Control Units. For example, a Garmin 430 has a nav power and a comm power input. These should be wired to two separate pins on the same CU.
- All wires for a particular trim or flap system must go to the same CU. Example: ALL position, motor power, and switch input wires for the pitch trim servo must be connected to a single CU, not split between two units. You can put pitch trim on one CU and roll trim on another. The same restriction applies for flaps. Do not split the power, position feedback, and switch input connections.
- If a device has a single power input, it should go to only one pin on one CU. Do not split the power wire and run a lead to each Control Unit.
- Spend some time planning possible failure modes and divide the devices between the two control units. For example, if you have two comm radios, put one on each CU. If you have a taxi light and a landing light, put one on each CU.
- The Device List will show when a CU has failed and you have a clear indication as to which devices are no longer controllable. You can select a specific device and the detail display will show which CU and pin the device is attached to. Note that a CU failure indication means that communication between the DU and CU has failed, and does not necessarily mean a device will turn off - it only means that a device is not controllable. The most likely failure mode is that the device remains in the state (on or off) it was in at the time of failure.
- **Configuration 3 Considerations:**
 - The battery contactor must be connected to J5 pin 5 on both Control Unit 1 & 2, so that either Control Unit can close the contactor. See wiring diagram.
 - The primary alternator must be connected to CU 1, and secondary alternator must be connected to CU 2. See wiring diagram.
- **Configuration 4 Considerations:**
 - Bus A battery contactor must be connected to Control Unit 1, and Bus B battery contactor must be connected to Control Unit 2. See wiring diagram.
 - The Bus A alternator must be connected to CU 1, and Bus B alternator must be connected to CU 2. See wiring diagram.
 - Control Unit 1 should be on the larger capacity bus (larger alternator) and CU2 should be on smaller capacity bus. This is because the starter is connected to CU1. Carefully plan the loads so that CU2 does not draw more than 80% of the rated output of the alternator. Do not worry about load shedding issues, as the system will reconfigure itself to drive the correct devices from the remaining alternator during a load-shed condition.
 - Be sure to run a wire from CU J5 pin 6 on EACH CU to the x-tie contactor.
 - Adjust the voltage regulator on Bus B to be about 0.3 volts below that of Bus A. Doing so will cause the devices which have redundant power inputs on each bus to draw from Bus A during normal operations.

6.6 Alternator and Voltage Regulator Considerations

Choosing the correct alternator and voltage regulator is an important part of planning your electrical system. The VP-200 series supports internally and externally regulated alternators, as well as the B&C SD-8 permanent magnet alternator. Vertical Power does not take a position regarding which type or brand of alternator is best.

This section is intended to present information to help you make a better decision about alternators and voltage regulators. Specifically, the VP-200 series has certain advanced functionality that may alter how you select alternators and voltage regulators.

The typical automotive-style voltage regulator does simply that – regulates the voltage to the field wires on the alternator. Varying the field voltage affects the output capacity of the alternator. Higher voltage means a stronger field to generate current which means more output. An internally regulated alternator provides the same function, but the regulator is housed in the alternator itself.

Certain internally regulated alternators provided by Plane Power, Ltd. (www.plane-power.com) have built in over-voltage protection. All alternators built by Plane Power are compatible with the Vertical Power system.

Externally-regulated alternators have the regulator in a separate box outside the alternator. Most voltage regulators provide only the voltage regulation function, and some allow you to adjust the voltage level. The B&C LR-3C (www.bandc.biz) external voltage regulator provides three functions: 1) voltage regulation, 2) under-voltage alerting, and 3) overvoltage protection. It is generally regarded as a high-quality product that has been through years of field experience. Note: B&C does not recommend the LR-3C be connected to PTCs for circuit protection. The VP-200 series does not use PTCs for the power circuits and is compatible with B&C voltage regulators. The under-voltage alerting is not needed as it is provided by the VP-200, and over-voltage protection is also not needed but acts as a redundant backup and cannot be disabled.

There is a long-standing and unresolved debate in the experimental community about the benefits of internally versus externally regulated alternators. The table below shows some of the pros and cons of each type:

	Pros	Cons
Internally regulated	<ul style="list-style-type: none"> • Simple to wire • No external boxes 	<ul style="list-style-type: none"> • Certain failure modes will cause over-voltage condition that cannot be stopped by removing power from the field wire*.
Externally regulated	<ul style="list-style-type: none"> • Separation of VR from alternator, and each can be serviced separately. • Removal of power from regulator shuts down alternator. 	<ul style="list-style-type: none"> • Extra box to install and wire • Extra cost and weight

*Note: According to Plane Power, their internally regulated alternators are designed to eliminate this failure mode.

Some common backup alternators (or second alternator in a dual bus system) are the accessory-drive mounted SD-20 alternator and the SD-8 PM alternator, both available from B&C Specialty Products. The one you choose is driven in large part by the size of the loads you need the backup alternator to carry. Documents are available on the Vertical Power website with details for wiring either one.

6.6a Over-voltage Planning

An over-voltage condition is initiated by a failure in either the voltage regulator or the alternator which causes the voltage to rise above a safe level for the avionics and other electrical equipment. Typically the over-voltage level is set at 16.0 volts for a 14v system and 32.0 volts in a 28v system.

Over-voltage protection is provided by the Control Unit, and therefore an external device is not needed for this function. Over-voltage protection is provided by removing power from the Field wire when the bus voltage exceeds a pre-set limit for a pre-set period of time. If your system comes with an overvoltage protection circuit, the Vertical Power system is compatible with “crowbar” type circuits. These simply short the alternator field wire to ground, causing the field circuit breaker to pop.

Nuisance over-voltage trips can be caused when a large inductive load (like a hydraulic pump motor) shuts off and the voltage regulator has not had time to respond. It is in full-charging mode and with the load removed, the voltage can spike. Both the over-voltage level and the time duration can be adjusted in the Vertical Power setup menus to reduce nuisance trips.

In certain rare instances, when using an internally-regulated alternator, the overvoltage condition cannot be remedied without physically disconnecting the large power wire (called the B-lead) from the alternator to the main bus. If you choose, you may add a contactor in line with the B-lead (call us if you decide to do this), but this adds additional complexity and failure points. And, it does not protect the alternator from possibly destroying itself during an over-voltage condition. We instead recommend using an externally-regulated alternator or an internally-regulated alternator that does not have this failure mode.

6.6b Low-voltage Planning

During flight, the normal bus voltage should be around 14.2 volts. You can set two separate low-voltage alert levels: one with the engine stopped and one with the engine running. The low voltage alert trigger (engine running) is recommended to be set at 13.0 v (double all figures for a 28v system), and at 12.0 volts (engine stopped). A low voltage condition is most likely due to one of the two following circumstances:

1. The alternator has failed causing the bus voltage to drop from 14.2v to 12.4 volts or less (double for a 28v system).
2. The electrical loads on the aircraft exceed the capacity of the alternator, which is unable to keep the battery fully charged. The bus voltage will slowly decline until the low voltage alarm is triggered.

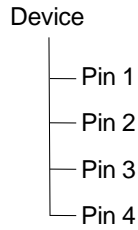
You do not need to wire an external under-voltage alert light or system. The VP-200 series provides under-voltage alerting, both visual and aural, and is pre-configured to switch to a backup alternator or bus, and load shed electrical devices.

Further information about load shedding and low voltage alarms is described later in this manual and in the Operating Manual.

6.7 Devices and Pins

A powerful feature of the VP-200 series is the ability to assign one to four pins to a device. This gives you a lot of flexibility in choosing how you manage loads together. In this section, we’ll list several examples that illustrate the concept and provide guidance on how you should plan your system.

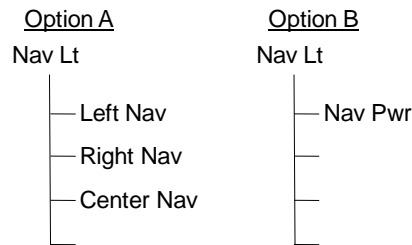
Each device and each pin is given a name in the setup menus. The *Device* is the “top-level” name that is displayed in the Display Unit screen. The *Pins* are the physical pins on the Control Unit that provide power to the device. Each Device has four “slots” to which you can assign pins as needed. The setup menus follow the following format:



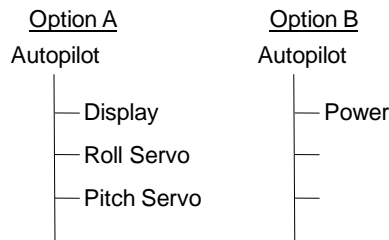
Consider the following factors when planning whether or not to group loads:

- Do you want to know the status of each individual load?
- Do you have enough pins for all the loads?
- If several loads are on a single pin, and one of the loads shorts, the entire circuit will shut off. If they are on separate pins, then only the faulted load will shut off and the other pins will remain on.
- Make sure that the circuit breaker value is sized to the smallest wire in a group of wires.
- Are you going to enable an backup circuit? If so, may want to gang the wires together on a single pin.

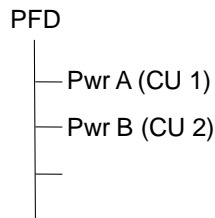
Example 1: Hooking up nav lights. Assume a left, right, and tail nav light. Option A shows each light wired into a pin, Option B shows the wires bundled into a single pin.



Example 2: Hooking up an autopilot. Assume a pitch servo, roll servo, and control head. Option A shows each load wired into a pin, Option B shows the wires bundled into a single pin.



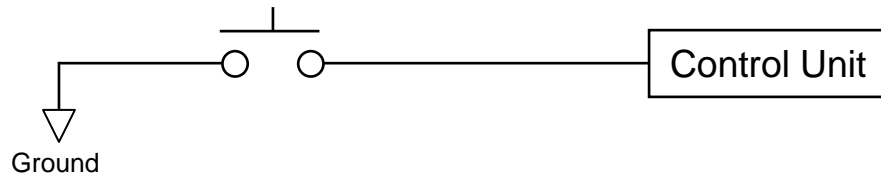
Example 3: Hooking up a PFD that has two power inputs, and each input is wired to a different CU in a dual CU (VP-200 Duo) system. The pins will turn on and off together, yet power is provided from two separate sources.



6.8 External Switch Wiring Considerations

The Display Unit and each Control Unit have eight input pins for optional external switches. The current for the devices being switched does not go through these switches. These switches simply tell the computer that the circuit to ground is closed, and the VP-200 series then tells the Control Unit to switch the device that you have configured on or off. Wire each switch so that one side goes to ground, and the other side goes to the input pin on the CU or DU. Any switch of your choice may be used since you are not limited to high-current switches. The switches carry only a few milliamps of current. The function of that pin is determined using the setup menu.

An example of a momentary switch wired to an input pin is shown here:



There are a variety of vendors that supply switches. Engraved rocker switches can be found at: http://www.engravers.net/aircraft/rocker_switches.htm .

External switches are optional, but most builders install external switches to operate the trim and flaps. These switches are the same ones used with conventional wiring. Each external switch can be assigned to one of the following functions:

CU Inputs

- Pilot Trim (pitch, roll, yaw)
- Co-pilot Trim (pitch, roll, yaw)
- Pilot Flaps (U, D)
- Co-pilot Flaps (U, D)
- Flap limit switches (U, D)
- User-selectable Device On
- Gear transition (J5, pin 11 or 12)
- Starter button (CU1 J5, pin 11 or 12)
- Annunciator input

DU Inputs

- Co-pilot trim (pitch, roll, yaw)
- Gear down switch (Left, Right, or Center)
- Gear up switch (Left, Right, or Center)
- User-selectable Device On
- Annunciator input
- Co-pilot flaps

There are 8 inputs on the Display Unit located on J3, pins 1-8. 8 inputs are also located on the Control Unit, J7, pins 16-19 and pins 34-37.

Certain functions can be triggered when a pin goes high, i.e. it goes to bus voltage rather than going to ground. Such inputs should be wired to the Control Unit, J5 pin 11 or 12. Their function can then be configured in the Setup Menus later.

6.8a Annunciator inputs

The VP-200 allows you to create your own annunciator displays on the screen to show when a certain condition exists. Rather than having a row of lights that are fixed to certain functions, you can configure the wording, color, voice alert, and the behavior of each annunciator. Each one shows up as a highlighted rectangle on the VP-200 display.



Example annunciators

These are typically used to alert a condition that can be detected by an external micro switch such as an open canopy, cabin door, or baggage door. Or such things as the Lasar ignition light or a chip detector light. The annunciators can be activated by a pin going to ground (pins on CU J7 p15-19, 34-37 or DU J3 p1-8) or a pin that is normally grounded then becomes un-grounded to activate the annunciator. Further, an annunciator can be triggered by a pin going to bus voltage (CU J5 pin 11 or 12). You can use the bus voltage input for something like a canopy seal pump annunciator or a starter engaged annunciator.

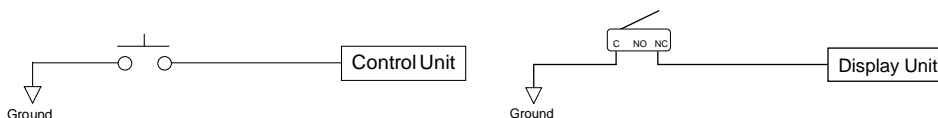
Annunciators for things like low voltage, over-voltage, cross tie, and starter are no longer needed as they are displayed elsewhere on the VP-200 display.

Some third party products may not be able to activate the discrete inputs (such as the LED control on the Gretz Aero GA-1000 – please call and ask about a low-cost adapter to make this work properly). Please contact us if you are not sure about the compatibility of your product. 20 milliamps are required to pull down the discrete inputs.

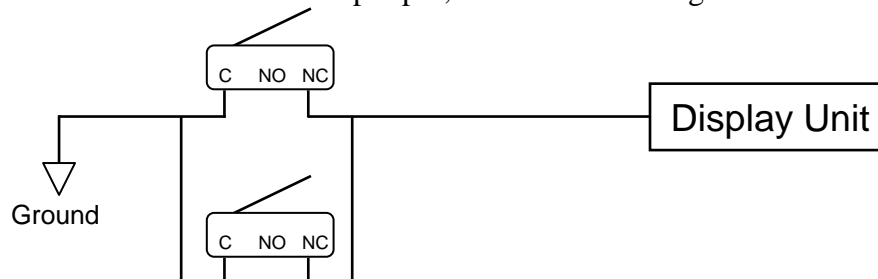
Each annunciator can be configured in the following ways:

- Name that is displayed
- Color
- Select which modes the annunciator is active
- Voice alert ‘beep- beep’ – yes or no
- Latching behavior – is it latched on when triggered or only on when the trigger is active
- Flashing - yes or no
- Does it trigger the master warning light – yes or no

Below are examples of external input switches wired to the active ground inputs.



Several switches can be wired to the same input pin, as show in the diagram below



Examples:

1. Set an annunciator labeled ‘Starter’. It will show whenever the starter is engaged.
2. Set an annunciator for the canopy, doors, or baggage door.
3. Set an annunciator for the Lasar ignition, Gretz Aero (call us) heated pitot tube, etc.

6.8b VR Avionics TSLM for turbine engines

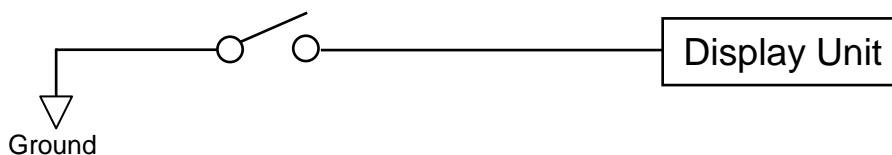
The TSLM has a serial data output over which the TSLM indications are sent to the VP-200 Display Unit, eliminating the need to wire discrete annunciators. See the *Turbine Supplement* document and wiring diagram in the documentation section of the Vertical Power web site for additional detail.

6.8c Wiring an external switch to control a device

External switches can be used to turn devices on and off. These inputs are provided to allow additional manual switching capability over and above the three switches installed on the Switch Panel. Before wiring these up, carefully determine whether you actually need the switches, or whether the mode-based switching is sufficient. Remember that any device can be turned on and off at any time from the Display Unit – it just takes several seconds to scroll to the device on the screen.

Each pin can be assigned to one or more devices using the set-up menus. When the input pin is grounded, then the device(s) turn on. If a pin that corresponds to a device is NOT grounded, then that device is generally going to be in Automatic state.

Example: Use a 2-position SPST OFF-ON switch to turn a device on. When the switch is off, no pin is grounded and the device is in Automatic state. When on, an input pin is grounded and therefore will turn a device to manual on.



You can use any external input pin on the CU or DU.

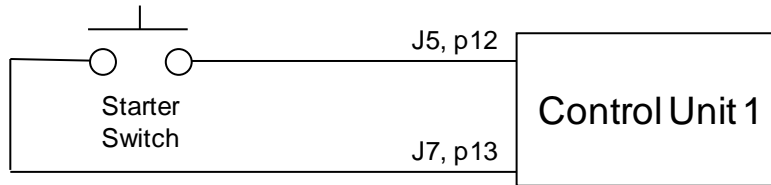
6.8d Wiring an external starter switch

Wiring an external starter switch is slightly different than wiring other external switches. This is to provide additional safety measures against inadvertent activation.

The Starter soft key, which is displayed during Start Mode and certain emergencies, provides normal activation of the starter. The starter can also be activated from the device menu by selecting the Starter item and then pressing the momentary ON button on the soft keys. However, it might be convenient to install a starter pushbutton located in a position that affords easy operation. During operation, the external starter switch is only active once the starter unlock code has been entered.

NOTE: Although it is optional, we recommend that an external starter switch is installed so that the starter may be engaged at any time.

Wire one side of the switch to the keep alive pin (J7 pin 13). Wire the other side of the switch to CU1, J5, pin 12. These both must be wired on Control Unit 1.

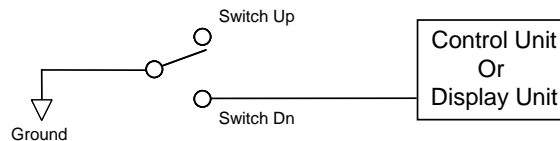


6.8e Autopilot wiring

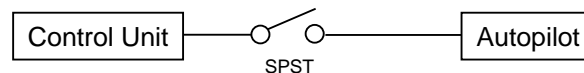
Depending on your aircraft and type of autopilot, you may want to have the ability to quickly disconnect power from the autopilot system. You may alternatively disconnect the autopilot by turning off power from the Device List on the Display Unit, but that can take several seconds. Wiring the autopilot may be accomplished in several ways, three of which are shown below:

Autopilot option 1: configure one of the three switches on the switch panel to control the autopilot Device. This allows you to easily flip the switch down and remove power from the autopilot circuit.

Autopilot option 2: configure one of the eight external switch inputs to turn off the autopilot device. This allows you to easily flip the switch down and remove power from the autopilot circuit. Wire it so that when the switch is up, no connection is made to a pin. When the switch is down, the pin is grounded. Set the pin to turn the autopilot device OFF when grounded.



Autopilot option 3: wire a switch in line with the power wire between the Control Unit and the autopilot. Wire the switch so that when up, the circuit is closed, and when down, the circuit is open. Note: Use an SPST switch sized for the current load of the autopilot.



6.8f Backup Circuits

The backup circuits allow you to wire backup power directly from the battery, through an external fuse and switch (separate from the VP-200 series), and then to the device. Each circuit can provide backup power to a device regardless of whether the switch internal to the Control Unit is on or off.

If you are wiring a backup circuit for an alternator, be sure the alternator or voltage regulator has built-in over-voltage protection. The backup circuit bypasses the OV protection built into the CU.

There are three different methods to wire backup circuits (simply called method A, B, C):

Backup Method A

Use when each circuit needs a 5A breaker or less. Two circuits are available and described below:

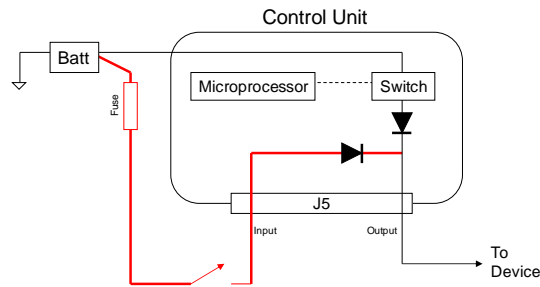


Figure 1: Overview of a single backup circuit

Each CU has two independent backup circuits, labeled Backup A and Backup B. You may wire one, both or none of the backup circuits. Power for Backup A comes in from the battery into J5 pin 9, and provides power to J5 pin 3. Power for Backup B comes in from the battery into J5 pin 10, and provides power to J5 pin 4. J5 pin 3 and 4 operate the same as other power pins, except when power is applied to the input pins (J5 pins 9 and 10, respectively).

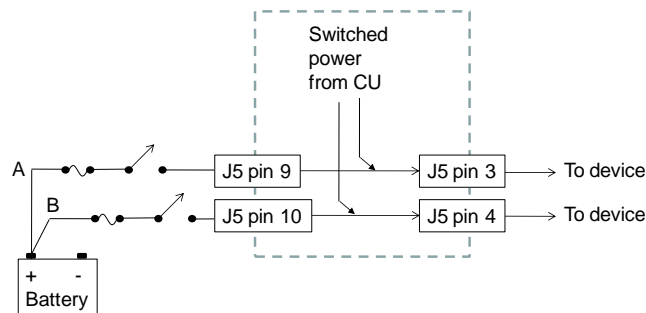


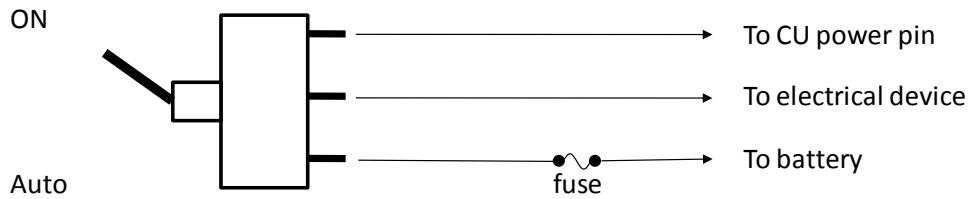
Figure 2: Two independent Backup circuits

As shown in the figure, when the external switch is turned on, fused power is provided directly from the battery to the device, and is electrically isolated from the computer-controlled part of the Control Unit. Regardless of the status of the battery contactor or microprocessor-controlled switch, power is provided to the device. The Device List on the DU will indicate that the external switch is on. **When battery power is switched on, there is no break in circuit continuity and therefore this option is appropriate for AHRS, EFIS, GPS, etc.**

Additionally, the Display Unit will indicate that each backup circuit is active, and alert you if the switch is left on after you shut down the engine. The intent is to use this circuit for devices that you may consider critical such as an EFIS or ADAHRS. Wiring these circuits is optional.

Backup Method B

Use when the 5A circuits (method A) are filled, or when you need more than 5A capacity. Backup capability is the ability to provide power to an electrical device independent of the switching internal to the Control Unit. Unlike the backup circuits (method A) built into the Control Unit, this type of circuit will not alert you if left on after engine shutdown or show any indication on the display that it is on.



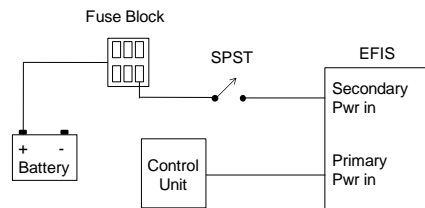
How it works: the switch is normally left in the Auto position, which provides switched power from the Control Unit to the electrical device. When the switch is moved to the ON position, uninterrupted power is provided directly from the battery to the electrical device. Make sure the switch and fuse are appropriately rated for the load and wire size. **When battery power is switched on, there is a break in circuit continuity** and therefore you should turn these on at the start of an IMC flight for devices like AHRS, EFIS, GPS, etc. Other devices like boost pump and lighting can cycle power without issue.

Example: You want to add backup capability to the boost pump, but it requires a 10A circuit. Wire the boost pump to a 10A circuit on the CU via a switch as shown above, and bring in a wire with a 10A fuse directly from the battery.

The documentation section of the web site includes a diagram showing how you can use the backup circuits to wire a “get home” backup system.

Backup Method C

Many modern EFISs have multiple, diode-isolated power inputs – typically a primary and a secondary power input. The diode isolation ensures that each power input is “independent” of the other power inputs. Method C allows you to wire a backup circuit into the secondary power input on the EFIS (or other device if that is the case) directly from the battery through a fuse and a switch. The EFIS will automatically choose between the inputs and select the one with the highest voltage. You must note to turn the switch(es) off at the end of a flight, and no alarming is provided by the VP system.



Wire a fuse or fuse block near the battery. Size the fuse for the wires and as per recommended by the EFIS manufacturer. Then wire to an SPST switch. The switch should be labeled Auto (down) and On (up). When the switch is off, power will be sourced from the VP Control Unit. When on, power will be sourced from either the battery bus directly or the VP Control Unit. If the CU fails, then the EFIS still has power from the backup circuit.

Backup Circuit Considerations

There is a great deal of subjective decision making that goes into determining the number of backup circuits to wire. Backups are not uncommon in other systems on the aircraft. For example, the old vacuum-drive attitude indicator had an electric turn and bank instrument for backup. A modern glass EFIS is often installed with backup altitude, attitude, and airspeed round-dial gauges. You have two magnetos for redundancy, and if one fails in flight you can safely land at a nearby airport. But, if one fails on the ground you would not likely takeoff with only one operating.

On one hand, backup circuits add more redundancy, but on the other add more complexity and failure points. Ultimately, you as the builder should do what you are most comfortable with based on your mission and aircraft. Here we will provide a few data points to help in your thinking and planning. They are not absolute or regulatory, only suggestions for thought.

There are two types of failures to consider. One type of failure prevents you from flying. The other type of failure occurs while you are flying and may be harmless or could require you land at the next opportunity.

With regard to failures that keep you from flying: there are many single-points of failure that exist on aircraft today. Would you start the engine or take off if any of the following conditions existed:

- Failed EFIS, AHRS, or engine monitor?
- Failed ignition or magneto?
- Leaky brake o-ring or tire inner tube?
- Starter failure causing you to hand-prop the engine?
- Failed alternator or battery contactor?

The point is there are many single points of failure that can keep you from flying, and the safest thing to do is fix the problem while you are on the ground. It's common sense to always have a Plan B if your plane breaks while you are away from home. With that in mind, the VP-200 should not be thought of any differently than any other component that may ground you if it fails. While you can wire backups for the master switch, starter, and alternator field to get you home, it may be overkill considering that there are many other components on the plane that are likely to ground you as well. Do you have two sets of engine instruments installed, including dual sensors for everything?

The other failure mode occurs when you are in flight. Perhaps the most critical is a backup for the attitude source. The others will depend on your mission and whether you carry a backup comm radio and/or backup GPS receiver. If you fly only VFR or have battery backups built into the EFIS system, then backup wiring may not be necessary. If you fly IFR, then critical circuits should be protected by backups and engaged prior to entering IMC conditions.

Switches for backup circuits engaged regularly prior to entering IMC conditions should be located on the instrument panel or in an easy-to-reach place. If you choose to wire backups such as a master switch, alternator field, and starter, these can be placed in a hidden location as you would not expect to use them except in the case of a system failure and while on the ground.

Aft-mounted battery considerations

If the battery in your aircraft is mounted in the aft section of the aircraft, you must take special care to route the backup switch wiring because the routing is longer than for front mounted batteries. You may want to consider running a slightly larger wire to account for the additional length. FAA AC 43.13-1B includes a chart (figure 11-2) to determine the wire size.

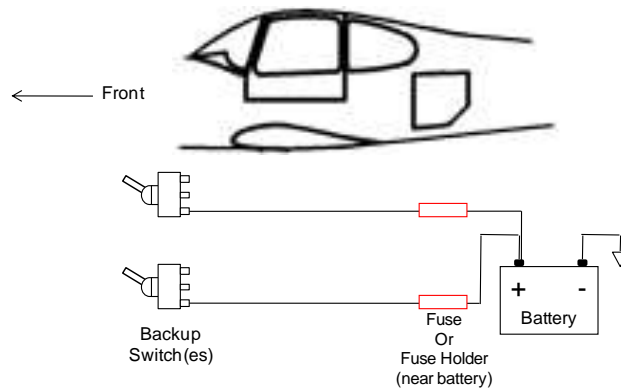
Another consideration is that the relatively long length of wire must be protected from short circuits. There are two options to choose from:

1. run each backup wire to the back, and to an individual fuse in a fuse block. Have a fuse block in back with a short wire (perhaps 12ga) to the battery. You don't need to protect the 12ga wire because it is so short. If a wire running to the front shorts, you lose just that circuit.

- run a larger wire from the back to the front. Install a larger fuse in the back to protect the long run to the front, then smaller fuses in the fuse block up front for each backup circuit. However, if the larger fuse blows all the backups fail in one shot.

Keep in mind these are backup circuits and normally only used when the primary switching method fails. Choose the option that works best for your mission and personal assessment of merits of each.

The diagram below shows the relative layout of the backup circuit components. Note that the fuses (or breakers) are in the back near the battery, providing protection for the wire run forward.



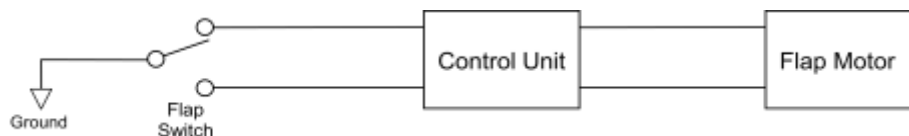
6.9 Flap System Wiring

You can wire a flap switch for the pilot and, optionally, one for the co-pilot. The flap switch should be an SPDT momentary action switch (ON)-OFF-(ON), with a middle OFF position. You can use a switch with a locking UP latch, just be sure to configure it as such in the flap section of the setup menus.

The flap switch has three pins: a common, and one to command flaps up and one to command flaps down. The pilot and co-pilot switches should be each wired separately if you want to have the option of disabling the co-pilot switch from the Options menu on the Display unit. Otherwise, they will always work together.

Both flap motor pins on the Control Unit (J3, pins 1 & 2) are wired directly to the flap motor. See the *Flap & Trim Wiring Diagram* on the web site.

The pilot's flap switch, flap position sensor, and flap limit switches should all be wired directly to Control Unit 1.



The flaps can also be controlled from the Device List using the soft keys.

RV flap system: Do not install the Van's Flap Positioning System (FPS). If you want intermediate stops or flap position feedback on the Display Unit, install a Ray Allen POS-12 position sensor, available from <http://www.rayallencompany.com/products/indsens.html>.



This sensor is wired to CU#1, J7 pins 10, 28, 29 (see Load Planning Worksheet).

You can purchase a clevis/pushrod kit from your local hobby shop, as the Ray Allen kit is not for use with the POS-12.

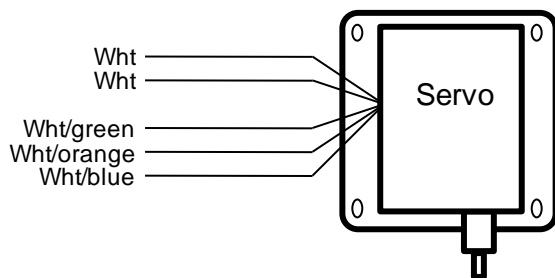
Lancair flap system note: reference the Lancair Flap wiring diagram (available on the VP web site) for instructions on wiring a Lancair Legacy/ES flap motor with limit switches and position sensor. Lancair IV uses a hydraulic flap system and is not controllable by the VP-200. Rdd Enterprises (www.rddent.com or 541.504.0305) sells an electric flap system for the Lancair IV-P, allowing greater control of the flaps and fewer hydraulic lines. However, you can install a flap position sensor (connected to CU1) to display the flap position on the DU.

Note on flap limit switches: limit switches should be wired in the normally closed (NC) position, meaning that the switch OPENS when the limit is reached. Limit switches are not normally needed (such as in RVs) unless the aircraft kit manufacturer specifically calls for them (Lancair, for example).

6.10 Trim System Wiring

Most experimental aircraft use pitch, roll and yaw trim servos from the Ray Allen Company (<http://www.rayallencompany.com>). These servos are self-contained units that include the trim motor as well as a position sensor. These servos are designed to run at 14 volts, and the Control Unit provides regulated 14v power to the trim motors so they can operate safely in 14v or 28v systems. The general principles described in this section apply to other brands of trim motor as well.

The Ray Allen trim servo (models T2-7A-TS, T2-10A-TS, or T3-12A-TS) has five 26ga wires, as shown in the diagram below:



The trim motor itself is driven by the two white wires. It does not matter how they are connected, as the polarity can be changed in the setup menus. The direction of travel is controlled by reversing the positive and negative connections to the trim motor. This is done conventionally using switches or relays, but is done in the Control Unit with solid-state circuitry. Therefore, no external relays or switches are required between the trim servo and the Control Unit

The position sensor uses three wires to determine the position of the sensor within the servo – white/green, white/ orange, and white/blue. The three wires are connected within the servo to a potentiometer, and are wired directly to J7 on the Control Unit. The connections are detailed in the Load Planning Worksheet.

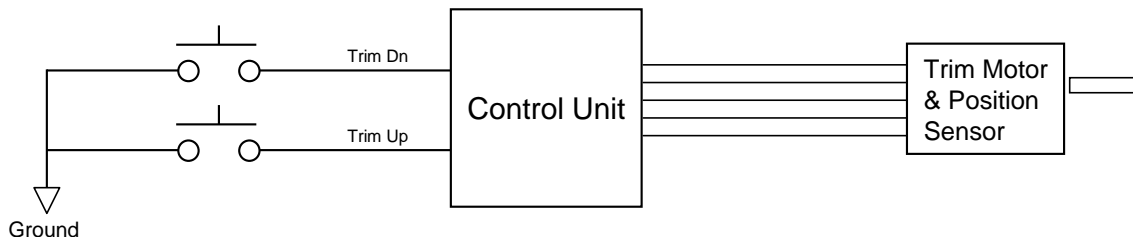
The trim motor wires and trim position sensor wires must be wired to the same trim group on the Control Unit. A trim group (designated as either group 1/blue or 2/yellow) consists of two pins for the motor and three pins for the position sensor. Simply put, you wire all 5 wires from a servo to the same trim group.

You can wire trim switches to control pitch, roll and/or yaw trim. Each CU has two trim circuits. The Display Unit has a trim indicator on the screen which shows the trim for all three axes. You can control two axes with the VP-200 and three axes through using the VP-200 Duo. If you are installing a VP-200 (one Control Unit) and want to control a third trim axis, you can do that by wiring the third axis in a conventional manner and getting power from one of the VP-200 power pins.

You can wire trim switches for the pilot and, optionally, for the co-pilot. The trim switches should be momentary action so the trim motor runs only when the button or lever is pressed. You can use either an SPST momentary action button OFF-(ON) or an SPDT momentary action switch (ON)-OFF-(ON), with a middle OFF position.

Each trim axis (pitch, roll, or yaw) requires two input pins: one to command trim in one direction, and one to command trim in the opposite direction. No external relays or indicator lights are required for trim wiring.

Each of the trim switches should be wired directly to the same Control Unit that powers the respective trim motor. For example, if the pitch trim and roll trim motors are all on the same CU, then the four pitch and roll trim switch wires should go to that same CU. If the pitch trim motor is on CU1 and the roll trim motor is on CU2, then the pitch trim switch should be wired to CU1 and roll trim switch to CU2.



The trim can also be controlled from the Device List using the soft keys.

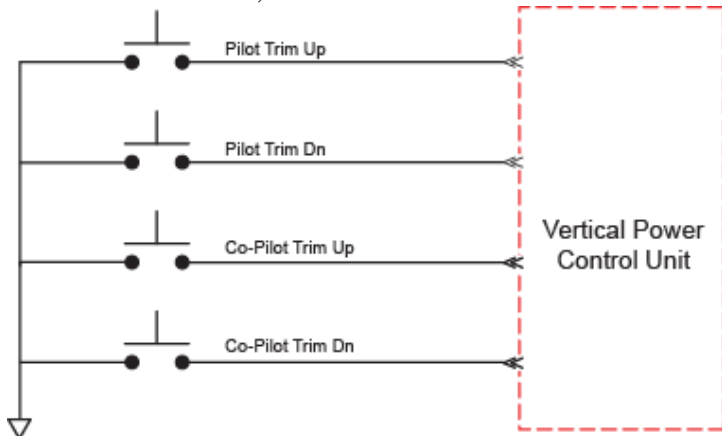
You may optionally wire a master trim disconnect switch in series between the CU and the trim motor.

6.11 Co-pilot Trim and Flap Wiring & Disconnect

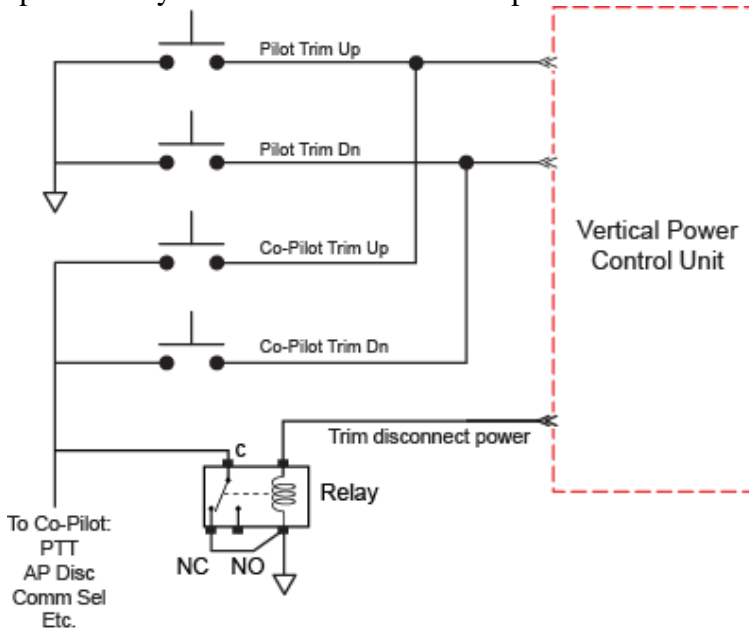
There are three ways to wire the co-pilot trim inputs, described below. The system will stop the trim motor from running when it receives conflicting inputs (see runaway trim in the operating manual for details).

Choose one of these three methods to wire the co-pilot trim and flap switches:

- Option 1 - disconnect just the co-pilot trim and flap switches using the Options menu soft key to do so. The co-pilot's trim switch(es) can be wired to either the CU or the DU. If the switches are wired to the CU, then the switch should be wired to the CU with its respective trim motor.



- Option 2 - disconnect ALL of the items on the co-pilot stick, even those that do not go through the VP system. Wire the pilot and co-pilot trim/flap switches in parallel in to a single input pin on the CU for each direction. For example, wire both trim up input switches into an input on the Control Unit. Additionally, wire an open power pin on the CU to a relay. This pin is powered ON while the disconnect is active. This pin can be used to drive a relay which can then disconnect power or ground or any other connections you have on the co-pilot stick. When you press Options-> Co-Pilot Disable then the designated pin becomes powered and opens a relay which disconnects the co-pilot switches.



The normally closed (NC) terminal on the relay should be tied to ground. The common (C) on

the relay should go the common ground on the co-pilot stick.

3. Install a switch to manually disconnect the common ground to the co-pilot stick.

Options 1 and 2 are operated by pressing the Options soft key, the pressing Co-Pilot Disable. Doing so will cause the system to ignore any co-pilot inputs and/or provide power to the Trim Disconnect power pin. The soft key is shown below.



Pressing Co-Pilot Enable soft key re-enables the co-pilot stick functions.

6.12 Wiring Hydraulic Pumps or Non-VP Air Conditioning

Aircraft that have a hydraulic pump (for flaps and/or gear) or a non-Vertical Power air conditioning system should install an isolation contactor. This is a fairly simple and straightforward installation and is detailed in the *Landing Gear Wiring* diagram in the Documents section at www.verticalpower.com.

The isolation contactor prevents the e-bus fuse (the small 20A fuse in the yellow in-line holder) from blowing when the hydraulic pump or non-VP AC is running while the system is on e-bus. The hydraulic pump and/or non-VP AC should be wired to the isolation contactor and not the battery contactor.

A refresher on VP system operation: power is provided to the Control Unit via a smaller 14 gauge wire connected directly to the battery through a 20A fuse (called the e-bus), or via a large gauge wire from the battery contactor. The CU automatically selects the source of power. Normally, the VP-200 runs on the e-bus during pre-flight or if there is a battery contactor failure. If the system is on e-bus and the hydraulic pump runs, it will blow the e-bus fuse. The isolation contactor isolates the hydraulic pump and or non-VP air conditioning from running when the system is on the e-bus.

6.13 Retractable Gear Wiring

A wiring diagram for retractable landing gear is available in the Documents section at www.verticalpower.com. Be sure to note and understand the isolation contactor function, as described in the previous section. This is a generic diagram and should be used for reference only to understand how to interface with the VP-200 series. You can wire and display switch inputs for 1, 2, or 3 gear legs.

There are two types of retractable gear system inputs and one power output.

Gear down-lock switch inputs. Micro switches should be wired so that each switch is closed when the gear is down and locked. One side of the switch is wired to the CU or DU, the other side is wired to ground.

Gear transition input. The small post marked “I” on the hydraulic pump solenoid provides positive power when the solenoid is active. This post is wired to the voltage sense input (J5, pin 11 or 12) on the CU. A 1K ohm, 1 watt resistor and a diode (see diagram) should be wired in series to provide short-circuit protection, and physically placed near the solenoid.

Gear power output. Power is provided to the external gear switch using any one of the generic power output pins on the CU. This circuit must use the reserved device name *Gear* in the setup menus. The circuit can be configured in the setup menus to remove power while the aircraft is on the ground (future feature, in the interim we recommend an airspeed switch in line with the gear switch).

Wiring Gear Inputs

You can specify active low gear switch inputs on the DU or CU for the following:

- Left Gear Dn
- Center Gear Dn
- Right Gear Dn

The following can be annunciated using the standard annunciators.

- Left Gear Up
- Center Gear Up
- Right Gear Up

Only those gear inputs that are configured are displayed on the screen. For example, if only the center gear is set to an input pin, then only the center indicator is displayed.

You can specify an active high input on either CU or any switched input (active when grounded) for the following:

- Gear transition

Note: to use a switched input, the bus voltage input from the hydraulic pump solenoids must be converted to a ground signal. Search VP forums for a “logic reversing circuit” or call tech support.

Retractable Gear Logic Choices

The aircraft must be wired to support one of the following gear logic schemas. The logic for each is as follows:

Disabled	Gear indicator disabled (default)
Gear Dn/transition	For each active Gear Dn input, the respective gear indicator is displayed in green. If the hydraulic pump is on (via an active high input), and the Gear Dn input is NOT active, then the respective transition indicator is shown. If the transition input is active, and the Gear Dn is active, then the Gear Dn indicator is shown. Typically, this is used when the hydraulic system powers only the gear, and therefore activation of the hydraulic system can be used to reliably show gear transition indications.
Gear Dn/no transition	For each active Gear Dn input, the respective gear indicator is displayed in green. No transition indicator is shown. Typically, this is used when the hydraulic system powers both the flaps and gear, and therefore activation of the hydraulic system cannot be used to reliably show gear transition indications.

6.14 Landing Light Wig-Wag (Pulsing) Considerations

Various circuits can be configured to wig wag external lights. In order to flash two different lights, they must each be wired to a separate pin on one or two Control Units. Lights that are wired together to a single pin cannot be flashed separately (although they can be flashed together). Wire each light that you want to flash independently to separate pin.

In the setup menus, you specify which devices you want to wig wag. It then wig-wags the pins that are assigned to those devices. For example, if you have a device called “Land Lt”, and it is configured with two pins, then those two pins will wig-wag. Another example: if you have two devices, one called “Land Lt” and one called “Taxi Lt”, and each is configured to control one light, then it will wig-wag those two lights.

6.15 Light Dimming Considerations

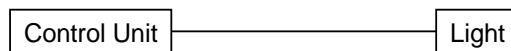
Each VP-200 Control Unit has three 5 amp dimming circuits. Each of these is configured in the same manner as standard on/off circuits, with additional capability for dimming.

The 18 amp circuits are designed for soft-starting halogen landing lights and not dimming.

The dimming circuits can be configured to operate in one of three ways:

1. **On/Off:** turns on and off the circuit just like standard non-dimming pins. Nav lights, strobe lights, and HID lights should be configured to on/off and may be wired to standard non-dimming pins.
2. **Soft start:** power will "ramp up" at turn on. When a cold light bulb is turned on, it draws a large amount of current and “shocks” the light filament. Soft start helps lights last longer. Select soft start only for devices that have a large in-rush at turn on, such as lights (but not for a Gretz Aero or Dynon heated pitot which have their own internal temperature regulator). Do **not** soft start avionics, HID lights, or other sensitive equipment.
3. **Dimmable:** allows you to control the brightness of the 5 amp circuits from the Device List soft keys. When turned on automatically, they will turn on to the pre-set brightness level. If one pin on an individual device is set to dimmable, then all pins must be dimmable (you cannot have a pin set to on/off and another set to dimmable)

Dimmable pins on the Control Unit should be wired to the corresponding light as follows:



A dimmable device can also be controlled by an external (on)-off-(on) switch. The switch inputs are called “pairs” because there is a Dim input and a Brighter input. When the dimmer input is grounded, the device will get dimmer, for example. They must be wired in specific pairs to specific inputs. Configure the inputs as CU1 Pair or CU2 Pair, and they must pair up as follows: 8-6, 7-5, 3-1, 4-2. The higher number is the brighter input.

Note: in the event of a processor reset on the Control Unit (this is not a normal condition, but should be taken into account for planning purposes), dimmable circuits will turn off until the processor operates properly again (typically <1 second). Therefore, essential avionics should not be wired to dimming circuits. Standard non-dimming circuits will NOT change state if the processor resets.

Each HID (Xenon) light should be connected to either a 10A or an 18A line. Configure for On/Off ONLY.

Another option is to wire an easily-accessible rheostat in line between the CU and the light. In this case, you can wire the light to a standard (non-dimming) pin as the rheostat provides the dimming function. Ensure the rheostat is sized appropriately for the electrical load.



When should I use the VP-200 dimmer and when should I use an external rheostat/dimmer?

The following are only recommendations. To dim lights using the VP-200 Display Unit, you scroll to the device on the Device List. When you do that, the soft keys change to *DIMMER* and *BRIGHTER* (vs. on and off for non-dimming circuits). Pressing the soft keys changes the brightness of the lights.

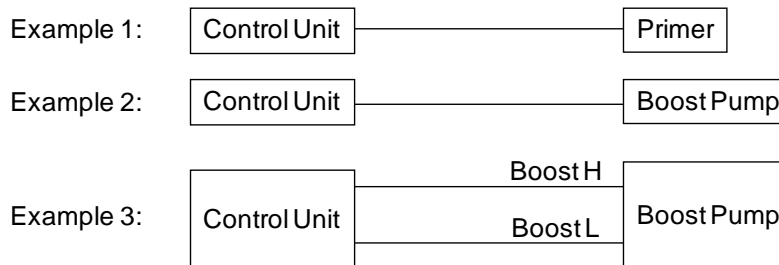
Our feeling, in general, is that not all interior lights are created equally. Below is a list of different types of lights and some considerations to think about:

- | | |
|-------------------------|---|
| Cabin lights | These lights illuminate the entire cabin and are typically on only during pre-flight and post-flight. Our recommendation is that they are controlled by the VP-200, so that you can turn them on automatically during pre-flight and/or post-flight modes. Also, you can turn them on with the remote. If you have a dimmer attached, then turn them on with the remote, they might not come on if the external dimmer is on a low setting. |
| Panel/instrument lights | These lights are internal to the instruments, or on posts or a glow strip on the glare shield. They often need fine-tune adjustments during flight, and our recommendation is to use an external dimmer knob. |
| Map lights | These are small lights that shine a fine beam of light at a specific area so you can read maps or approach plates. Typically they have a dedicated switch near the light so they can be easily turned on and off as necessary. We recommend a switch or dimmer knob near the lights for this purpose. |
| Baggage lights | See Cabin Lights. |

6.16 Boost Pump & Primer Considerations

The VP-200 supports the use of a boost pump and/or a primer pump. A single-speed boost pump (such as that used in Van’s aircraft with Lycoming engines) is labeled BOOST on the device list. A dual-speed boost pump (such as that used in Lancair aircraft with Continental engines) is labeled BOOST L and BOOST H (two separate items) in the device list. A primer pump, used on carbureted engines, is labeled PRIMER on the device list.

The BOOST and PRIMER pumps are wired from the Control Unit directly to the power wire on the pump. The BOOST H and BOOST L requires two wires from two separate pins on the Control Unit. Each is a separate device on the device list and can therefore be controlled independently. The examples below show this:



BOOST, BOOST H, and BOOST L should be wired to 10A or 18A circuits.

If PRIMER is used on the device list, one of the soft keys on the DU becomes Primer during Start Mode so you can prime the engine prior to starting.

If BOOST is used on the device list, one of the soft keys on the DU becomes Primer during Start Mode so you can prime the engine prior to starting.

If BOOST H is used on the device list, one of the soft keys on the DU becomes Primer during Start Mode so you can prime the engine prior to starting. During emergencies or above a specified altitude, either BOOST L or BOOST H may be configured to supplement the mechanical fuel pump during certain flight conditions.

Typically, on a Continental engine, the Boost H is used for priming a fuel-injected engine. Boost L is used when the mechanical fuel pump fails or if the pilot desires to turn on the electric boost pump for a backup. Because Boost H is only used to prime the engine (a soft key allows you to run the boost H device during Start Mode), it is not normally assigned to an external switch. We do recommend that Boost L is assigned as an external switch (either on the Switch Panel, or to an external switch input pin). If your configuration differs from this or are not sure, please contact us as well as your engine manufacturer for additional information. It is the builder's responsibility to configure this properly to match the specific needs of his engine. Additionally, don't forget to configure the boost pump operation under Emergency configuration in the setup menus.

BOOST L and BOOST H may not be turned on simultaneously when switched manually from the Device List. However, both may run simultaneously if commanded from a Mode change or external switch. DO NOT wire or configure your aircraft so that:

- An external switch or switches can run both at the same time. Use an ON-OFF-ON switch (with some sort of BOOST H lockout) that runs either one, but not both.
- Switch Panel switches can operate both at the same time
- Both can run at the same time in a specific Mode.

Like any other device, the boost pump can be manually controlled from the device list, a switch panel switch, or an external switch. You can also wire the boost pump to operate in case of a system failure by following the instruction at the end of the Backup Circuits section.

6.17 Aux Battery Considerations

Aux battery voltage can be measured on pins J5 11 or 12. The voltage is displayed graphically below the main battery on the electrical diagram. Install a 1000 ohm, ¼ watt resistor in line near the battery positive terminal, then run the wire to either of the pins above.

6.18 Electronic Ignition Considerations

The VP-200 can be used with various electronic ignitions (EI) as long as the appropriate safety considerations are taken into account. Most EIs, such as Lightspeed or E-mags, require external electrical power to operate. Others, such as P-mags or Lasar, have internal backups and can operate with or without external power. P-mags require external power for starting and idle.

Make sure that at least one ignition source is wired directly to the battery as per the ignition manufacturer's instructions if you are running dual EIs that require external power!

If at least one magneto or p-mag is installed, you can provide power to the other ignition via the Control Unit. Consider using some form of Backups Circuit (see section 6.8f) to provide power in case of multiple failures (failure of the magneto and failure of the CU at the same time-unlikely but possible).

Some examples are shown below, and are meant to be guidelines only. **The builder is responsible for determining the appropriate level of redundancy for his or her aircraft:**

- Dual Lightspeed or e-mag ignitions: wire one directly to the battery (per manufacturer's instructions) and one to the Control Unit. Or, wire both to the battery per diagram in the documentation section of the web site.
- One Lightspeed/e-mag and one magneto: wire the Lightspeed/e-mag to the Control Unit.
- Dual p-mags: wire both to the Control Unit.
- One e-mag and one p-mag: wire both to the Control Unit on individual power pins.
- Dual magnetos: neither is wired to the Control Unit, as they don't require external power.
- Lasar: Wire the Lasar power and annunciator circuits to the CU and DU, respectively.

Most EIs come with a p-lead connection that disables the ignition when the p-lead is grounded, simulating the behavior of a magneto. The p-lead should be wired to the magneto switch on the Vertical Power Switch Panel (see later section, *Wiring the Switch Panel*Wiring the Switch Panel).

With some ignitions (p-mags for example), you may want to disconnect power to test the power-off operation. You can do this two ways without having to wire an external switch to interrupt power:

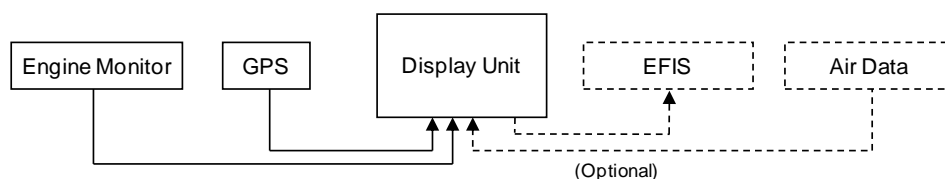
1. You can configure an *IGN Check* button to appear on the soft keys during Run-up Mode,. Pressing this button will turn off power to the ignition(s) in sequence.
2. Use the Device List to scroll to the IGN device and turn off using soft keys.

6.19 Subaru Engine Installation

Please reference the Subaru Supplement document located on the Vertical Power web site under Documentation.

6.20 Data Connections

As part of the planning process, you will need to consider which data needs to be sent to the VP-200 series. The system requires engine data and GPS data inputs, and optionally, an air data (indicated airspeed) source. These data inputs are wired into the serial I/O receive ports on the Display Unit. The diagram below shows an overview of the connections:



You can also output VP information to select EFIS systems. See VP Data Output later in this section.

RS-232 serial data wires are comprised of three wires: a transmit, receive and serial ground wire. The engine, GPS and air data are receive-only (the DU only receives the data) and therefore only two wires are needed. The correct method is to wire from the transmit pin (on the data source, like the engine monitor) to the receive pin on the Display Unit. There are several options to wire serial connections depending on the way the transmitting box is designed. The use of shielded wire is at the builder's discretion.

- Option 1: Using two conductor shielded wire, connect one wire from the transmit pin on the data source to the receive pin on the destination (Display Unit). Connect the serial ground from the data source to an open serial ground on the Display Unit. Connect the wire shield at the back shell on each d-sub connector. Do not use the shield as the serial ground.
- Option 2: Some units do not provide a dedicated serial ground, and combine the grounds together. In this case, connect one wire from the transmit pin on the data source to the receive pin on the Display Unit. You may optionally use shielded wire, and connect the wire shield at the back shell on each d-sub connector. Do not use the shield as the serial ground. Be sure to ground the transmitting unit (such as an engine monitor) to the same ground block as the Control Units are grounded.

6.20a Engine data

These data are used to present the engine instruments on the LCD screen, as well as flag alarms and determine the Modes of operation. An engine data stream input is required for normal operation of the Vertical Power system. Without engine data input, the Modes must be changed manually using the soft keys. You should not wire the engine probes directly to the Display Unit or Control Unit. The VP-200 series accepts an RS-232 serial data stream from the engine monitor, which converts the analog signals from the engine probes into a digital signal that is fed to the Display Unit.

Run a wire from one of the following pins to Display Unit J3 pin 21. If the engine monitor has a serial data ground, run that ground to the Display Unit serial ground J3 pin 10, 11, 12, 13, or 14.

- Grand Rapids EIS 4000/6000: Pin 11 (Green/Black). The EIS can be installed on the instrument panel or hidden elsewhere.
- Electronics International MVP-50: Pin 10 (port 3) on the 25 pin d-sub connector on the display should be configured for Chelton data output format. You can run a wire from this port to both the Display Unit and the Chelton unit(s).
- Dynon SkyView: As of this writing, data output from the SkyView system is not enabled by Dynon, but will be included in an upcoming software update. It is likely this output will include both engine data and indicated airspeed, so only one data line from SkyView to the DU is needed. To provision the wiring so that it is ready when the software upgrade is available, use

any RS-232 serial port (1 through 4, but not 5) from any SkyView Screen and wire that to the DU.

- Dynon EMS-D10: Pin 11. This pin is also used for PC communications. Serial ground is pin 9.
- Dynon EMS-D120: Pin 11 (orange). This pin is also used for PC communications. Serial ground is pin 30.
- Dynon FlightDEK D-180: Use the EMS 37-pin connector. Pin 11 (orange). This pin is also used for PC communications. Serial ground is pin 30.
- Dynon SkyView. We expect integration by the end of 2011. Two wires are needed: a GPS and a data output. Wire from a serial port on the SkyView to a serial input on the VP-200 display unit. Configure that port on the SkyView to output ADAHRS and EMS data at 57600. Set the VP serial port to Dynon SkyView.
- Advanced Flight Systems AF-3400/3500: Any of the serial outputs can be used. Find one that is not being used, or if it conflicts with another function, determine the function that you don't want to use. You can also use an open serial port on a second AFS EFIS. If all the serial outputs are used, consider installing a separate altitude encoder and using that serial port. For example, if you want to use serial port 4, it is on the DB9 connector (next to the Ethernet jack) pin 1. Configure serial port 4 for Chelton output. This data stream also includes indicated airspeed, so an extra air data serial line connection is not needed.
- Garmin G900X. Starting with Garmin software version 9.01, the G900x outputs engine data over an RS-232 serial data line. Wire an RS-232 OUT on the GIA 63W to the serial input on the Vertical Power Display Unit. To configure the G900x to output these data, go to the appropriate GIA RS-232 setup page and set the desired RS-232 output to "Aviation2" at 28800 baud. Fuel level is not included in the output, so you will need to disable the display of that gauge on the VP-200 Display Unit. The following data are not currently output by the G900x, but will be in a future software release: IAS, fuel used (totalizer), fuel pressure, fuel level. The following data are currently output: RPM, man pressure, CHT, EGT, TIT (L&R), oil temp, oil pressure, OAT, fuel flow.
- Garmin G3X. The G3X sends engine data, GPS groundspeed, and indicated airspeed to the VP-200. The VP-200 sends trim and flap position, and mode to the G3X. Run two wires (serial transmit and receive) between a serial port on the Garmin G3X MFD and a serial port pair on the VP-200 Display Unit. You do NOT need to run any trim or flap position feedback wires to the GSU 73. Only run those wires to the VP Control Unit as described in this manual. Configure the G3X MFD serial port for "Vertical Power." On the VP-200, configure the serial port for "Vertical Power #2" format. You can also configure the amps and volts displays on the G3X to get their data from the VP-200.
- Chelton EAU. Same as Grand Rapids EIS.
- IK Technologies AIM-3000. J2 pin 2 in the serial output. J2 pin 5 is the gnd. You may remove the display head if desired.
- JPI EDM-950. Call for instructions.
- MGL Avionics EFIS: Use the MGL USB to serial adapter and set to EIS output format.

The table below shows the data available from each format:

Serial Protocol	RPM	Man Pres	Fuel Level	Fuel Flow	Fuel Pres	Oil Pres	Oil Temp	OAT	EGT CHT	Batt Current	Alt Current	Ground Speed	GPS Lock
Grand Rapids EIS	x	Aux	Aux	x	Aux	x	x	x	x	Aux	Aux		
Grand Rapids EIS (Chelton)	x	Aux	Aux	x	Aux	x	x	x	x				
Chelton MVP-50	x	Aux	Aux	x	Aux	x	x	x	x				
AFS	x	Aux	Aux	x	Aux	x	x	x	x				
IK Technologies (IV)	x	x		x	x	x	x	x	(1)				
Dynon EDS	x	x	(3)	x	x	x	x	x	x		(2)		
Aviation Data Format I												x	x
Aviation Data Format II	x	x		x	x	x	x	x	x	(2)	x	x	x
GPS NMEA 0183												x	x
GPS Map Com												x	x
Aerosance FADEC	x	x			x	x	x		x				
(1) 2 EGT's and CHT's only													
(2) Only 1 current value available													
(3) Has Center Tank; not displayed													

6.2ob GPS data

These data are used to calculate the Modes of operation and flag other alarms and notifications. A GPS input is required for normal operation of the Vertical Power system. Without GPS input, the Modes must be changed manually using the soft keys. Most handheld and panel-mount GPS units have an RS-232 output which may be wired to the Display Unit. A wide variety of GPS units are available, and some of the more popular ones are listed below. If yours is not listed, it should have an NMEA 0183, MapCom, or Aviation Data format output which can be used.

Run the serial wire from the GPS unit to the DU J3 pin 23.

- Garmin 430/530. Choose one of the serial output pins. You may run the same serial line to both the Vertical Power system and another box (an EFIS for example). Configure the serial output for Aviation Data format. Note that only one output on the Garmin at a time can be configured for this format.
- Garmin 480: Choose one of the serial output pins that supports MapCom data format. You may run the same serial line to both the Vertical Power system and another box (an EFIS for example). Configure the serial output for MapCom data format.
- Dynon SkyView: SkyView will be able to output NMEA GPS data in 2011. Wire from a serial port on the SkyView to a serial input on the VP-200 display unit. Configure that port on the SkyView to output NMEA data at 9600 baud. Set the VP serial port to NMEA (9600).
- Garmin G900X: Use any unused RS-232 output on either GIA 63W box, each of which has eight RS-232 outputs. These are located on connector P603. Wire an RS-232 OUT on the GIA 63W to the serial input on the Vertical Power Display Unit. To configure, follow these steps: 1) Go to the GIA RS-232 / ARINC 429 CONFIG page in configuration mode. 2) The RS-232 output channels are on the bottom of the page. Enable the cursor and scroll down to whichever channel you wired. 3) Set the data type to AVIATION. If the G900X software and configuration is updated afterwards, then this output must be reconfigured.
- Garmin G3X: See G3X under engine data section, above.
- Chelton EFIS with Chelton/Pinpoint GADAHRS: Connect GPS serial Tx pin on the GADAHRS (pin 14) to the Display Unit pin 23. Connect GADAHRS serial ground (pin 19) to serial ground on the DU. Set VP input to NMEA 183. See *VP Chelton Wiring.pdf* in the documentation section of the web site.
- Chelton EFIS with non-Chelton GPS: Wire from port 9 serial output on IDU to serial input on DU. Select MapCom data format for the input on the DU.

- Grand Rapids EFIS (with GPS receiver installed): Choose one of the serial output pins and configure it for NMEA 0183 format, 9600 baud. Note: you cannot configure two serial outputs on the GRT EFIS for the same data format. If multiple units need the same data stream, then run two wires – one from the same output pin to each unit.
- Handheld unit (Garmin 396, etc.): Purchase the power/data cable (bare wires) accessory. Run the comm1 or comm2 transmit wire to the DU. The black wire on the cable is the data and power ground. Use the handheld's setup menus to configure the output on the GPS unit to NMEA 0183 format, 9600 baud.
- Blue Mountain EFIS G4: set up a serial port on the G4 to output NMEA 183 data format.
- MGL Avionics EFIS: Use the NMEA #2 transmit port.

6.20c Air data

Indicated airspeed (IAS) is used to enable certain features such as flap and gear warnings and other features that require this data. This feature is *optional* because GPS data is sufficient for most features, but is recommended if you have air data available. Most EFIS units have a serial data output format that includes IAS. This feature is not yet supported in software but we recommend wiring it in advance.

Run the serial wire from the box providing air data to the DU J3 pin 25.

- Grand Rapids EIS 4000/6000 with optional airspeed port: Pin 11 (Green/Black). The airspeed data is included with the engine data stream, so no additional wiring is required over and above the basic engine data connections.
- Grand Rapids EFIS: Choose one of the serial output pins and configure it for Air Data Z format, 9600 baud. Note: you cannot configure two serial outputs on the GRT EFIS for the same data format. If multiple units need the same data stream, then run two wires – one from the same output pin to each unit.
- Advanced Flight Systems AF-3400/3500: No additional connection is needed. This data is included with the engine data stream.
- Chelton EAU: TBD
- Garmin G900X: See G900X under engine data section, above.
- Garmin G3X: See G3X under engine data section, above.
- Chelton EFIS with Pinpoint/Chelton GADAHRS: The airspeed output from the GADAHRS requires a 429 to RS-232 converter box, available from Vertical Power. Wire this box per the VP/Chelton wiring diagram available on the VP web site. Alternatively, you may also use an alternate air data source like a backup EFIS (from Dynon or AFS) or Grand Rapids EIS with airspeed option. Wire as shown in this section.
- Dynon SkyView: See SkyView under the engine data section above.
- Dynon EFIS-D10A: Pin 10. This pin is also used for PC communications. Serial ground is pin 9.
- Dynon EFIS-D100: Pin 10 (white). This pin is also used for PC communications. Serial ground is pin 9.
- Dynon FlightDEK D-180: Use the EFIS 25-pin connector. Pin 10 (white). This pin is also used for PC communications. Serial ground is pin 9.
- Blue Mountain EFIS G4: configure a serial output port on the G4 to "external HUD" output.
- MGL Avionics EFIS: Airspeed is output along with the engine data.

6.2od Altitude Data

As of software version 22, attitude data is supported for boost pump reminder feature. Altitude data is supported in the following inputs from external devices. Be sure to set the altitude field in the Data Association menus to one of these inputs. You can verify correct input of data by looking at the altitude field in the system info menu (Options 3x from main screen). GPS formats output GPS altitude and others output either baro-corrected or uncorrected (29.92) altitude.

<i>Format selected as an input on the VP-200</i>	<i>Notes</i>
AFS AVTN	
Aviation Format	
Aviation II Format	
Dynon EFIS	
EIS 2000, EIS 4000, EIS 6000, EIS 9000, EAU (Chelton)	If pitot/static option is installed in EIS.
AFS 3400/3500	
MVP-50 (Chelton)	If pitot/static option is installed.
IK Tech IV	If pitot/static option is installed.
GPS MapCom	
GPS NMEA 0183	Not all versions of NMEA 0183 support altitude.
GPS NMEA 0183 #2	Not all versions of NMEA 0183 support altitude.
Vertical Power #2	
Dynon SkyView	Coming late 2011 (part of ADAHRS data format in section above)

6.2oe VP Data Integration with EFIS

The VP-200 can output data to select EFIS systems. Currently, Grand Rapids Technologies supports this data format in v33 and later software on the HX. Wire from one of the serial output (TX) pins on an unused port (for example, pin 28 on the DU) to an open serial input on the EFIS. The DU transmits at 19200 baud. Optionally, you may wire another serial line from the EFIS to the VP for future expansion. Use the same serial port TX/RX pair on the VP DU and EFIS (in the above example, use the serial receive pin 29 on the DU).

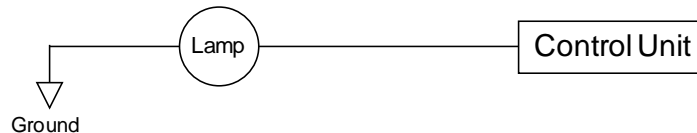
The data set includes Mode, trim and flap position, master warning, volts and amps. Therefore, you do not need to install shunts for the EFIS, and trim and flap position are reported over the data line rather than having to hard-wire to the EFIS. Additionally, any alarms on the VP-200 will show on the EFIS alarms. Please contact the EFIS manufacturer for specific implementation of this data.

6.21 Master Warning Light

The VP-200 series provides the ability to control an external “master warning” light. The use of this light is optional. Wire the light to J7 pin 31 on Control Unit 1. This pin is protected internally with a 1A self-resetting fuse, and is different than the power pins on J3-J6 in the following ways:

- not listed on the Device List
- no fault indications
- not manually switchable.

Use a light or LED that draws ½ amp (500 milliamps) or less and wire as shown:



6.22 Climate Control System (CCS)

The CCS Installation and Operating Manual is available separately in the Documents section of the VP web site.

6.23 Load Planning Worksheet

Completing the Load Planning Worksheet will guide you through the planning process and hopefully answer many questions you may have along the way.

You will find that the Load Planning Worksheet has many uses. It can be used to:

- plan pin connections prior to entering the data in the setup menu
- analyze overall electrical system loads
- balance loads between two Control Units (CU), in a dual-CU system
- aid while wiring your aircraft
- document the wiring in your aircraft for future reference

Below, the steps necessary to complete the Load Planning Worksheet are outlined:

1. Determine the overall configuration of your system and the type of alternators you will use. Note that you may re-evaluate this decision once you’ve completed the planning exercise – that’s OK as it can be easily changed while you’re planning. It becomes more difficult once the aircraft is wired!
2. Make a list of all the loads, where they will be located, and the **actual** current draw of each load. Flaps and electric trim are transients and don’t need to be calculated in the load totals.
3. Determine the length and size of each wire.
4. Determine which loads will make up a device and how many pins are needed for each device. Up to four pins may be assigned to a single device. For example, if there is a navigation/position light on each wingtip and the tail, there will be three power wires, one from each light. You may merge these wires into a single wire running to the Control Unit or choose to have three individual wires run to the Control Unit. Some avionics have more than one power input wire.
5. Determine the circuit breaker value for each load. This value is typically provided by the manufacturer. Remember, the circuit breaker value is determined based on the size of the wire. The wire is sized based on the load it provides power to.

6. Decide what optional external switches you need. Options include flap and trim switches, canopy or baggage door switches, gear switches, gear circuits, remote starter switch, and switches to control individual devices.
7. Build the checklists

With the above in mind, read through the detailed planning instructions below and then fill in the worksheet. The worksheet is divided into several Excel worksheet tabs. Don't worry about getting it correct right away. It will likely require a few iterations before you are comfortable with the results. You never know what insights you'll have as you do the planning!

6.23a Filling out the System tab

This tab in the worksheet documents your overall electrical system configuration. Enter your tail number, check the type of system you are planning to build, volts, ignition, and alternator types.

6.23b Filling out the Device List tab

This worksheet helps you plan how devices function and how devices can be grouped together to provide powerful features in-flight. The other worksheets are "pin-centric", while this worksheet is "device-centric." In other words, think about how devices will work, not pins. An example worksheet is provided to the right of the blank worksheet. The following describe each column of the worksheet.

- **Device Name:** Create a list of the devices you want to control. These devices will be shown on the Device List on the display unit. Be sure to reference Appendix A and the reserved device names wherever applicable. You now have a list of most of the devices that will be controlled. Flaps, trim, starter, and x-tie contactor and battery contactor should not be included on this list because they have their own setup menus. Don't forget to add the alternator Field(s), which are also reserved names.
- **Mode:** Columns B-K list the 10 flight Modes. For each mode, list whether you want that device to be on. Put an x in the box at the intersection of the mode and the device to indicate that device should be turned on for that mode. Note that trim and flaps always have power, and gear, starter, battery contactor, x-tie contactor are controlled automatically based on other conditions than the Mode. You should leave Gear off during all modes.

For config 1: Use *Field Pri* for the alternator field. This should come on during Modes where the engine is running.

For config 2-3: Use *Field Pri & Field Sec* for the alternator fields. *Field Pri* should come on during Modes where the engine is running. *Field Sec* should be set to off for all modes.

For config 4: *Field A & Field B* should both come on together during Modes where the engine is running.

Additionally, simple rules can be configured in the setup menus to turn a device on whenever another device is on. For example: *Turn on [Audio] whenever [G430] is on.* Such rules may mean you don't have to switch a device via each Mode. Take a look at the example section on the right side of the worksheet to see this implemented.

- **VMC Shed:** Put a check in this column if you want this device to be turned on when shedding electrical loads in Visual Meteorological Conditions (VMC), otherwise the device will be turned off. This typically occurs when there is an alternator failure.

Notes on load shedding: load shedding is meant to turn off devices, when an alternator fails, that are not absolutely necessary for the type of flying you do. Load shedding should be configured to allow you to fly safely and for an indefinite period of time to your destination or until VMC conditions exist. To be safe, you should plan the loads to be a maximum of about 80% of the rated output of your backup alternator. You have two ways to structure this: 1) increase the size of your backup alternator, or 2) minimize the loads. Once you are running on the backup alternator, you should be able to continue your flight and keep the bus voltage running at its normal level. Too much current draw from the devices will cause the bus voltage to slowly decline, even with an alternator running. Use the *Device Amps.xls* document to assist in your planning.

The load shedding configuration can be changed (via the Setup Menus) later during the flight test phase, if necessary, based on actual flight testing.

If you do not have a backup alternator, then load shedding should be configured to minimize battery drain until such time you can land safely. Typically, 30 minutes is a good target to shoot for. This can be verified during the flight test phase.

Load shedding is enabled by two different means:

- | | |
|-------------|--|
| Emergency | Press the red Emergency button, then select either the “Alternator Failure” or “Electrical Fumes” soft key. The system may ask for the current weather conditions (VMC/IMC) and then begin the load shedding process. |
| Low voltage | When your primary alternator fails, the bus voltage drops below a pre-set alarm level, at which time the low voltage alarm is activated. You can continue in this state, or select the red emergency button then “Alternator Failure.” The backup alternator is then brought on-line and the load shedding process is initiated. |

One final note: do not think about load shedding the old-fashioned way where you must tie a group of devices to a specific power bus. Whether you plan one bus or two independent busses, one alternator or two, the VP-200 creates a “virtual bus” to drive the specified devices from the proper power source.

- **IMC Shed:** Put a check in this column if you want this device to be turned on when shedding electrical loads in Instrument Meteorological Conditions (IMC), otherwise the device will be turned off. This typically occurs when there is an alternator failure.
- **Avionics Group:** Put a check in this column if you want the corresponding device to be part of a group called "Avionics." During pre-flight, this allows you to turn on all your avionics with a single soft key.
- **Display on Page:** The Device List shown on the right-hand side of the screen has three pages and each page can display up to 22 devices. In this column, indicate the page (1 through 3) on which you want the device to appear. Vertical Power recommends that important devices or devices that you can't see visibly if they are on or off (like boost pump or nav lights) appear on page 1, then less important devices on page 2 or 3. The DU rotary knob allows you to quickly switch pages.
- **Remote Control:** Put a check in this column if you want the corresponding device to be switched on or off by the remote control, which has four buttons which can be set to any device. For

example, you can assign all the lights to one button, and have the other three buttons for other features. For example, you may want to assign the cabin light to a button to turn on the light at night when approaching the aircraft. The system can be configured so that pressing the key fob turns a device on and off, or is only on while the key fob button is pressed.

6.23c Filling out the Control Unit tabs

There are two tabs for Control Units. Use the Control Unit tab for a single Control Unit installation, and use both tabs for a dual Control Unit installation. Note that the starter and flaps pins on Control Unit 2 are not used.

J3-J6 are power connectors, and J7 is a d-sub connector.

Many boxes are colored to help organization. Boxes shaded in grey mean that no entry is required. The most common reason is that a pin is unused. Boxes shaded in yellow identify those pins which have a wire as part of the standard wiring harness.

Take each device you created from the Device List and assign it to one or more pins. In the picture below, you can see that the boost pump, which only has one power wire, is assigned to J4 pin 3, a 10A max circuit. The device name is Boost and the pin name is Pwr. The circuit breaker value is set to 7 amps. The Garmin 430, which has two power wires – one for the nav radio and one for the comm. Radio - uses two pins. J4 pin 5 powers the comm., and is set to 10A and J4 pin 8 powers the nav and is set to 5 amps. The Device Name for both pins is the same.

Also note the backup alternator, called Field Sec uses two pins. In this case, it is a B&C LR3C external voltage regulator which needs two power inputs: one to sense the bus voltage, and one to power the alternator field. J4 pin 4 powers the voltage sense pin, and the pin name is V Sense and set to 2 amps. J4 pin 10 powers the alternator field, and the pin name is Field and set to 2 amps. The Device Name for both pins is the same.

	123VA	Max Amps	Device Name	Pin Name	Circuit Breaker
J4 Power					
1	E-bus input from battery		E Bus		
2	Unused				
3	10A output 1	10	Boost	Pwr	7
4	10A output 2	10	Field Sec	V Sense	2
5	10A output 3	10	G-430	Comm	10
6	To GND block		Ground		
7	3A output 4 (regulated +12v)	5	Fan	Pwr	3
8	5A output 5	5	G-430	Nav	5
9	5A output 6	5	MFD	Pwr	3
10	5A output 7	5	Field Sec	Field	5

Column explanations:

- **Max Amps:** The maximum current load that a pin is capable of handling. A load drawing more than this amount of current will fault (i.e., turn off) the load.
- **Actual Amps:** The actual current drawn by a device. It is recommended you measure the ACTUAL current draw of each device prior to installation in the aircraft using an ammeter (commonly available from a friend at no cost or from Radio Shack, Sears, and electronic

supply stores for a reasonable one). The total actual current draw should not exceed 60 Amps per Control Unit.

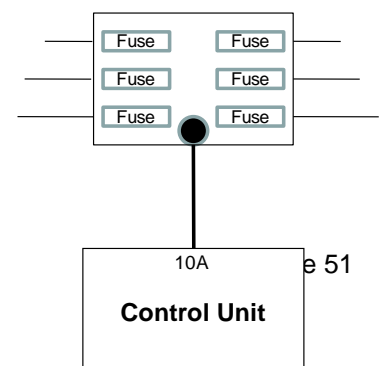
- **Device Name:** This is the name you want to associate with a device. This name appears on the right hand side of the Display Unit screen. Each device can have up to four pins assigned to it and all pins of a device are turned on or off together. If a pin is faulted the device will show a fault, but the other pins associated with that device will remain on. The setup menus come with many names already pre-defined, and VP recommends you use those names rather than creating your own. For some devices, reserved names (found in appendix A) are required to be used so that those items operate properly.
- **Pin Name:** Choose a name for each pin that is part of the device. For example, you might have a device named "Nav Lt", and have the three pins labeled "Left", "Right", and "Tail".
- **Circuit Breaker:** The maximum current allowed for that pin. You can enter any value between 1 and the limit of that pin in increments of 1A. This value is equivalent to a circuit breaker or fuse (which of course you don't need to use any more). If a load draws more than the Circuit Breaker value, then that load will show a fault. If too large of a breaker value is used, then the wire may overheat or fail. If too small a value is used, then the device may fault the circuit because it draws too much current. In its pre-made harnesses, VP-200 series includes only four sizes of wire: Signal wires – 22AWG, 5A circuit - 20AWG, 10A circuit - 18AWG, and 18A circuit - 14AWG. Above all, follow manufactures' recommendations about circuit breakers. Example: If your NAV/COMM radio documentation calls for a 2-amp circuit breaker, use 2 amps even though the 20AWG wire running to the radio is capable of carrying 5 amps.
- **Dimmer Type:** This applies only to the dimmable circuits. Select one of three behaviors for each circuit.
 1. **On/Off:** turns on and off the circuit just like normal pins.
 2. **Soft start:** power will "ramp up" at turn on. Select soft start only for devices that have a large in-rush at turn on, such as lights (but not for HID lights) or a heated pitot tube (but not for a Gretz Aero or Dynon heated pitot which has its own internal temperature regulator). Do **not** soft start avionics or other sensitive equipment.
 3. **Dimmable:** allows you to control the brightness of these circuits from the Device List.
- **Wire Marking:** The lettering marked on the wire provided in the wiring harness kit.
- **AWG:** The size of the wire based on the industry standard American Wire Gauge.
- **Length:** The estimated length of the wire you will need for this device, and if a yellow shaded row it refers to the wire included with the wiring harness kit.

Fill in J7 with the appropriate data, switch, and trim/position sensor connections. Note that the flap position sensor is wired to J7 and the flap motor power is wired to J3. The keep alive circuit has power to it at all times.

What if I run out of power pins?

There are several options if you have more electrical devices than power pins on the Control Unit. Evaluate each of the following and choose the one that makes the most sense for you:

1. Send your LPW to info@verticalpower.com and we can help you with it. Best done over the phone.
2. Combine several devices together on a power pin. Typically these are low-current devices that are all switched on and off together. Since the circuit protection is designed to protect the wire, you can group items as long as the CB value does not exceed the specs for the smallest wire. For example, and XM receiver and CO detector



could be combined on a circuit and set to 2A fuse. Downside is if one device faults, then all devices lose power.

3. Create an auxiliary bus by running an 18 gauge wire from one of the 10A power pins (set CB to 10A) to a fuse block with 6 or so fuse holders. From each fused tab, run a wire to the device. Do not install fuses rated at more than 3A, and ensure the total load does not exceed about 8A. Often devices that need a 1 to 3 amp fuse draw less than half an amp, so you can easily put 6 or 8 devices on a fuse block. When an individual fuse blows, the others are unaffected. All devices will be turned on and off together.
4. If you're wiring backup circuits, you may already have a fuse block designed to power the backup circuits. Run devices off this fuse block, through external switches.
5. Install an additional Control Unit.

6.23d Filling out the Display Unit tab

Enter the function for each of the switch inputs and data I/O. The Display Unit is a good place to run the co-pilot trim inputs, baggage door, cabin doors, etc.

A serial TX (transmit) pin on the DU should be wired to the serial RX (receive) pin on the other serial device.

A serial RX (receive) pin should be wired to the serial TX (transmit) pin on the other serial device.

The ACK button (J3 Pin 9) **MUST** be wired to a momentary pushbutton switch which can be located on the control stick or location of your choosing. This button is used to silence alerts and scroll through checklist items. If you want to wire multiple ACK buttons, wire them all to this pin.

Wire DU J3-37 to the un-switched audio input on your audio panel. Wire DU J3-18 to the audio ground (lo) input on the audio panel. If you have multiple audio signals into a single un-switched audio input, be sure to use an audio mixer to combine the audio signals.

Vertical Power Load Planning Worksheet (beta version)					
Display Unit					
	Pin Use	Wire Marking	AVG	Length (ft)	Notes
J3 37 Pin D sub	Female d-sub connector on Control Unit, Male connector for wiring harness				
1	External Switch Input 1				
2	External Switch Input 2				
3	External Switch Input 3				
4	External Switch Input 4				
5	External Switch Input 5				
6	External Switch Input 6				
7	External Switch Input 7				
8	External Switch Input 8				
9	ACK: momentary switch	ACK	81	22	5 Required
10	Ground for serial connections				
11	Ground for serial connections				
12	Ground for serial connections				
13	Ground for serial connections				
14	Ground for serial connections				
15	Do not connect				
16	Do not connect				
17	Do not connect				
18	Audio Ground (low)	whi	22	5	Wire to input low on audio panel
19	Do not connect				
20	Serial 1 TX (output)				
21	Serial 1 RX (input)				For engine data input
22	Serial 2 TX (output)				
23	Serial 2 RX (input)				For GPS data input
24	Serial 3 TX (output)				
25	Serial 3 RX (input)				
26	Serial 4 TX (output)				
27	Serial 4 RX (input)				
28	Serial 5 TX (output)				
29	Serial 5 RX (input)				
30	Do not connect				
31	Do not connect				
32	422 Trc				422 on DU serial 40 & higher
33	422 Trc				
34	422 PDC				
35	422 PDC				
36	Do not connect				
37	Audio Output (high) - to unswitched high input	whi	22	5	Connect shield at audio panel

6.23e Filling out the Checklist tab

Example checklists are shown and should be modified to fit the specific requirements of your aircraft. Each checklist corresponds to a specific Mode, and when enabled, will automatically present the

checklist when you enter that Mode. The emergency checklists correspond to that specific emergency, and are presented when that emergency is activated.

6.23f Review

It is a good idea to review the Load Planning Worksheet in its entirety, remembering that it is easy to make changes on the Excel worksheet. Changes can be made later on after the information is entered in the setup menus.

Review the following common mistakes:

- Use reserved names (see Appendix A) in all instances where they apply. For example, use Boost rather than creating a device labeled Fuel Pump.
- Make sure the Device List names match up with the device names on the Control Unit layout.
- Double check that you've specified the correct size wiring.
- Verify that the trim and flaps are grouped and wired correctly. Pilot trim and flap input switches should be on the same CU as the motor wires. Co-pilot input switches should be on the same CU as the motor wires, or on the DU input pins.
- Make sure that the starter, flap motor, e-bus, battery contactor, and x-tie contactor are wired to their designated pins (shown in magenta).

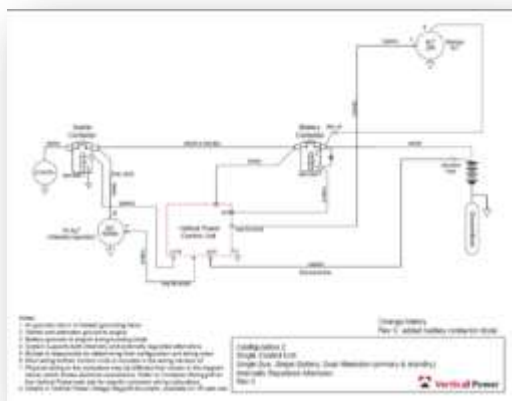
You are now ready to begin installing your system!

7 Step 2: Install Components and Wiring

7.1 Pre-Installation

Warning: Disconnect battery power before installation.

Before you begin the actual wiring, be sure to review and understand the wiring diagram for your specific electrical system configuration. Vertical Power supports four different configurations, and the wiring diagrams can be found on the web site in the 'Documents' section. You must wire your aircraft to match one of the configurations. Any deviations may cause unsafe or unknown results. Please contact Vertical Power tech support if you have ANY questions. An example of the Config 2 diagram is shown below:



Prior to installation and wiring, the following should be considered:

- The battery(ies) in the aircraft should NOT be connected until the wiring is installed and each circuit is individually tested. Do not run wires while the battery is connected.
Tip: Disconnect the battery ground cable first, then the positive cable. When re-connecting, connect the positive cable first then the ground cable. Doing so ensures you won't spark the positive connection to the airframe.
- Consider bench testing the system and the devices prior to actually installing it in the aircraft. This allows you to become familiar with the system in a comfortable environment.
- Modify, if needed, the wiring harnesses to match your Load Planning Worksheet prior to installing in the aircraft. If the wiring harnesses are complete prior to installation in the airplane, you can "lay them in" the airframe.
- The easiest method is to run the wires from the Control Unit or Display Unit to their destinations. For example, simply run the wire from the Control Unit to the landing light area, along with a ground wire, and that circuit is basically complete.
- Use good quality, gold-plated connectors for intermediate connections. For example, you may want to use a connector for all the instrument panel wires that go to the rest of the airplane. Consider using a connector for all the control stick wires, so that you can remove it later if needed.
- Plan the physical wire routing in your aircraft prior to installing the harnesses. Drill any necessary bulkhead holes and protect sharp edges with snap bushings, grommets or other suitable fastener.
- The Display Unit and Switch Panel are not designed to run as standalone units. They must be connected to the Control Unit to operate correctly.
- Leave room for service loops (extra lengths of wire), so that you can easily remove and install components later.

DO NOT GRIND, FILE, DEBURR, OR DRILL METAL OR FIBERGLASS AIRFRAME COMPONENTS WITH THE UNITS INSTALLED, AS SHAVINGS MAY GET INSIDE THE UNITS AND CAUSE INTERNAL SHORT CIRCUITS.

Use the empty blanks (for Control Unit, Display Unit, and Switch Panel) during construction. These blanks are available for a small, fully-refundable deposit from Vertical Power.

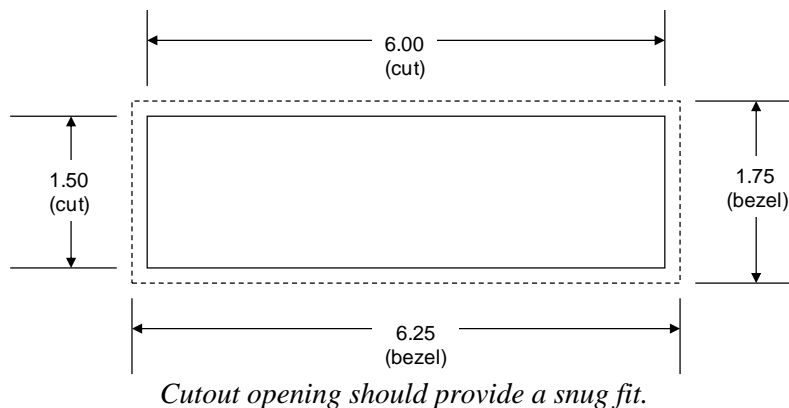
7.2 *Installing the Display Unit*

The DU should be located in the instrument panel where a graphical engine monitor would normally be located. No external air cooling is required. The USB interface jack is located on the back of the unit, and if easy access is not afforded, a short USB extension cable maybe installed and mounted to provide easy access when needed. The dimensions are available on the Vertical Power website. Note that the unit is slightly taller and wider than the panel cutout, and that the unit mounts from **BEHIND** the instrument panel. A 6ft cable is included to connect the DU with the CU, and you may use a cable up to 15 feet long. The DU should be attached to the panel with the supplied 6-32 x 3/8" screws. Do not use screws longer than 3/8".

7.3 *Installing the Switch Panel*

The Switch Panel should be located where it can be easily accessed using the same hand that you use to manipulate the throttle controls. A 6 ft cable is included to connect the Switch Panel with the CU, and you may use a cable up to 15 feet long. The unit dimensions are shown below, and the dotted line shows the outline of the bezel which his 1/8" larger on each side than the hole. The hole should be slightly larger than the inside dimensions. The unit mounts from the **FRONT** of the instrument panel and is held in place using a bracket on the back side.

Note: the rear mounting bracket holds the Switch Panel flush with the instrument panel. It is not strong enough to keep the switch panel from rocking or sliding. Therefore, the opening should be made as snug as possible so that the Switch Panel does not move within its opening. **DO NOT OVERTIGHTEN THE REAR MOUNTING BRACKET.**



7.4 Installing the Control Unit

The CU is typically located behind the instrument panel, but may be mounted almost anywhere in the interior of the aircraft where it is protected from direct exposure to the elements.

Locate the CU taking the following into account:

- The CU should be located inside the cabin, away from occupants and baggage.
- Do not locate near sensitive equipment such as a compass or AHRS. While no known interference exists, you should test and verify that an operational CU does not affect other equipment prior to finalizing the equipment locations.
- While the CU itself is water-resistant, every effort should be made to locate it away from possible water exposure. If you have a tip-up canopy or believe it may occasionally be exposed to water, use RTV silicone sealant to fill the small holes where the case meets the end caps. Do not put sealant on the connectors.
- The CU should NOT be mounted to the firewall where it is exposed to direct heat and vibration.
- Locate where you can relatively easily access the CU and the power connectors for troubleshooting during installation and in the future.
- Air should be allowed to circulate around the CU. A fan is not required.
- Do not mount where occupants can easily touch, kick, bump, or otherwise disturb the CU.
- The wiring harnesses from the CU should be secured at a point near the CU.

Recommended CU mounting locations:

RV-7, 9, 10: horizontally under the intermediate bulkhead (located between the firewall and instrument panel) using fabricated angle aluminum brackets. The CU(s) is positioned roughly above the rudder pedal assembly, mounted to the brackets/intermediate bulkhead. For easy access, the Control Unit(s) can be mounted hanging downward from the brackets.

Lancair Legacy: on the avionics tray in front of the instrument panel, along the tunnel behind the seats, or in the aft section of the fuselage.

Lancair ES, IV-P: on the avionics tray in front of the instrument panel, forward of the door along the fuselage, or in the aft section of the fuselage (within the pressure vessel).

Note on mounting the Control Unit(s) in the rear of the aircraft

You can mount the CUs in the aft section of the aircraft without issue. This may be attractive when space behind the panel is crowded or if the batteries are in the back of the fuselage. However, the standard wiring harnesses provided by Vertical Power assume the CUs are mounted up front near the instrument panel. You will need to modify the standard harness (wire lengths are listed in the Load Planning Worksheet) to accommodate the longer wire runs to the avionics and other equipment mounted in the front of the aircraft.

The CU is designed with three mounting holes/slots on each side, and should be secured with a minimum of two AN3 (10-32) or 8-32 bolts, one on either side of the case.

- Mount the CU so that it is securely attached to the mounting surface.
- If mounting in a composite aircraft, or on non-conductive surface, run a wire from the CU chassis to the main ground block. Use a ring terminal around the mounting bolts or one of the four Philips screws at the outside edge of each faceplate. The red anodization acts as an insulator, so use a toothed lock washer or gently scratch off the anodization so the ring terminal is electrically conductive with the case.
- Ensure that the small switch on the side of the CU is set appropriately. CU1 should be set to 1 and CU2 should be set to 2.

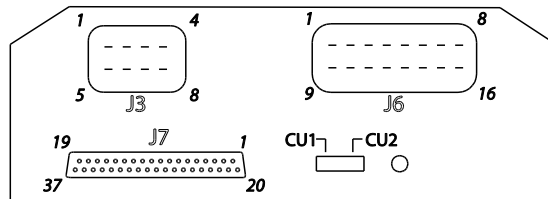


Figure 3: CU select switch must be set correctly

- If two Control Units are installed, connect the CU-Interlink cable between the CU connectors (9 pin d-sub connector) on each CU.
- If two Control Units are installed, the SP connects to CU #1. The SP connector on CU #2 is unused.
- Note the opposite gender of the db15 connectors on the CU that go to the DU and SP. When “laying in” cables, orient the male and female ends to match appropriately.

7.5 Wiring the Display Unit

The Display Unit is wired to the Control Unit(s) via pre-fabricated cables. Data and other inputs, as well as audio output, are wired using the 37-pin d-sub connector. The inputs will be configured using the setup menus later in the installation process.

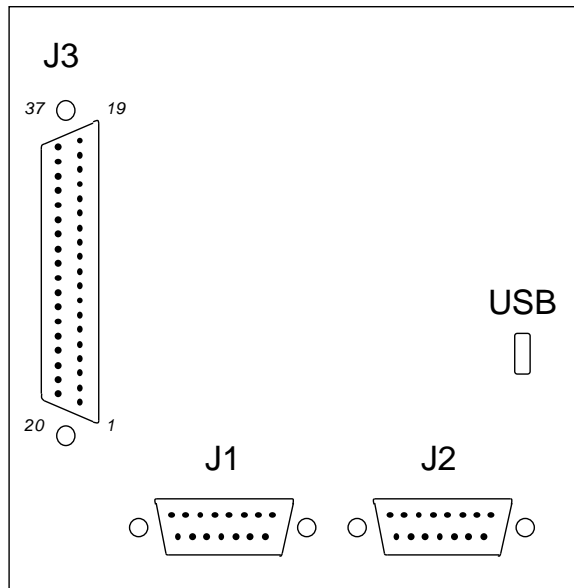
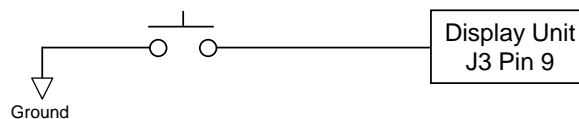


Figure 4: Back side of Display Unit

- Lay in the pre-manufactured cable(s) between the Display Unit and the Control Unit. This cable has a male 15-pin connector on one end and a female 15-in connector on the other end. Orient the cable(s) so that the FEMALE connector on the cable plugs into the DISPLAY UNIT.
- Connect the cable from J1 to Control Unit 1. Tighten the thumbscrews on each connector.
- Connect the cable from J2 to Control Unit 2, if installed. Tighten the thumbscrews on each connector.

Note: J3 on the Display Unit is a female (socket) 37-pin d-sub connector. The connector with the wires attached to it is male (pins).

- Connect J3 pin 9 to an external momentary (ON) SPST switch. This is the ACK (acknowledge) switch, which will be used to acknowledge alerts and checklist items. The button should be located in a convenient location either on the control stick or near the throttle quadrant. The other terminal on the switch should be wired to ground.



- Wire the serial out from the EIS (or other Engine Data Unit) to the appropriate Serial RX (receive) pin on J3. The default is pin 21. If a specific serial/digital/data ground wire is provided on the engine monitor, wire that to J3 pin 10. Otherwise, ground the EIS to the same place the CU will be grounded.
- Wire the serial out from the GPS unit to the appropriate Serial RX (receive) pin on J3. The default is pin 23. In most cases, you may split the GPS out wire and run it to multiple inputs. Ensure that the GPS output is configured correctly for NMEA 0183 output, using the GPS setup menus. If a specific serial/digital/data ground wire is provided on the GPS, wire that to J3 pin 10. Otherwise, ground the GPS to the same place the CU will be grounded.
- Optionally, connect the wire the serial out from the air data source (EFIS, for example) to the appropriate Serial RX (receive) pin on J3. Use the pin specified in your Load Planning

worksheet. If a specific serial/digital/data ground wire is provided on the EFIS, wire that to J3 pin 10. Otherwise, ground the EFIS to the same place the CU will be grounded.

- Wire the audio out J3 Pin 37 to the un-switched audio high input on the audio panel or intercom. Wire the audio ground J3 pin 18 to the un-switched audio low input on the audio panel. Use 2-conductor shielded wire, and ground the shield at the audio panel side only.
- Connect J3 pins to any external switch inputs (trim, flap, and/or device switches) as you've specified on the Load Planning Worksheet. Connect the other side of the switch to ground.

Before plugging in the J3 connector, be sure to double check that the wires are in the correct positions within the connector, and verify proper operation of pins coming from the external switches using a multi-meter or test lamp.

- Install the d-sub hood on the connector and plug into J3.

The Display Unit installation is complete.

7.6 Wiring the Switch Panel

The Switch Panel is wired to Control Unit 1 via pre-fabricated cables. The magneto P-leads are wired using the 4 pin power connector. The optional wiring harness includes the magneto wiring harness.



Figure 5: Back side of Switch Panel

Note: On some models J1 is mounted upside down from that shown above.

- Lay in the pre-manufactured cable between the Switch Panel and the Control Unit. This cable has a male 15-pin connector on one end and a female 15-in connector on the other end. Orient the cable(s) so that the MALE connector on the cable plugs into the SWITCH PANEL. On a dual CU system, the SP cable goes to CU #1.
- Connect the cable from J2 to Control Unit 1. Tighten the thumbscrews on each connector.

After routing the two 18-ga shielded wires to the engine compartment, they must be connected to the ignition. Following are suggestions – be sure to reference the installation manual for the ignition you are installing. In the case of Slick mags or Lasar ignition, the inner wire should be connected to the p-lead post, and the shield should be connected to the screw on the case of the mag (near the p-lead post). Strip the shield back about 2 inches, then solder a 20-ga wire to shield and cover with heat shrink tubing. Crimp ring terminals to the end of each wire then connect to the mag. For P-mag or Lightspeed, connect the inner wire to the “p-lead” on the ignition. You may or may not need the shield. The black wire on pin 3 on the Switch Panel goes to ground, and it should go to the same ground block as the ignition.

- Connect J1 Pin 1 to the P-lead connection on the right mag using shielded 18 gauge wire. Connect the shield to the ground wire on Pin 3.

- Connect J1 Pin 2 to the P-lead connection on the left mag using shielded 18 gauge wire. Connect the shield to the ground wire on Pin 3.
- Connect J1 Pin 3 to firewall ground using 18 gauge wire
- Install the Molex connector on J1 until you hear a snap, indicating it is locked.

The magneto P-leads are wired to a switch in the switch panel, and are electrically isolated from the rest of the system. The magneto switch is a high-quality mil-spec rotary switch designed for use with standard magnetos as well as electronic ignition. The VP-200 series does not control the mag p-leads in any way. It does, however, read the position of the mag switch. Therefore, if the VP-200 system should fail, the engine will continue to run.

- Verify proper operation of the mag switch using a multi-meter. Disconnect the p-leads from the mags and test at the mag side of the wire.
 - Both p-lead wires should be grounded when the switch is in Off position.
 - The left mag p-lead should be grounded when the switch is in the Right position. The right mag p-lead should be un-grounded.
 - The right mag p-lead should be grounded when the switch is in the Left position. The left mag p-lead should be un-grounded.
 - Both p-lead wires should be un-grounded when the switch is in Both position.
- Use this opportunity to verify that your ignition system can provide uninterrupted RPM data to the engine monitor. Please refer to “Magneto Wiring” in the Electrical System Basics section of this document.

The Switch Panel installation is complete.

7.7 Wiring the Control Unit

The Control Unit is the heart of the wiring system in your aircraft, and careful planning up front will make the installation process fairly straightforward. The Control Unit has four connectors for high-current power and one connector for low-current power and signals.

7.7a Wiring Considerations

Review the *Connector Service Manual* and *Contactors Installation Guide* prior to proceeding with this section.

The power connectors are labeled with the pin numbers next to each hole on the black side of the connector.

Caution: the firewall forward wiring must be wired exactly as specified in the *Config 1-4.pdf* document that matches the configuration you’ve selected in the Load Planning Worksheet. Pay special attention to the where each alternator b-lead attaches to contactor, and which side of the contactor is “power in” and “power out.”

Begin the Control Unit wiring.

- Double check that the correct wires are in the correct pins in the correct connector**, based on your setup in the *Load Planning Worksheet*. Remove any unused wires from the connector. Additional wires can be easily added later.

- Begin by plugging the connectors into the Control Unit and let the wires hang freely. Group the wires into bundles that go to a specific location in the aircraft. For example, group all the wires that go out to the left wing together.
- Run the bundles to their respective general locations. Keep in mind that ground return wires may also need to share space in the bundle as well.
- Determine the best way to secure the wires near the Control Unit to minimize stress on the wires at the connector.
- For dual Control Unit installations, repeat each step for Control Unit 2. Note that the flaps and starter are wired only from Control Unit 1.

7.7b Wires from Dedicated Pins

Most power pins on the Control Unit are configurable, but a few have dedicated functions.

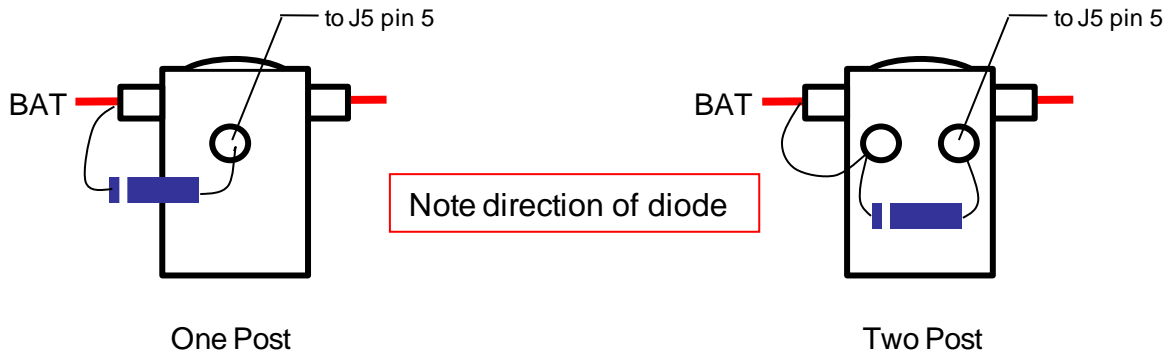
- Connect J3 Pin 4 to the starter contactor. Use the small post on the contactor labeled “S.”
- Connect J4 Pin 1 (red wire) directly to the battery using the included in-line fuse holder. The fuse holder should be mounted near the battery. You may connect the fuse holder to the battery itself, or the battery side of the battery contactor. Do NOT install the fuse or connect the battery until a later step.

Note: Use only the Bussman slow-blow MDA-20 fuses for normal operations. A readily-available 1/4 x 1-1/4” 20A in-line fuse may be used temporarily. Additional fuses may be ordered from Vertical Power, Digikey (part no. 283-2726-ND) or Mouser (part no. 504-MDA-20) if needed.

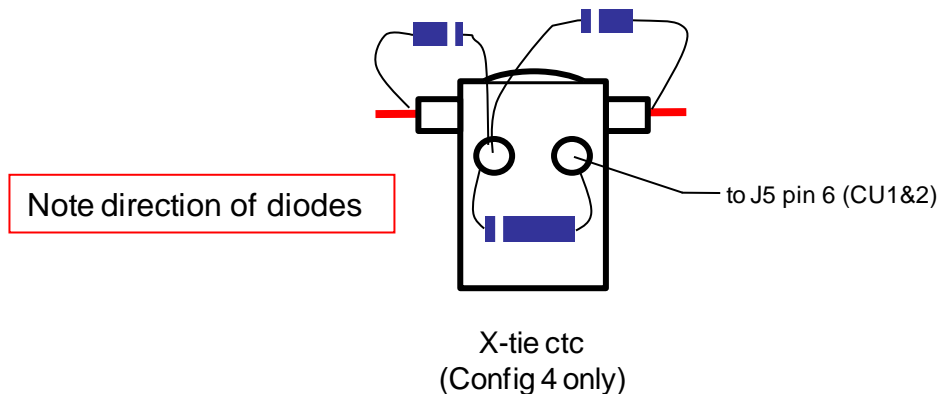
Install the fuse holder wires and leads as shown:



- Crimp the fuse holder leads using the NON-INSULATED pins on a crimper tool. The dimple left by the crimp should be on the side of the lead without the seam on it. This is a very important connection, so verify the crimp is a good one. You might also consider a small dab of solder between the wire end and metal fuse holder.
- Give the crimp a good pull to ensure it is secure, then pull the fuse holder leads into the rubber insulation boot.
- Connect J5 pin 5 to the battery contactor as shown below. For dual Control Units on a single bus (Config 3), wire J5 pin 5 from both Control Units to the battery contactor.
- Connect the diode (included with the system) to the battery contactor as shown below. Although optional, it is highly recommended. The diode will extend the life of the contactor, and may serve to minimize damage to sensitive avionics. Reference the *Contactor Wiring* document on the Vertical Power web site.



- Connect the main power wire from the battery contactor to the power lug on the Control Unit using a ¼" (0.250") ring terminal. Cover with a molded plastic cover. Torque to 36 in-lb (3 ft-lbs). **Do not over-torque the nut** – all you need is a snug fit. The power lug is a soft copper alloy and will break if over-torqued. Make sure that a washer is installed along with the ring terminal.
- If a x-tie contactor is installed, connect the diode (included with the system or with contactor) to the x-tie contactor as shown in the *Contactor Wiring* document on the Vertical Power web site. You can purchase a x-tie contactor from B&C Specialty Products (www.bandc.biz) with all diodes already assembled.



This diagram shows the small post on the left has positive power from both buses via diodes.

- Connect J7 Pin 13 to any keep-alive pins on the EFIS, clock, etc.
- Connect the three ground wires (J4 Pin 6, J5 Pin 7, and J6 Pin 8) to the firewall or main ground block. Do **not** connect the three ground wires together and then run a single wire to the firewall. All three wires should be connected to the same ground block.

7.7c Instrument Panel Wiring

- Connect each wire from the bundle of wires going to the instrument panel to its respective device or switch.

7.7d Cabin Wiring

- Connect each wire from the bundle of wires going to the cabin area to its respective device or switch.

7.7e Wing Wiring

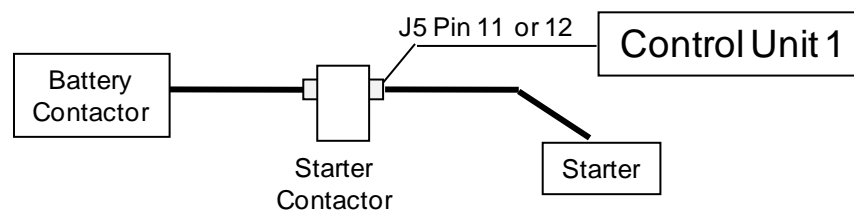
- Connect each wire from the bundle of wires going to each wing to its respective device. You may optionally install a connector at the wing root.

7.7f Starter Safety

If the starter solenoid is failed closed during system power the startup sequence is designed to allow the e-bus fuse to blow, preventing propeller rotation. Because the electrical system can be turned on from outside the aircraft using the remote key fob, this sequence is meant to limit prop rotation when you do not have ready and immediate access to the master switch. If this occurs, the starter solenoid should be replaced, and the e-bus fuse(s) replaced.

To know if your starter is engaged during flight, we recommend installing a ‘Starter’ annunciator, which is wired as shown below (just like any other annunciator):

- Install a wire from the switched side of the starter contactor (the big post that is connected to the wire going to the starter) to CU1 J5 pin 11 or 12. Use a ring terminal to secure the wire to the large post on the starter contactor. Use a 1K ohm, ¼ watt resistor in-line near the starter to provide circuit protection to the wire. Be sure to configure this feature in the setup menus.



7.7g Trim & Flaps

The wiring for the trim and flaps does not require any additional fuses, relays, or indicators. For Van’s aircraft, you do not need to install the Flap Positioning System (FPS).

The flap motor is powered through the J3 power connector, and the position feedback is connected through the J7 d-sub connector. Connect the flaps as follows:

- Connect J3 Pins 1 & 2 to the flap motor. Each pin goes to one of the two wires on the flap motor. The polarity does not matter.
- If installing a linear flap position sensor, connect J7 Pins 10, 28, 29 to the sensor. The colors on the wiring harness match the colors on a Ray Allen sensor and can be connected color to color. If you are not using a Ray Allen sensor, the function of each wire is detailed in the Load Planning worksheet.
- Connect J7 pins to any external switch inputs (pilot and co-pilot) as you’ve specified on the Load Planning Worksheet. Connect the other side of the switch to ground.
- Lancair: wire the flap motor and flap motor limit switches per the wiring diagram available on the Vertical Power web site. Do not install the flap relays shown in the Lancair installation manual.

The trim wires are grouped together by trim function, and shown in the same color by group on the Load Planning worksheet. They are separated from each other by number, but are physically located next to each other on the connector. Each trim servo has five wires: two for motor power, and three for position feedback. Connect the wires for each trim system as follows:

- Run the 5-conductor wire (five wires bundles together) to the trim motor. The colors on the wiring harness match the colors on a Ray Allen sensor and can be connected color to color. If you are not using a Ray Allen sensor, the function of each wire is detailed in the Load Planning worksheet.

Note: in some aircraft, it is desirable to provide a connector near the elevator trim servo. A popular method is to crimp d-sub connector terminals (machined barrel, mil-spec) to the servo wires and to the wiring harness. First, slip a piece of large heat shrink tubing over the wiring harness and move aside for later. Then, connect the terminals on each wire pair and seal with heat shrink tubing, which insulates as well as provides a secure connection. Be sure to offset each terminal so that the bundle doesn't get too big. Cover the bundle of wires with the large heat shrink tubing.

- Connect J7 pins to any external switch inputs (pilot and co-pilot) as you've specified on the Load Planning Worksheet. Connect the other side of the switch to ground.

7.7h Aux battery voltage measurement

- If you have an aux battery, install a 1000 ohm, ¼ watt resistor in line near the battery positive terminal, then run a 20 or 22 gauge wire to either CU J5 pin 11 or 12.

7.7i External Switches

- Wire any external switch inputs as you've specified on the Load Planning Worksheet. These are typically used for annunciators.

7.7j Retractable Landing Gear

See landing gear wiring diagram on the Vertical Power web site under Support->documentation.

Details TBD

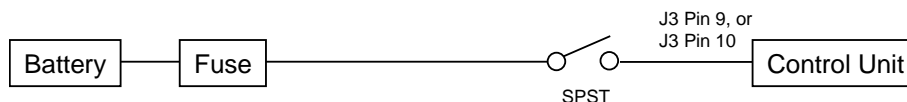
7.7k Air Conditioning

Air conditioning should be wired externally and separate from the Vertical Power system according to the instructions that come with the air conditioning system.

7.7l Backup Circuits

As described in *6.8f Backup Circuit* (be sure to read this section), you can wire backup circuits using three different methods. Depending on the number of circuits you wire, you can use either in-line fuse holders or a fuse block that holds several fuses.

For Method A, each backup circuit should be wired individually as shown in the picture below. Nothing further needs to be done with the wiring or the setup menus.



The steps are:

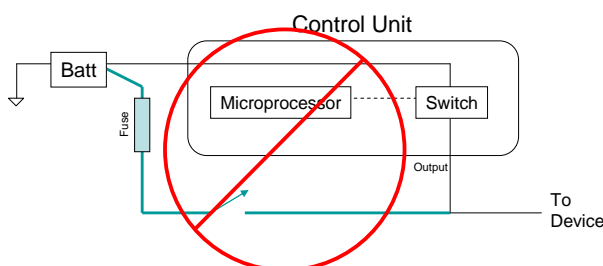
- Connect a fuse holder directly to the battery or battery side of the battery contactor. Make sure the fuse is removed until the entire installation is complete. Use a fuse that matches the value you've already determined for the device being controlled.

Warning: Do not use a fuse rated for greater than that specific circuit is rated. Doing so may

damage the Control Unit and affect the safety of flight. J5 Pin 9 and Pin 10 are rated for a maximum of 5A each.

- Mark the in-line fuse holder to indicate the fuse value.
- Run a wire from the in-line fuse holder to an SPST switch in the cockpit.
- Run a wire from the SPST switch to J5 Pin 9 or 10

Only the backup circuits should be wired in this manner. Do not wire other circuits so that battery power is provided directly to the device, as illustrated in the diagram below.



Doing so may cause unreliable operation and may blow the fuse under certain circumstances.

- Wire any additional external backup circuits (method B) that you planned.

For Method B and C, the wiring is independent of the Control Unit. Reference the *Backup Wiring* document of the web site for wiring details. You can use the same fuse block as used for Method A, if desired.

Make sure the switches you use are rated for the current of the devices they are controlling.

7.7m Grounding

- Verify all devices are properly grounded.

7.7n Testing Individual Circuits

At this point, all the wires should be connected to their respective devices. The purpose of this step is to verify correct installation of the wiring.

Taking your time and being methodical on this step will save troubleshooting time later.

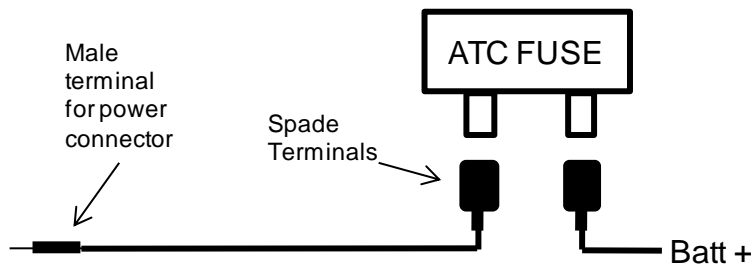
Warning: make sure that the following are carefully checked prior to proceeding:

- Disconnect the large wire going to the starter to eliminate any chance that the starter may be accidentally engaged. Temporarily cover the exposed end of the wire with electrical tape.
- Make sure that the propeller area is clear and can rotate freely.
- Verify that the fuel system is sealed or empty.
- Verify that the area around and under the flaps is clear.
- Verify that the area around the trim motors and tabs is clear.
- Verify the high-voltage strobe wiring is either sealed or connected to a strobe light.
- Check for any other conditions that may be problematic during testing.

NOTE ABOUT MEASURING VOLTAGE: Solid-state switches have a characteristic that will show near bus voltage on a power pin even when that pin is off. Don't worry, it won't cause sparks or arcing. There is no "power" behind the voltage, it is simply an artifact of the solid-state switches (a specialized transistor). In order to measure voltage correctly, there needs to be a load on the pin, like a test lamp, when taking measurements. If the pin is off, the voltage will be zero when there is a load on it. If the pin is on it will read at bus voltage when there is a load on it.

Then proceed with the following steps:

- Disconnect the wiring harness connectors from J3, J4, J5, J6, and J7 on each Control Unit, if connected.
- Verify that the correct wire is in the correct connector location using the Load Planning worksheet as a reference.
- Prepare two 20 or 22 gauge wires about 15ft long each with a female d-sub connector terminal crimped on one end and an in-line 2A fuse on the other.
- Prepare two 18 gauge wires about 15ft long each with a male terminal (Molex P/N 19417-0048, available from Digikey or Mouser) crimped on one end and an in-line 10A fuse on the other. These wires are included in the Vertical Power wiring harness kit. Using a bare-end wire, paperclip or screwdriver rather than the Molex male terminal may damage the gold coating on the terminals inside the connectors.



- Using the 18 gauge wire, connect one wire to the positive terminal of a battery (any battery is OK as long as it matches the voltage of the aircraft battery). Check that the negative on the battery is attached to the ground terminal or airframe.
- For each 5A, 10A and 18A circuit, push the male terminal from the test wire into the connector and verify the device turns on. Note that certain devices may have multiple independent power inputs, like a Garmin 430 or SL-30.
- Insert the wire into J3 Pin 4 and verify starter contactor operation by an audible click.
- Connect the other wire to ground. Insert the wires into J3 Pin 1 and Pin 2 and verify the flap motor operates through its expected range of motion. Flipping the pins will change the direction of the motor.
- Connect the aircraft battery positive lead to the battery contactor. Connect the battery ground to the airframe.
- Verify that the main power wire going from the battery contactor to the Control Unit is secure and insulated.
- Insert the grounded test wire into J5 Pin 5 and verify battery contactor operation by an audible click.
- If J5, Pin 6 is connected, verify proper operation of the device attached to that device. If it is a Bus-Tie contactor in a dual bus system, engage the battery contactor for testing.
- Using an ohm meter or test lamp, verify each of the three ground wires is grounded properly.
- Using the 22 gauge wire, connect one wire to the positive terminal of a battery (any battery is OK as long as it matches the voltage of the aircraft battery). Check that the negative on the battery is attached to the ground terminal or airframe.

- Connect the other wire to ground. Insert the wires into the correct trim motor power terminals and verify the trim motor operates through its expected range of motion. Flipping the pins will change the direction of the motor.
- Using an ohm meter or test lamp, verify that the external switch inputs to the DU and CU operate correctly. Each pin should be grounded when its respective switch is turned on. This includes all trim and flap switches as well as canopy, door, start, or other switches.
- Install the fuse(es) in the backup circuit fuse holder(s), if installed. Using a voltmeter or test lamp, verify that J5 Pins 9 and/or 10 are on when the backup switch is on, and off when the switch is off.
- Install the included (MDA-20) fuse in the e-bus fuse holder(s). Verify that bus voltage exists on J4 Pin 1 for each CU.
- Remove any test leads and do a sweep to check for loose or exposed wires. Leave the large wire to the starter disconnected until asked to re-connect in the ground testing phase.
- Verify the CU Select switch on the side of each CU is set properly.

You are now ready to power up the system.

- Connect J3 – J7 to each CU.
- Press the green power button on the switch panel to turn the system on. The DU will take about 20 seconds to boot up, and you should immediately see the switch panel lights sequence through a self-test.

Note: If you notice anything unusual, press and hold the green power button for 2 seconds to shut off the system.

8 Step 3: Configure the system settings

You are now ready to configure the VP-200 series to operate in your particular aircraft. This section describes the “mechanics” of the setup process. To better understand how the system uses the values during a flight, refer to the VP-200 Operating Manual.

Configuration is done using the Display Unit, and settings are propagated to the CU and Switch Panel. The settings are stored in the Display Unit and can be backed up on to a USB flash memory device. The DU comes from the factory with basic settings that likely don’t match your setup. You can build on those settings or load an example configuration file from the Vertical Power web site and then modify it.

You can plug a standard USB computer keyboard in to the USB port which will help speed the setup process.

Access the setup menus by selecting the Options soft key and scrolling through the pages until you see Setup. **Setup can only be entered from Pre-flight or Post-Flight Mode.**

The setup menus are organized as follows:

1. Electrical System Setup
2. General Setup
3. Device Menu
 - a. Starter & Cross-tie setup
 - b. Device names
 - c. Pin names
 - d. Device setup
 - e. Wig-Wag setup
 - f. Autopilot disconnect alarm
 - g. Climate Control (if installed)
4. Flap, Trim & Gear Menu
 - a. Flap setup
 - b. Pitch trim setup
 - c. Roll trim setup
 - d. Yaw trim setup
 - e. Flap check setup
 - f. Pitch, Roll, Yaw check
 - g. Co-Pilot Setup
 - h. Landing gear setup
5. Serial Ports Menu
 - a. Serial Ports Setup
 - b. Data Association
6. Engine Menu
 - a. Engine Setup
 - b. Engine Gauges
 - c. Instrument layout
7. Checklist Menu
 - a. Behavior
 - b. Edit Checklists
8. Emergency Setup
9. Annunciator Setup
10. Software & Settings
11. Associate Remotes
12. Change Start Code
13. Change Admin Code
14. Factory Settings

Setup Main Menu

Electrical System Setup

General Setup

Device Menu

Flap, Trim & Gear Menu

Serial Ports Menu

Engine Menu

Checklists Menu

Emergency Setup

Annunciator Setup

Software & Settings

Associate Remotes

Change Start Code

Change Admin Code

Factory Settings

Follow the instructions in the order below for initial setup.

Press *Save* or *Exit* soft keys to save each page of settings.
Do NOT power off the system while in the setup menus.

8.1 Setup Menus

A description for each item in the setup menu is shown in the Settings tab of the Load Planning Worksheet. Use the LPW as the source for the settings you enter into the setup menus. The LPW has

more settings listed than are currently implemented in the software. As additional features are implemented in the future, you can enter those settings from the LPW.

8.1a Electrical System Setup

This step should be performed before any other steps.

- Go back and verify that the wiring between the alternator(s), battery(s), contactor(s), and CU(s) is exactly as specified in the wiring diagrams. Re-read the *Contactor Service Manual* and pay special attention to which side of the contactors everything is wired.
- To set up the electrical architecture, press Options -> Setup -> Electrical System Setup.
- Under Configuration Type, select your electrical system config (1-4), as specified in the Load Planning Worksheet.
- Set the values for the low voltage and overvoltage conditions. The values in the image are recommended for 14v systems (double for 28v system):

Electrical System Setup	
Electrical Configuration	2
Volts bottom red, engine off	12.0
Volts bottom red, engine on	12.9
Over voltage trip	16.0
Aux Battery Input	Disable

Note: if you change the Electrical Configuration, the Field devices will be cleared. Make sure to re-configure the Field devices using Device Setup menus.

- Under Aux Battery Input, select the pin used to measure the aux battery voltage, if any.

8.1b Input Pin Verification

This step verifies that the discrete inputs on the CU(s) and DU are working correctly. The inputs referred to in this section are Switch Input 1 – 8 on each CU, active-high inputs J5 pins 11 and 12 on each CU, and Inputs 1-8 on each DU.

- Go to Options -> System Info -> Input Levels.
- For each input that you have wired, trigger that input. If you cannot trigger it manually, be sure to check it later when conditions exist that allow you to trigger the input. You should see the corresponding item on the screen go from Lo (inactive) to High (active), or the voltage rise from 0V (zero volts) to the bus voltage. For example, if you have a door micro-switch you can move it manually and see the indicator on the “grid” change as you open and close the switch.

8.1c General Setup

- Enter the settings on this page from the Load Planning Worksheet.
- When setting the device that flashes during power on, do not set any device that will exceed 15 amps.
- Items under Mode Control section are default for a Lycoming engine. You may need to modify these based on the performance of your aircraft, and you can fine-tune them later during the flight test phase.
- Press *Save* when done.

8.1d Device Setup

- To set up the devices, press Options -> Setup -> Device Menu.

- Plug a standard USB keyboard into the back of the Display Unit. You can use the rotary knob to enter names, but it is much quicker with the keyboard.

This section assumes you are already familiar with devices and power pins, as explained earlier in this manual. The process for setting up devices is summarized as follows:

- Step 1: Create the set of names for all the devices
- Step 2: Create the set of names for all the power pins
- Step 3: Set up the devices by assigning pin names to device names setting breaker values, and mode switching behavior.
- Step 4: Configure the starter and J5 pins 11/12.
- Step 5: Configure the emergency operations setup.
- Step 6: Set up the autopilot disconnect feature.

These steps are explained in detail below.

Step 1: Create the set of names for all the devices

- When in the Device Setup menu, select Device Names.

The screen looks like this:



- See Appendix A for an explanation of Reserved Names for devices.

The soft keys function as:

- Add name: Press to add a new device name. Type the name into the magenta box, and press Enter (on the keyboard) when done.
- Delete name: Press to delete the selected name. Reserved names cannot be deleted.
- Exit: Exits this setup page.
- Select: Pressing the rotary knob highlights or exits a specific selection. It also allows you to **edit** an existing device name. Rotating this knob in a text entry field allows you to edit characters by rotating the knob.

Note: Pressing F1 – F5 keys on the USB keyboard works the same as pressing the 1 – 5 soft keys.

- Delete names that you do not plan to use. You can always add new names in the future. Note: Reserved names cannot be deleted, and will only show up on the device list if pins are assigned to the name.
- Add names from the Load Planning Worksheet that are not already included in the list. You do not need names for trim, flaps, or any of the reserved names. Names can be typed in using the keyboard or the rotary knob. To enter a name from the rotary knob, press Add Name soft key, then scroll using the rotary knob until you get to the letter you want. Press select to go to the next letter. You can use the space and backspace keys as needed. Press select twice in a row to enter the name.
- Exit out of this setup page.

Step 2: Create the set of names for all the power pins

- When in the Device Setup menu, select Pin Names.

The soft keys function as:

Add name: Press to add a new pin name. Type the name into the magenta box, and press Enter (on the keyboard) when done.

Delete name: Press to delete the selected name. (function not implemented yet)

Exit: Exits this setup page.

Select: Pressing the rotary knob highlights or exits a specific selection.

- Add pin names from the Load Planning Worksheet that are not already included in the list. You do not need names for trim or flaps.
- ~~Delete names that you do not plan to use. You can always add new names in the future.~~
- Exit out of this setup page.

Step 3: Set up the devices by assigning pin names to device names.

- When in the Device Setup menu, select Device setup.

The screen looks like this:

Device Setup							
Device Name	Boost		Page	1			
Load Shed	VMC: Off	IMC: Off	Remote	None	On/Off		
Batt Ctc Failure	Turn OFF at failure		Switch	SP	2	Manual On	
Pin Name	CU	Conn	Pin	Breaker	Cur Fault	Fuse	Behavior
Pwr	1	J6	1	10	off	standard	on/off
N/A	1	J3	5	5	off	standard	on/off
N/A	1	J3	5	5	off	standard	on/off
N/A	1	J3	5	5	off	standard	on/off
Preflight	Beforestart	Start	Afterstart	Taxi	Runup		
Off	Off	Off	Off	Off	Off		
Takeoff	Cruise	Maneuver	Landing	Postflight			
On	Off	On	On	Off			
Save Device	Clear Device		Exit				

The soft keys function as:

Save Device: Saves the current settings. **You must press save to save the settings.**

Clear Device: Press to clear the settings. To delete the device, you must go to Device Names and delete the name. The Device only appears if one or more pins is assigned.

Exit: Exits this setup page.

Select: Pressing the rotary knob highlights or exits a specific selection.

- Scroll using the rotary knob until the Device Name field is selected. Press the knob to highlight the field (it will turn magenta when highlighted). Rotating the knob while the field is highlighted will scroll through all of the device names.
- For each device name, press the rotary knob to de-select the Device Name field and scroll to the other fields. Set a field by pressing the rotary knob. Once highlighted, rotate the knob to select from the available choices.
- Choose the page number you want the device name to appear on. The Device List on the right-hand side of the screen has three pages. You can place a maximum of 21 names on each page. We recommend placing the ones you want quick access to on page one, then others on pages two or three.
- If you want this device controlled by the remote key fob (during pre-flight and post-flight modes only), set the remote key number. The device can be set so it turns on and off, or is only on while the key fob button is pressed. The keys are shown in the diagram below.



Setting up a “Lights Check” button

One nice feature with the remote is you can configure it to turn on all your exterior lights so you can turn them on and off with a single button press. Any number of devices can be assigned to a specific button on the remote. Simply assign each of the lights (landing, strobe, nav, etc.) to a specific button on the remote.

- Configure if you want the device on or off during a load shed. Before a load shed occurs, it will ask you if the weather is IMC or VMC and shed accordingly. If a switch on the switch panel is set to IMC.VMC, then it will use that switch to determine current weather.
- If the battery contactor fails, you can select which devices are left on. A device will only be left on if it is already on at the time of battery contactor failure. Do not allow the total current draw of the devices left on to exceed 15 amps.
- Configure a switch to control the device, if desired.

The device can be assigned to a switch, either on the switch panel or an external switch wired into one of the switch inputs. The switches on the Switch Panel are two position and can be set to the following Control Types:

- Manual On: Up=manual on, down=Auto.
- Manual Off: Up=Auto, down=manual off.
- Manual On/Off: up=manual on, down=manual off.

If using an external switch, select the external switch input and the CU or DU. On dual CU systems the switch input must be on the same CU as the device.

Dimming pins:

A dimmable device can also be controlled by an external (on)-off-(on) switch. The switch inputs are called “pairs” because there is a *Dim* input and a *Brighter* input. When the dimmer input is grounded, the device will get dimmer, for example. They must be wired in specific pairs to specific inputs. Configure the inputs as CU1 Pair or CU2 Pair, and they must pair up as follows: 8-6, 7-5, 3-1, 4-2. The higher number is the brighter input.

- Configure each pin as specified on the load planning worksheet.

Pin Name	CU	Conn	Pin	Breaker	Cur Fault	Fuse	Behavior
Pwr	1	J5	3	5	off	standard	on/off
N/A	1	J3	5	5	off	standard	on/off

Pin name: select a name from the list you built earlier

CU: select the Control Unit. Only selectable on the VP-200 Duo system.

Conn: choose the connector as referenced on the load planning worksheet

Pin: choose the pin as referenced on the load planning worksheet

Breaker: set the circuit breaker value, which can be any integer value between 1 and the maximum

Current fault: The pin can be configured to detect a “current fault” or open circuit. When a circuit with this feature enabled is turned on and does not draw any current for 3 seconds, the circuit is faulted. You can use this to detect burned out lights, faulty boost pump, failed avionics fan, or inop heated pitot tube for example. The minimum detectable current is about 100ma, so this should be used on devices like lights, strobes and loads that draw at least 100ma of current.

Fuse: select either standard or slow-blow. Only use slow-blow if you have repeated nuisance trips with standard setting.

Behavior: for dimmable circuits, set the type of behavior. (see 6.15 Light Dimming Considerations for details). Note: if any one pin is set to “Dimmable” then all on that device must be set to dimmable. Only J6-12, 13, 14 are dimmable.

Note: A single device that has multiple pins will be listed in multiple places on the Load Planning Worksheet. You can always go back to a device and add a pin later if you forget the first time around.

- For each mode, select whether you want the device on or off. Select Yes if you want the device on during that mode, and No if you want it off. The default is ON from After-start to Landing Modes.

Note: Field Sec (Configs 2-3) should be set to No for all modes. In Config 4, Bus A alternator (Field A) and Bus B alternator (Field B) should be set to yes when you want them on – they run independently of each other.

- Repeat this process for each device.
- You cannot edit Device Names. If you want to change the name of a device, you must go to the Device Name setup page, delete the name, create a new device name, and set up the device again.
- Exit out of this setup page.
- From the Device List on the main screen, scroll through each device on each page and verify it is configured correctly.

NOTE: When exiting the setup menus, any changes to the mode settings are NOT reflected in the current mode. You must power cycle the system.

Step 4: Set up the starter and cross tie pages.

- Go to Options -> Setup -> Device Menu -> Starter & Cross-tie Setup.
- Select the Device List page number you would like the start item to appear on.
- Select the circuit breaker value and fuse type (note: leave fuse type in 'standard' unless you have repeated nuisance trips)
- If config 4 is selected, you may select the Device List page number you would like the X-tie (bus cross tie) item to appear on
- If enabled, the cross tie can be configured to close automatically while the starter is engaged.
- Select the input pin for the external starter switch, if installed.
- Press Save when done.

Step 5: Set up Wig-Wag Setup.

- Go to Options -> Setup -> Device Menu -> Wig-Wag Setup.
- Select one or more devices to wig wag. The pins that will be affected are shown on the right side of the screen. If a single device is selected, then the first pin on that device will be selected. If it has a second pin, then that will wig-wag too. If two devices are selected, then the first pin on each device will wig-wag.
- Set the speed above which the pins will wig-wag.
- Set the delay. A 5 second delay minimum is required to detect no-current or over-current conditions. We recommend a minimum 30 second warm up period for HID lights.

Step 6: Set up Autopilot disconnect alarm.

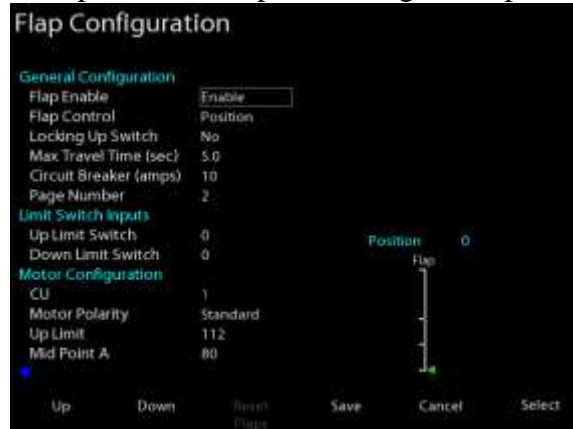
- Go to Options -> Setup -> Device Menu -> Autopilot Disc Alarm Setup.
- Select the device which is the autopilot. If this device has more than one pin assigned to it, the system uses the first pin to measure current.
- Set the current (amps) threshold to 1.0 amps. When the current draw goes above this limit, the AP Disc alarm is armed, then when the current falls below this level the alarm is activated. A Trutrak autopilot typically draws about .2 amps when on (but not engaged) and about 1.6 amps when engaged, assuming the servos and control head are all wired to one power circuit. You can vary this threshold for different autopilots and configurations.
 - o If the feature is not working using the default value of 1.0, try the following: Once the autopilot is operating, use the device list to determine the current draw with the autopilot ON but not engaged, and then again when it is engaged. Set the threshold to some value in between these numbers. You can usually do this on the ground without the engine running.

8.1e Load Shed Setup

Load shedding is configured as part of the device setup, described earlier.

8.1f Flap Setup

- To set up the flaps, press Options -> Setup -> Configure Flaps, Trim & Gear -> Flaps.



Verify that the flap switch(es) is in the neutral (middle) position, and that the area around the flaps is clear before starting flap configuration. When moving flaps for the first time, carefully check that airframe components don't bind or bend under the motor load.

The limit switches will not operate correctly until configured. If using limit switches, use caution when moving the flaps until you can verify the limit switches are operating correctly.

Use the rotary knob to scroll through the configurable items, selected with a gray box. When you want to select an item, press the rotary knob and the box changes to magenta color. Rotate the knob to change the value. Press the rotary knob to confirm the change.

Entering a 0 value in the switch inputs disables that input.

- Follow this process to configure your flaps:

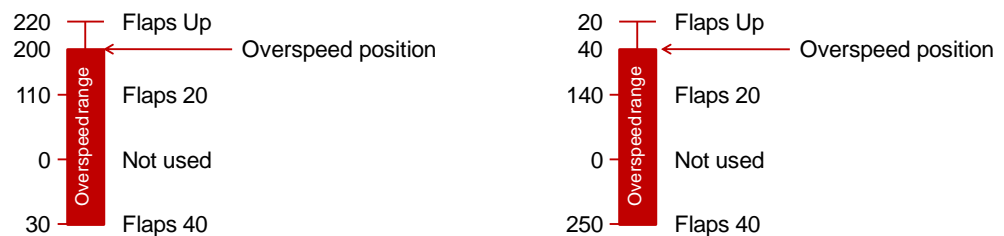
General Configuration

Flap enable	Enable/Disable. Set to enable if the Control Unit controls the flaps. Set to disable if your flaps are not operated electrically by the CU.
Flap control	Position/Momentary. Position=flaps can be set to stop at intermediate positions (requires position sensor). Momentary=flaps run only when flap switch is pressed. Set this to Momentary for now.
Locking up switch	Yes/No. If your flap switch locks in the up position, set this to yes. If it is a momentary up switch, set this to no. When set to yes, the following occurs: a) the max travel time is ignored when the flaps are running up b) the 'flap up' input switch(es) are ignored as part of the flap/trim switch fault checks on startup.
Max travel time	Set the maximum time (in seconds) the flaps can run per switch input. This prevents the motor from continuously running if the position sensor should fail or a control wire shorts. If the max run time is exceeded, the flap circuit will fault (disable the switch inputs), and you can run the flaps from the Device List as a backup.
Circuit breaker	Set the circuit breaker value for the flap motor circuit.

Page number Specifies the device list page (1 – 3) on which to display the Flaps item.

Max Flap Speed The indicated airspeed above which the flap down switch is disabled and the flap over-speed alarm is triggered. Set this value to 0 to disable both the flap down switch disable function and the flap over speed alarm. This function only works if an airspeed input is configured and working properly in Serial Ports Menu setup.

Over-speed Position The flap position below which the flap over speed alarm is triggered. If the flaps are BELOW this setting and the IAS is higher than the Max Flap Speed, the Flap Over speed alarm is activated. Since each aircraft is different, this speed may correspond to 10° of flaps, or maybe 30°. We recommend you set it somewhere just a bit BELOW the flap up setting. When we say BELOW we mean the actual physical flap position, not the numerical value used to show the position. Here are some examples:



Slow retract If enabled, the flaps retract at approximately half speed while in takeoff mode.

Flap Limit Switches

If using limit switches, verify the Control Unit is wired to the normally closed terminal on each limit switch (when the flap reaches the limit switch, the switch opens). Wire the up limit switch and down limit switch to the appropriate input pins on CU1. The limit switches cannot be wired to CU2. We recommend setting the switch short of the actual stop limit so that if the flap does overrun the switch it will not be overextended and possibly damage the airframe. Once you have verified the up and down limit switches operate correctly, move the limit switches further out to their respective endpoints until the correct travel limit is achieved.

Up limit switch Set the input pin on CU1 that is connected to the up limit switch. The other side of the switch should be grounded.

Down limit switch Set the input pin on CU1 that is connected to the down limit switch. The other side of the switch should be grounded.

Motor Configuration

CU Specifies the CU that controls the motor. Always CU1.

Motor polarity Standard/Inverted. Press the Up or Down soft key, and the flaps should move in the appropriate direction. If not, change the polarity until the flaps run in the correct direction.

Note: The Up/Dn and midpoint limits only need to be set if a position sensor is installed.

Up limit Run the flaps all the way up using the Up soft key. Select this item by pressing the rotary knob. The current position value, displayed on the right, will be entered in the box. You can adjust it manually using the rotary knob. We

recommend setting it a few numbers short of the actual limit to allow for position slop.

Midpoint A/B Allows you to set intermediate flap stops. These are disabled when the flap control is set to Momentary. Disregard for now.

Down limit Run the flaps all the way down (or the desired end point) using the Down soft key. Select this item by pressing the rotary knob. The current position value, displayed on the right, will be entered in the box. You can adjust it manually using the rotary knob. We recommend setting it a few numbers short of the actual limit to allow for position slop.

Note on up and down limits: make sure the limit value (the number 0 - 255 corresponding to the position) is set before or at the point of the physical limit. For example, if the down limit value is set to 0, but the furthest it goes is down to 8, then it will never reach zero and continue to drive the motor in anticipation of reaching zero. When then *max travel time* triggers, then the circuit will fault.

End point extent Only applies if Flap Control is set to *Position*. Time in seconds that the flaps will run extra when at the top and bottom travel limits. Usually this should not need to set greater than 1 second. This is to eliminate the slop inherent in the position sensor, which is used to stop the flaps at the top, bottom and intermediate position. If limit switches are used, the flaps will not run beyond the limit switches.

Use the example below to see how using this feature can eliminate slop in the position sensor. For the settings at both the top and bottom stops, you should set the value so some number “inside” the range so that the sensor will cause it to stop early, then the *end point extent* time will run the flaps to the end. Additionally, air loads during flight will likely change the readings somewhat, and this technique will account for that as well. Note that the actual readings may be reversed in your installation.

	Actual Reading	Recommended Setting
Top	→ 12	→ 20
15°	→ 48	→ 48
Not used		0
Bottom	→ 248	→ 240

Pilot Configuration

Up switch input Set the input pin on CU1 that is connected to the flap up switch. The other side of the switch should be grounded.

Down switch input Set the input pin on CU1 that is connected to the flap down switch. The other side of the switch should be grounded.

Co-pilot Configuration

Co-pilot controls	Enable/Disable. Enable if co-pilot control inputs are wired. A separate menu item is available from the Options menu that allows you to easily disconnect the co-pilot controls during normal operations.
Switch input unit	CU/DU. Select the unit to which the up and down switches are wired.
Up switch input	Set the input pin on CU1 or DU that is connected to the co-pilot flap up switch. The other side of the switch should be grounded.
Down switch input	Set the input pin on CU1 or DU that is connected to the co-pilot flap down switch. The other side of the switch should be grounded.

- Go back and change any settings so that it matches your desired final configuration. Setting can be changed in the future if needed.
- Press the Save soft key.
- Verify operation of pilot and co-pilot flap controls from the main page.

Because air loads on the flaps cannot be simulated on the ground, you may have to modify the limit settings once you begin flight testing. See the troubleshooting section in this manual if your flaps are not operating properly.

8.1g Flap Checks Setup

When the Flaps are enabled, you can then configure the Flaps Check Setup which specifies the limits for the “Check Flaps” alarm. If the flaps are out of the specified limits, then a Check Flaps alarm sounds. We recommend flying a few flights first to get the flap limits set correctly, then go back and set the flap alarm limits.

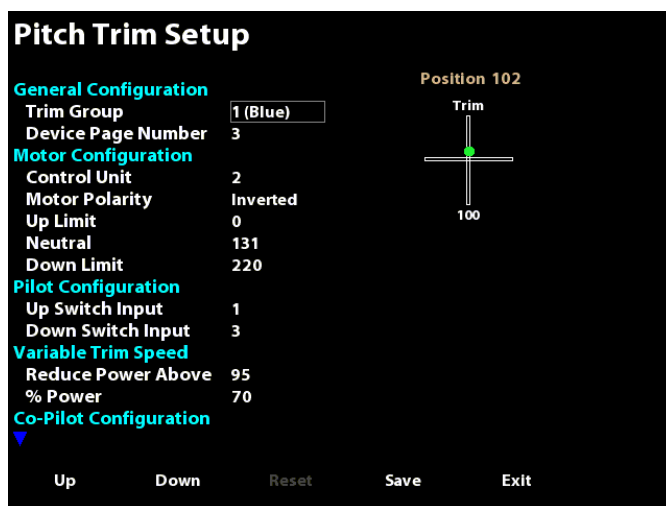
- Adjust the upper and lower limits so that the green range shows where the flaps should be for the modes specified at the bottom portion of the screen. The values that are set in the Flap Setup are displayed next to the graphs. If the green range goes to the end limit of the graph, then run the limit a bit past it to account for any slop in the sensor. For example, if the end limit on the graph is 15, then set the limit to 5 or 10 to account for “a little extra.”
- Enable the modes where the checks should be active.

Note: Taxi is listed twice. The system differentiates between taxi for takeoff and taxi back after landing.

8.1h Trim Setup

- To set up the trim, press Options -> Setup -> Configure Flaps, Trim & Gear -> Pitch/Roll/Yaw Trim.

Each of the three trim setup pages is similar. The pitch trim page is shown below for guidance.



Verify that the trim switch is in the neutral (middle) position, and that the area around the trim motor/tabs is clear before starting configuration.

When operating the trim motor for the first time, carefully check that airframe components don't bind or bend under the motor load.

Use the rotary knob to scroll through the configurable items, selected with a gray box. When you want to select an item, press the rotary knob and the box changes to magenta color. Rotate the knob to change the value. Press the rotary knob to confirm the change.

Entering a 0 value in the switch inputs disables that input.

- Follow this process to configure your pitch trim, and repeat for each trim system installed:

General Configuration

Trim group Disable/1 (Blue)/2 (Yellow). Select the trim group, referenced on the Load Planning Worksheet, to which the five trim wires are connected.

Device page number Specifies the Device List page (1 – 3) on which to display the trim item.

Motor Configuration

CU Specifies the CU (1 or 2) that controls the motor.

Motor polarity Standard/Inverted. Press the Up or Down soft key, and the trim should move in the appropriate direction. If not, change the polarity until the trim runs in the correct direction. Down trim is usually the forward switch, and trim up is usually the aft switch. The elevator trim tab should run down when pressing the up trim button.

Up limit Run the trim all the way up using the Up soft key. Select this item by pressing the rotary knob. The current position value, displayed on the right, will be entered in the box. You can adjust it manually using the rotary knob.

Neutral limit Run the trim to the neutral position up using the Up/Down soft keys. Select this item by pressing the rotary knob. The current position value, displayed on the right, will be entered in the box. You can adjust it manually using the rotary knob. Neutral can be any position you choose, but it is recommended that neutral is set to the takeoff trim position.

Down limit Run the trim all the way down using the Down soft key. Select this item by pressing the rotary knob. The current position value, displayed on the right, will be entered in the box. You can adjust it manually using the rotary knob.

Pilot Configuration

Up switch input Set the input pin on the corresponding CU that is connected to the trim up switch. The other side of the switch should be grounded. This must be on the same CU as the trim motor is connected.

Down switch input Set the input pin on CU1 that is connected to the trim down switch. The other side of the switch should be grounded. This must be on the same CU as the trim motor is connected.

Variable Trim Speed (Pitch only)

Reduce Power above Set the speed above which the pitch trim runs at a slower speed. Currently uses groundspeed for the input value.

% Power Set the percentage of full speed that the pitch trim motor should run when the aircraft speed is above the 'reduce power above' speed.

Co-pilot Configuration

Co-pilot controls Enable/Disable. Enable if co-pilot control inputs are wired. A separate menu item is available from the Options menu that allows you to easily disconnect the co-pilot controls during normal operations.

Switch input unit CU/DU. Select the unit to which the up and down switches are wired.

Up switch input Set the input pin on the CU or DU that is connected to the co-pilot trim up switch. The other side of the switch should be grounded.

Down switch input Set the input pin on the CU or DU that is connected to the co-pilot trim down switch. The other side of the switch should be grounded.

- Repeat this process for each trim axis.

8.1i Trim Checks Setup

When each individual trim axis is enabled, you can then configure the Trim Check Setup for that axis which specifies the limits for the "Check Trim" alarm. If the flaps are out of the specified limits, then a Check Trim alarm sounds.

- For each enabled axis, adjust the upper and lower limits so that the green range shows where the trim should be for the modes specified at the bottom portion of the screen. The values that are set in the Trim Setup are displayed next to the graph. If the green range goes to the end limit of the graph, then run the limit a bit past it to account for any slop in the sensor. For example, if the end limit on the graph is 15, then set the limit to 5 or 10 to account for "a little extra."
- Enable the modes where the check should be active.
- Press SAVE and exit.

8.1j Landing Gear Setup

- Go to Options -> Setup -> Flap, Trim & Gear -> Landing Gear Setup.

- Configure one, two or three of the landing gear indicators. Not all three need to be configured. Only those configured are displayed on the screen. When each input is grounded, the corresponding indicator light is green.



- Configure the transition indicator. This is typically from the hydraulic pump solenoids, and shows yellow on the indicators when this is active and the gear is not down.
- Configure the alarm speed. This is in units as reported by the airspeed data source. Airspeed input **MUST** be enabled and working correctly for this to work. If the aircraft is in Cruise or Landing Mode, and the airspeed is below this value and not all gear indicators are green, an alarm will sound. Set this to 0 to disable the alarm.
- Configure the gear circuit and disable below speed. This is in units as reported by the airspeed data source. Airspeed input **MUST** be enabled and working correctly for this to work. If the airspeed is below this value then the specified circuit will turn off. BE sure this circuit is not assigned to a switch or remote. This should be assigned to the device that controls power to the landing gear switch. Set this to none to disable this feature.

Note: to test that altitude is working correctly, from the main screen go Options (3x), then system info. Altitude is shown on that page and should match the altitude from the reporting device.

8.1k Co-Pilot Disconnect Setup

- To set a device to use as a co-pilot disconnect power wire (see Section 4 for details), press Options -> Setup -> Flap, Trim & Gear -> Co-Pilot Disconnect.
- Select the desired device. The device will turn on whenever the 'Co-Pilot Disable' button is pressed.

Set the following items for the device itself under Device Setup:

- 1) Have all modes for the device set to 'Off'
- 2) Load shed should be as desired
- 3) Batt ctc fail should be 'Leave On'
- 4) It is not recommended to set up this device as a remote controlled device or assigned to any switches on the switch panel or external switch.

8.1l Serial Port Menu

When configuring the system, follow the sequence shown herein to configure the serial menu and engine menu.

The Serial Ports Menu has two sub menus:

1. Serial Port Setup – set the data format coming into the port
2. Data Association – set where each engine parameter is coming from.

Serial Port Setup

Serial Ports Menu

Port #1	EIS 6000	Bytes: 22429818	Packets: 255597
Port #2	GPS NMEA 0183 (4800)	Bytes: 21099298	Packets: 251943
Port #3	None	Bytes:	Packets:
Port #4	None	Bytes:	Packets:
Port #5	None	Bytes:	Packets:

There are five serial input and output ports on the Display Unit. They are 8-bit, RS-232 ports that operate from 4800 baud to 115200 baud. The baud rate is set automatically based on the serial data stream selected. Although each serial port can be individually configured, the recommended configuration is:

Serial input 1: engine data

Serial input 2: GPS data

Serial input 3: air data (optional)

Serial input 4: VP-200 data output (to GRT HX only). This configures the TX and RX ports.

Serial input 5: open

Each serial port has a counter to show the number of bytes received. The counter increases as data is received, and means only that a connection is established. If the packet counter is moving, then data is recognized in the proper format.

If Indicated Airspeed (IAS) is on an existing engine input then you don't need to designate a port for air data. If IAS is coming in on a dedicated serial port, then set that port to the correct data type.

- The following formats output IAS if the airspeed option is installed: EIS
- The following formats output IAS: EIS(Chelton Output), MVP-50(Chelton Output), AFS 3400/3500, Aviation II Format (maybe), Air Data Z, Dynon EFIS

- Scroll to the desired data input port using the rotary knob.
- Press the rotary knob to select the field (it will turn magenta), and then rotate the knob to select the desired input format.
- Exit the serial ports menu when complete.

Data Association

Data Association Setup					
Fuel Level	EIS 6000	Fuel Flow	EIS 6000		
Fuel Pres	EIS 6000	Man Pres	EIS 6000		
Oil Pres	EIS 6000	Oil Temp	EIS 6000		
RPM	EIS 6000	EGT/CHT	EIS 6000		
Batt Amps	None	Alt Amps	None		
OAT	None	TIT	None		
Hyd Pres	None	Carb Temp	None		
Gnd Speed	GPS NMEA 0183 (9600)	Airspeed	EIS 6000		
%Pwr-FADEC	None	Coolant Temp	None		
Gearbox Temp	None				
Aux Inputs	EIS 6000				
Aux Input #1	Fuel Left	Integer	Aux Input #2	Fuel Right	Integer
Aux Input #3	Man Pres	Decimal	Aux Input #4	Fuel Pres	Integer
Aux Input #5	None	Integer	Aux Input #6	None	Integer
Save			Exit		

The data association screen tells the system where to get specific engine data parameters. For most installations, all the engine data comes from one source and the GPS data comes from another source.

- Make sure you have done the serial port setup in the previous section first.
- Set the data source for each engine parameter you want to monitor. The sources allow you to choose from the items selected in the serial port setup menu.
- Set the source for GPS data.
- Set the source for the airspeed data.
- If you are using a GRT EIS as the data source, set the Aux Inputs field to EIS and configure each of the aux inputs as you have them configured on the EIS itself.
- Be sure to set the data field on both the top and bottom sections (main and aux inputs) if necessary.*
- If you are using Chelton, AFS, or MVP-50 data source, then the aux fields are set automatically.
- Save & Exit the Data Association menu when complete.

8.1m Engine Menu & Timers

The Engine Menu has three sub pages: Engine Setup, Engine Gauges, and Instrument Layout. Each is described below.

Engine Setup

Engine Setup

Engine Type	Lyc/Cont 6 cyl
Magneto Switch	On Switch Panel
Runup bug	1800
Fuel Flow (avg)	6.0
Cruise Speed (avg kts)	150
OAT Offset (EIS)	No
Run-Up Check	Yes
Max RPM Drop	175
Max Mag Delta	50
EGT Temp Range	100
RPM Stable Range	3

- For each item, set the desired value.
- If the Switch Panel has a magneto switch, then set to 'On switch panel'. For alternative engines or turbines which do not have a mag switch installed, select 'Not on switch panel'.
- Set the run-up bug to the RPM you normally perform a run-up. This bug is also used to switch into Run-up mode.
- The fuel flow and cruise speed values are used on the Fuel Summary screen, typically shown during Pre-Flight Mode.
- If the displayed OAT value is off by 50 degrees, or a large negative number, enable the OAT offset.
- Run Up Check. This enables or disables the Mag-Check Assist™ function. Configure the limits for the mag check and RPM delta, and also the range of the normalized EGT display (how much the EGT changes when on one mag). The RPM Stable Range is the range within which the RPM must stay for two seconds to register as stable. The default is +/- 3 RPM, which means the RPM must stay within 6 RPM. We recommend leaving the default values until you've had a chance to perform several run-ups and then adjust the values if necessary.
- Yellow Range Alarms. Enable to sound alarms when gauges are the yellow range. Disable to inhibit alarms when in the yellow range.
- 10K Boost Reminder and Boost Pump Device. Enable this feature and select the appropriate boost pump device that should be on when above 10,000 ft. Note that this does not turn on the boost pump, but rather reminds you to turn it on if it is not already on.
- Save when done.

Engine Gauges

This section is where the engine limits and engine alarms are set. The VP-200 supports an innovative feature that lets you customize engine alarms so they only go off during specified modes of flight. Whenever an exceedence occurs, the engine gauge itself will change color to show the exceeded. Each gauge can be disabled or enabled individually. CHT and EGT cannot be disabled individually, although the settings are there for it.



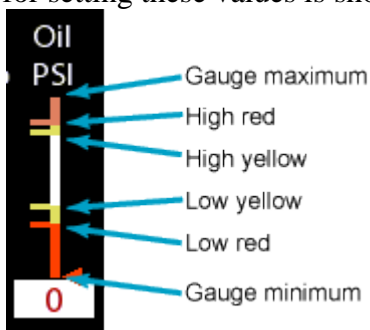
You can further tailor the following items:

- Alarm latch. If latched, the alarm annunciator will stay on until acknowledged.
- Master warning. The master warning light flashed then goes steady.
- Audible alarm. An audible alarm is played in your headset.
- Mode settings. Setting 'Alarm' will enable the above three features by mode.

IF 'NO ALARM' IS SET, THE ONLY INDICATION IS THE GAUGE WILL CHANGE TO YELLOW OR RED. TO HEAR THE ALARM OR FLASH THE MASTER WARNING, YOU MUST SET THE ALARM FOR THAT MODE.

For example, you may want to turn off the fuel pressure alarm in Pre-flight, Before-Start, Start, and Post-flight modes. You may want to turn of the RPM alarm in Takeoff mode, for example.

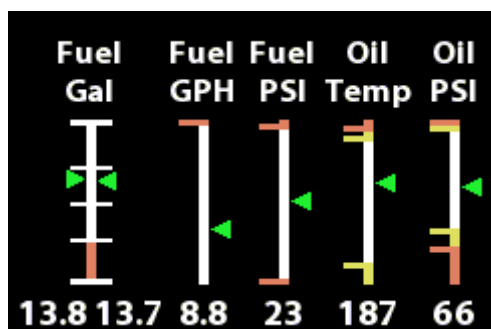
Most gauges have a red and yellow zone at the top and bottom ranges of the gauge. The nomenclature for setting these values is shown in the diagram below:



To disable any range value, set it to zero. The high red must be below the gauge maximum.

The RPM gauge also allows you set a middle RPM range in yellow to indicate an RPM restriction. Use the Instrument Layout Setup menus to set the relative position of the RPM and manifold pressure gauges.

Each setup will be unique based on your engine. We recommend setting the limits so that the green range is large, and that you can easily tell at a glance if everything is “in range”. The picture below shows an example in cruise mode where the indicators form an easy to read pattern.



- For each item, set the desired values.
- For CHT, the minimum yellow range is used only for the Before Takeoff Checks function, and does not alarm except during the check.
- BE SURE TO PRESS ‘SAVE GAUGE’ FOR EACH GAUGE.
- Exit when done.

Instrument Layout Setup

You can configure the two large engine gauges shown on the top left side of the Display Unit to represent a specific engine parameter during each Mode. For example, you may want to see Oil Pressure and RPM during start, Oil Temp and RPM during taxi, and Man Press and RPM during flight.

Additionally, Fuel Summary and Flight Summary functions are provided and typically used during Pre-Flight and Post-Flight Modes, respectively.

- For each Mode, select the appropriate gauges using the rotary knob.
- For Postflight Mode, set and/or enable one or more of the timers (engine and flight timers). Soft Key 3 enables you to set the increments to change the timer value. A description of the timers is shown below in the next section.

Instrument Layout			
MODE	LEFT GAUGE	RIGHT GAUGE	
Preflight	Manifold Pressure	RPM	
Start	Oil Pressure	RPM	
Afterstart	Oil Pressure	RPM	
Taxi	Oil Temperature	RPM	
Runup	Manifold Pressure	RPM	
Takeoff	Manifold Pressure	RPM	
Cruise	Manifold Pressure	RPM	
Maneuver	Manifold Pressure	RPM	
Landing	Manifold Pressure	RPM	
Postflight	Timer		
Engine Timer	Enabled	Engine Hours	733.4
Flight Timer	Enabled	Flight Hours	192.5
Tach Timer	Enabled	Tach Hours	45.1
Tach Timer RPM	2000		
	Hours Scale	Save	Exit
	0.1		

Engine and Flight Timers

As shown in the previous section, you can configure three different timers.

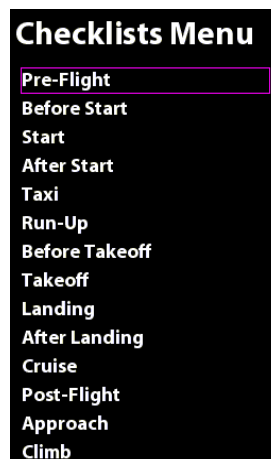
1. Engine timer: timer runs whenever engine is above roughly 500 RPM. This is equivalent to a Hobbs meter connected to an oil pressure switch.
2. Flight timer: timer runs when the aircraft is above 35 kts GPS GS or IAS.

3. Tach time: timer runs whenever RPM is above 2000 RPM (or as configured). This is roughly equivalent to a mechanical tach timer but does not log time below 2000 RPM.

Each timer can be enabled or disabled so you can use only the timers you need. The initial time can be set from the setup menu and is then incremented automatically on each flight.

8.1n Checklist Setup

The Checklist Setup page lists all of the checklists available in the Vertical Power system. Each checklist is tied to a specific mode or emergency procedure, and can be either enabled or disabled. For example if you don't want to have the landing checklist appear when the VP-200 switches into landing mode, then disable the landing checklist. Conversely, if you want a checklist to appear, enable it for that mode or emergency.



The Taxi checklist appears when switching to Taxi Mod after engine start at first movement.

The Before Takeoff Checklist appears when switching to Taxi Mode after Run-Up Mode or when the Before Takeoff Checks function is initiated during taxi or run-up.

The After Landing Checklist appears when switching to Taxi Mode after Landing Mode.

To set checklist “check-off” behavior:

- From the Checklists Menu->Behavior, select whether pressing the ACK button (external ACK switch wired to the DU) checks off an individual checklist item or a complete page at a time.

To build or edit a checklist:

- From the Checklists Menu, use the rotary knob to select the checklist you want to enable.
- Press the Enable List soft key. If it is dimmed, then the checklist is already enabled.
- Press the Edit List soft key.
- Use the soft keys to add, edit, or delete an item. You can scroll to the different items using the rotary knob.



- Each checklist item has two fields: an item field and an action field. Select the field and use either the keyboard or rotary knob to enter the field text.
- If a checklist runs more than 7 items, it will automatically show the additional items on a second and/or third page when the checklist is displayed.
- Repeat for each checklist item you want to create
- Press *Exit* when done

To disable a checklist:

- From the Checklists Menu, use the rotary knob to select the checklist you want to disable.
- Press the Disable List soft key. If it is dimmed, then the checklist is already disabled.

8.10 Emergency and Operations Setup

- Go to Options -> Setup -> Device Menu -> Emergency and Operations Setup.
- Select the type of boost pump that should be on when:
 1. the engine failure button is pressed, or
 2. the Auto Boost™ feature is engaged (if enabled).

For Continental engines, we recommend the Boost L be set, but you must check with your engine manufacturer to be sure.

The Auto Boost™ feature automatically turns on the specified boost pump when fuel pressure drops below the low red region (as configured) in Takeoff, Cruise, Maneuver, or Landing Modes. This feature should be used with fuel injected engines only, and only when turning on the boost pump in any situation will not flood or stall the engine. If you are not sure, contact your engine manufacturer. This should be used with the un-metered fuel pressure reading (fuel pressure taken between the mechanical fuel pump and the fuel injection servo).

- Enable or disable the Auto Boost™ feature.

The system can be configured to display an alarm if the aircraft is drawing more current than the backup alternator can provide. This applies to config 1, 2, or 3 only.

- Set the current alarm limit for the backup alternator, in amps. Typically, this should be set at about 80% of the rated value of the backup alternator. Set to 0 to disable the alarm.

The VMC/IMC switch handles both load shedding and turning on-off specific devices. When switched to IMC, the configured devices are turned either on or off. This allows you turn on or off up to 6 independent devices with a single switch.

- Set the IMC/VMC Switch if desired.
VMC/IMC: Up=IMC, down = VMC. Certain emergencies such as alternator failure will ask for the current weather condition (MC/VMC) to determine how to load shed. If this switch is enabled, then the VP-200 will automatically use the position of the switch as the weather input.
- Set each of the devices you want to control when the IMC/VMC switch is in IMC position, and set the action (on or off) that occurs. This action occurs if the device is in auto state at the time. The IMC switch works in addition to any other switches you may have for a device. For example, if you have a separate landing light switch and designate the landing lights to turn off for the IMC switch, then the two can both control the same light.

8.1p Annunciator Setup

You can create user-defined annunciators which are triggered by any of the input pins on the Display Unit or Control Unit. Reference your Load Planning Worksheet to find the input pins used to trigger the annunciators. The setup page is shown to the right. The first three lines allow you to select the specific annunciator input pin you want to configure. Change the values on the first three lines to select the input pin, then select and change the values below. The items are:

Label	DU/IO #	Master Warning	Yes
Unit	DU	Latch Alarm	No
Unit #	1	Audible Alarm	Yes
Pin #	IO #1	Flash Label	No
Signal Level	Low	Label Color	BLUE

	Preflight	Beforestart	Start	Afterstart	Taxi	Runup
Alarm	No Alarm	Alarm	No Alarm	Alarm	No Alarm	No Alarm
Takeoff	Cruise	Maneuver	Landing	Postflight		
Alarm	No Alarm	Alarm	No Alarm	Alarm		

New Delete Save Save & Exit Exit

To create a new annunciator, press the 'New' soft key and type in the name in the label field. This will appear on the screen when the annunciator is active. Select the unit and input pin. Then select the behavior and modes where the annunciator is active. The annunciator will only appear on modes that are set to 'Alarm'.

Label	Type in the text for the label. If it too long you can shorten it later.
Unit	Select where the input pin is located - CU (Control Unit) or DU (Display Unit)
Unit #	Select Unit 1 or 2 in a dual CU system.
Input #	Each CU and DU has 8 inputs. Enter the input number (1-8). This is not the pin number.
Signal Level	Low – the annunciator is on when the pin is grounded. High – the annunciator is on when the pin is un-grounded (not grounded).
Master warning	The master warning light come on along with the annunciator.
Latch alarm	Once the annunciator is triggered, it will stay on until acknowledged by the pilot.
Audible alarm	A double beep is played in the headset when the annunciator is shown.
Flash label	The annunciator is flashed three times then goes steady.
Label color	Choose from the available colors.
Modes	Set the mode when the annunciator will appear. For example, you may not want a door annunciator to show in Pre-flight and Post-flight modes.

8.1q Before Takeoff Checks

The Before Takeoff Checks function verifies that certain conditions are met when the **B4 TO Checks** button is pressed. The button is soft key 4 and appears in Taxi Mode and Run Up mode.

The Before Takeoff Checks function is not specifically configured in one spot. Rather, it checks several settings that are configured throughout the system. Therefore, you must individually check that each desired setting is configured properly and enabled. Each function must be individually enabled in the setup menus to use this feature.

When the B4 TO Checks button is pressed, the following items are checked:

1. Mag switch is in the both position – must be in BOTH
2. Trim is in the configured takeoff range – each enabled axis must be in green range
3. Flaps are in the configured takeoff range – must be in green range
4. Oil temp is in the normal range – must be in green range
5. CHT is in the normal range – must be in green range, above CHT low yellow limit

NOTE: For trim checks, the specific trim axis must be enabled AND the mode to check it must be enabled in the Check Trim setup menu. The same is true for flaps.

8.1r Software & Settings

You can update software for the entire VP-200 in a single button press. There are two types of files used by the VP-200:

- **Application software**, which contains the code that runs on the microprocessors. The filename looks like 2009_10_19r2006i_200VP.tgz and/or 2009_10_19r2006i_200VP.vpd

- **Settings file**, which contains the settings unique to your aircraft. You can save this file and load it back later or load it into another system. This filename is VP_Data.tgz

Warning!

After performing an Update Software process or Import Settings process, thoroughly verify proper operation of each electrical device, including flaps and trim. Do not fly the aircraft until the electrical system has been verified for correct operation. Verify proper operation during each Mode. Do not fly in IMC conditions until you are comfortable the new software is stable.

Application Software

Updated software is available periodically at no charge from the Vertical Power web site (go to Support then Software pages). Using an internet-connected computer, download the software file onto the supplied USB flash drive, which can be plugged in directly to your computer. You do not need to take the computer to the airplane to load the software, only the USB flash drive. If several versions of the app software are on the flash drive, the VP-200 will load the latest. If you want to revert to an earlier version, delete or rename the latest version.

Caution! Do not shut off the system while the software update is in progress.

- Follow the instructions in the release notes on the web site.

Export Settings

All of the settings can be saved to the USB flash drive as a backup. **We highly recommend saving your settings, once completed, to the flash drive and keeping it in the plane at all times.**

Do not shut off the system while the export is in progress.

To save the current settings:

- Insert a USB flash drive into the USB port on the back of the Display Unit.
- Press the *Export Settings* soft key. Monitor that the data is exporting. This action will write over any older files that you have exported.
- Exit when done.

Import Settings

You can restore your saved settings using the file previously saved to the USB flash drive.

Do not shut off the system while the import is in progress.

To import your saved settings:

- Insert a USB flash drive into the USB port on the back of the Display Unit.
- Press the *Import Settings* soft key. Monitor that the data is importing, then turn off the system when import is complete. **Do not operate the aircraft if any errors occur.** Cycle power to the system, check that all the units are functioning, and then re-attempt the Import Settings process.

Warning!

If any hardware component (Control Unit, Display Unit, Switch Panel) is replaced, you must perform an Update Software and then an Import Settings. This ensures all components have the same software and the same settings. Failure to do so may cause unreliable system behavior.

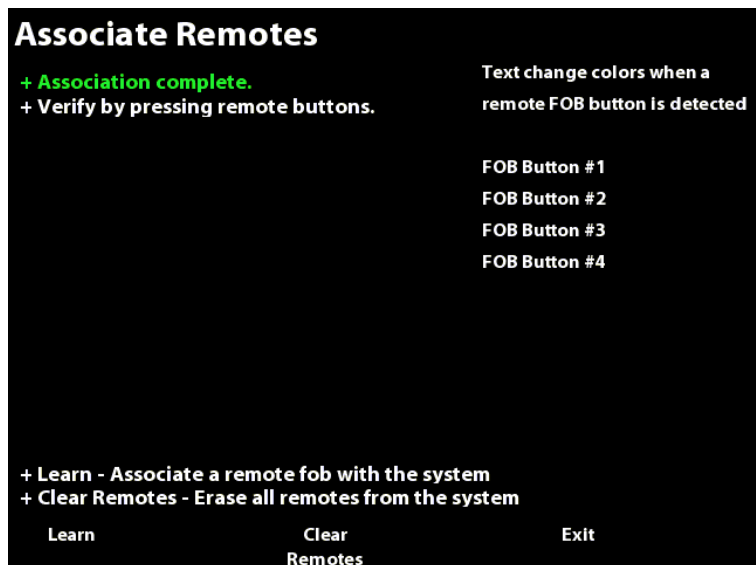
The USB flash drive should be carried in the aircraft at all times with the latest application software file and the latest setting file on it.

8.1s Associate Remotes (Learn)

You can associate one or more remote key fobs with the VP-200. The remote control radio receiver is part of the Control Unit. It is highly recommended that you clear the existing remote codes and associate your remote with your Control Unit, otherwise, other remote controls may be able to activate your VP-200 system. The association process, also called the **learn** process, creates a unique encrypted link between your remote and your Control Unit. The remote will only operate in Pre-flight Mode. One remote is included with the system, and additional remotes are available from Vertical Power or your dealer.

Follow these steps:

- Verify that the antenna is connected to CU #1
- Select “Associate Remotes” from the main setup menu
- Press the *Clear Remotes* soft key to clear any existing remotes
- Press *Learn* soft key. The receiver now is configured to learn the special code coming from your remote key fob.
- Follow the instructions on the screen. As you press the remote key fob buttons, the text for each button will change to green when the button is pressed, verifying proper operation. **Verify each button changes the text to green.**
- Repeat the learn process for each remote that you want to associate.
- Press *Exit* soft key when finished.



8.1t Change Start Code

In order to move from Before-start Mode to Start Mode, you must enter the four digit start code using the soft keys, labeled 1, 2, 3, and 4. The default start code is 1-2-3-4. We recommend changing the code at installation. If you forget the code, the Display Unit must be returned to Vertical Power for servicing.

- Select “Change Start Code” from the main setup menu.
- Follow the on-screen instructions to enter your new code.
- Press *Exit* soft key when finished.

8.1u Change Admin Code

In order to access the setup menus, you must enter a four digit code using the soft keys, labeled 1, 2, 3, and 4, after *Options* then *Setup* soft keys are pressed. The default admin code is 4-3-2-1. We recommend changing the code at installation, and change it to something different than your start code. If you forget the code, the Display Unit must be returned to Vertical Power for servicing. Once the admin code is entered, the setup menus are unlocked until the system power is turned off, then back on.

- Select “Change Admin Code” from the main setup menu
- Follow the on-screen instructions to enter your new code.
- Press *Exit* soft key when finished.

9 Step 4: Ground test the system

The ground test steps are performed in two parts: the first part without the engine running and the second part with the engine running.

9.1 Part 1

Read the VP-200 Operating Manual before starting the ground tests.

Perform the following steps without the engine running. The battery will drain during testing, so have either a charger or ground power available.

Turn on the unit using the green power button. The directions below list only the minimum steps needed for testing. More detail about operating the system is provided in the VP-200 Operating Manual.

- Verify the Display Unit is in Pre-flight Mode.

9.1a Device switching

- Press the rotary knob on the DU and the top item on the Device List becomes highlighted in magenta. The soft keys change to allow switching of the device. Rotating the rotary knob will move the highlight up and down the list. Scroll back to the top item on page 1 (the page numbers are shown right below the Device List).

Use caution when activating the starter circuit.

Ensure the propeller area is clear, and verify that the wiring is secure and the nuts on the contactors are tight. Verify mixture is lean, throttle is closed, and mag switch is set to OFF. The starter soft key is momentary action.

- Press the On soft key, and verify the highlighted device turns on. Press the Off soft key and verify the device turns back off. Press the Auto soft key and verify the device turns back to the appropriate on/off state for this Mode. If the device turns red, that circuit is faulted, meaning it is either shorted or draws too much current for the circuit breaker value you set. After you have tested all the circuits, fix the fault(s) by verifying the wiring and that the wire is on the right pin in the connector.
- Rotate the rotary knob to the next device and repeat. Verify that each device turns on and off with the soft key press. Continue to pages 2 and 3 of the Device List if they exist.

- With Flaps or Trim highlighted, confirm that you can move them using the soft keys. Note: Make sure the area around and under the flaps is clear!
- Before testing the gear circuit, properly support the aircraft and make sure the area around the gear is clear. Press the On soft key to provide power to the gear circuit. Cycle the gear several times. Verify the gear up and transition indications are proper. Press the Off soft key and verify the gear turns back to white. Cycle the gear switch and verify the gear does not operate. Press the Auto soft key and verify the device turns back to the appropriate on/off state for this Mode.

9.1b External switches

- Verify the pilot flap switch operates as expected.
- Verify the co-pilot flap switch operates as expected.
- Verify the pilot trim switches operate as expected.
- Verify the co-pilot trim switches operate as expected.
- Verify the co-pilot disconnect function works properly.
- Verify door, canopy, and other external annunciators operate as expected (by Mode).
- Verify that external switches operate as expected. (future)

9.1c Switch panel

- For each of the three paddle switches, verify that its assigned Device operates correctly based on the way they are configured in the setup menus.
 - Manual on: on when up, and auto when down
 - Manual off: auto when up, and off when down
 - Manual on-off: on when up and off when down
- Press the red emergency button momentarily. Verify that the emergency screen appears (you can tell because a lot of things turn red). Press the button again to exit the emergency screen.
- Place your finger over the light sensor for at least 5 seconds. Verify that the screen dims.
- Press and hold the green power button for two seconds. Verify the system shuts off.

9.1d Remote control

- With the system off, press the center button on the remote control. You may need to hold it down for ½ to one second. Verify the system turns on.
- Verify that the remote works from about 30 feet way in various directions. Note that if your plane is parked near a metal hangar, the hangar may reflect the signals and increase the range. You may purchase a larger antenna from Vertical Power if you want longer range.
- Press each of the buttons that is configured to control a device turns that device on and off.

9.1e Serial data

- Verify the engine data stream is working by noting non-zero engine indications on the screen.
- Verify the GPS data stream by noting the NO GPS indicator is extinguished. With the aircraft outside, turn on the device that provides the data stream and give it time to fix its location. Note that some GPS units do not send out the data stream unless an active waypoint is entered.
- Verify any additional data inputs are displayed correctly, if installed.

9.1f Mode behavior

- Set the VP-200 in Pre-flight Mode.
- Look at each Device on each of the three Device List pages. If there is a small symbol next to the device name, it means that it is forced on or off and will not switch automatically with each

Mode change. Scroll to the Device with the symbol next to and press the Automatic soft key.
Repeat for each device with a symbol next to it.

- Using the Device List and soft keys, turn off the Device that provides engine data (such as an EIS). This will force the system into manual Mode change operation, and will not cycle modes automatically.
- Using your LPW as a guide, verify that each Device is either on (green) or off (white) for Pre-Flight Mode. Make a written note of any inconsistencies to fix later.
- Press the Before-start Mode button. The VP-200 will switch into Before-start Mode. Verify that each Device is either on (green) or off (white) as specified in the LPW.
- If a checklist is enabled, verify the checklist appears and clear it using the ACK button installed on the panel or control stick.
- Verify that one or both battery contactors are off (white). If not, wait 30 seconds and they should turn off (they will stay on if more than 12A is being drawn by the devices).
- Enter the start code.
- Once the start code is entered, the VP-200 will be in Start Mode. Verify the battery contactor(s) closes. You should be able to hear a faint click as it closes.
- Cycle through the Modes in the following order:
After-start (go to the next mode within 3 seconds)
Taxi
Run-up
Takeoff
Cruise
Maneuver
Landing
Taxi
Post-flight
And for each Mode, check the following:
 1. each Device is either on (green) or off (white) as specified in the LPW
 2. A checklist appears, if enabled
 3. The two large engine gauges are as specified in the LPW.
- Go to the setup menus and change any incorrect settings.
- Place the device that provides engine data back in Automatic.

9.1g Verify emergency handling

Refer to the VP-200 Operating Manual for complete details on each emergency procedure.

With the engine off:

- Press the emergency button to activate the emergency soft keys.
- Press the emergency button again to de-activate the emergency soft keys.
- Press the emergency button again to activate the emergency soft keys.
- Press the Engine Failure soft key, and verify the correct devices turn on or off and checklist appears.
- Press the Restore soft key.
- Press the Engine Fire soft key, and verify the correct devices turn on or off and checklist appears.
- Press the Restore soft key.
- Press the Alternator Failure soft key, and verify the correct recovery procedure (including load shedding) is executed and checklist appears.
- Press the Restore soft key. The Fields will still be manually off or on.

- Select a device from the Device List, and press All Auto soft key. All devices should be back to automatic (no symbols to the left of the device name).
- Press the Elect Fumes soft key, and verify the correct devices turn on or off and checklist appears.
- Press the Restore soft key.

9.2 Part 2

Read the VP-200 Operating Manual before starting the engine and performing taxi tests.

This section verifies the proper operation of the VP-200 with the engine running. The main objectives for this section are:

- Verify engine starting and proper mag operation
- Verify proper alternator operation
- Verify proper automatic Mode switching

If this is coincident with first engine start, be sure to integrate the kit manufacturer's first engine start safety procedures with the test plan specified herein. You may consider first verifying proper operation of the engine and once that is complete, begin the electrical system test.

Prolonged low-power operation of a new engine may adversely affect the engine. Be sure you understand the engine break-in requirements, and balance those against the time needed to test the electrical system.

9.2a Starting the engine

These procedures are published as a guideline. Follow the engine manufacturer's starting and safety procedures.

- Ensure that the battery is fully charged. If the voltage drops rapidly during engine start, then the battery is bad or not fully charged.
- From Start Mode, press the *Start Engine* soft key.
- Once the engine is running, verify the oil pressure and other engine gauges operate correctly. The VP-200 does not have any engine data calibration features (fuel level can be calibrated in a future software release) – calibration should be done on the engine monitor that supplies data to the VP-200.
- Verify [if feature enabled] flaps come up and trim resets to neutral.
- Once the oil pressure is within normal limits (white area), verify the VP-200 automatically changes to After-start Mode.

9.2b Verify alternator operation

- Once in After-start Mode, the alternator field(s) will turn on.
For config 1, the Field Pri should be green (on).
For configs 2 and 3, the Field Pri should be green (on) and the Field Sec should be white (off).
For config 4, both Field A and Field B should be green (on) and the x-tie should be white (open).
- The voltage should settle around 14.0v (or 28.0v).
 - For config 4, the Field B (accessory mounted) alternator may not generate sufficient voltage below about 1500 RPM.

- For config 2 or 3, turn off Field Pri and turn on Field Sec to test the backup alternator. The backup (accessory mounted) alternator may not generate sufficient voltage below about 1500 RPM. The voltage should settle around 14.0v (or 28.0v). Select a device on the device list and press the *All Auto* soft key. Confirm by pressing *Yes*.

9.2c Verify trim and flap operation

- Operate each trim axis to verify operation and correct indicator display.
- Operate the flaps through their full range of motion. Verify indicator display.

9.2d Verify Mode switching

These tests should be incorporated into your taxi test plan. Proper mode switching requires both GPS and engine data. If the needed data are not available, the system will enter manual mode switching and the Mode will be displayed in yellow.

If the After-start, Taxi, and Run-up Modes changes automatically and correctly, that is an indication that the data is being received and interpreted properly. Under these conditions, the Modes will change correctly in the air, assuming the settings under Setup->General Setup->Mode Control are correct.

Mode Control	
Min running engine (RPM)	500
Min run time after start (sec)	5
Max speed in pattern (kts)	115
Max RPM in pattern	2300
Max normal taxi speed (kts)	15
Max normal idle RPM	1200
Transition to Cruise (min)	1

With the engine running:

- Verify the engine gauges work correctly.
- Verify the GPS has fixed its position.
- Verify the Mode name is white.
- Taxi forward and verify a change to Taxi Mode within a few seconds. If this does not occur, go to Options->System Info and verify that the GPS groundspeed changes as you taxi.
- With brakes set, run up the engine to the engine run up bug (+/- 100 RPM) on the RPM gauge. Verify the change to Run-up Mode.
- Cycle the mag switch to the L and R positions and verify a change in engine RPM. Return to Both position. With some electronic ignitions, the RPM drop may be imperceptible, in which case a check of the wiring is the way to verify the installation.
- Cycle the mag switch to OFF just for a split second, and you should hear the engine stop. This means both mags are grounded properly. Set the switch back to Both before the engine quits.
- Bring the engine back to idle RPM and taxi forward. Verify the change to Taxi Mode.
- Once stopped, verify the mag switch position indicator matches the actual switch position.
- Shut off the engine. Verify the change to Post-flight Mode.
- Verify [if feature enabled] flaps come down and trim resets to neutral.

With the engine and system OFF:

- Turn on the backup switches, one at a time, and verify that the correct devices are powered.
- Turn off the backup switches, and repeat for each one.

10 Step 5: Flight test the system

This section verifies the proper operation of the VP-200 during flight. The main objectives for this section are:

- Verify correct data inputs
- Verify proper automatic Mode switching

- Verify operation of trim and flaps
- Verify proper setting of circuit breaker values
- In-flight familiarization with emergency procedures

Prior to flight, make sure you understand the following, which is described in the Operating Manual:

- Principles behind Mode switching and what should happen during each Mode
- How to clear faults
- How to switch devices on and off manually
- How the runaway trim system operates
- Emergency operations

This section provides a series of recommended steps, and you should incorporate these steps into the overall flight test plan as you deem appropriate. Go back and review the ground test steps, as complete and thorough ground testing will mitigate the risk of trouble while airborne.

Warning: Do not fly the aircraft until you are comfortable everything operates correctly on the ground, and you are knowledgeable about the systems and their proper operation.

10.1 Notes about first flight

It is the pilot's responsibility to develop a test plan that ensures a safe and productive first flight. Typically, the first flight is focused on verifying basic flight characteristics and proper engine operation. With that in mind, we recommend deferring electrical system tests until after you are comfortable that the engine and airframe are performing as expected, and you are comfortable flying the aircraft. We recommend the following configuration for first or early flights, and it can easily be changed for later flights:

- Configure the switch panel to control the boost pump and the landing light. If you are using a dual-speed boost pump, configure one switch to control Boost L and the other for Boost H.
- Plan on operating the boost pump and landing light manually using the Switch Panel.
- Configure the gear circuit to manual on, so it is always on, even on the ground.
- Consider configuring the autopilot circuit to manual off, so it is always off.
- Configure the flaps to operate in *momentary* (flaps only move when the flap switch is pressed). It may take a few flights to "dial in" the proper limit settings for *position* (flaps move to next position when flap switch pressed), and you can do that once the basic flight characteristics are proven.
- After run-up, place the VP-200 in Maneuver mode. Maneuver mode should be configured so that the landing lights and boost pump are off for Maneuver Mode, and other devices are configured as you want them during the flight test. The system will not switch out of Maneuver mode automatically.
- After you have completed enough flights to begin the electrical system tests, re-configure the switch panel and devices to their normal settings.

If you are installing the system as a retrofit, it is still important to complete as much of the testing on the ground as possible.

10.2 VP-200 system checkout

Now that initial aircraft checkout flights are complete, you can proceed with the electrical system tests.

Once airborne, keep an eye out for traffic and obstacles during the test procedure. Carry a handheld radio as a backup in case of electrical system failure. If you encounter any difficulties in flight due to improper setup or unknown electrical system behavior, land as soon as practical or simply shut the electrical system off (hold the green button for three seconds). Problems should be noted in the air and diagnosed on the ground. You cannot enter the setup menu while the engine is running anyway. If you have completed a thorough check out on the ground, the chances of problems while airborne are greatly reduced.

Verify each of the following in flight.

- Verify correct bus voltage on each bus.
- Cycle flaps.
- Run each of the trim axes. Verify by feel that it is operating correctly and that the indicator display is operating. Caution: many aircraft are very sensitive in pitch axis. Use extreme caution.
- Go to Options (3x) then System Info. Verify the GPS groundspeed is accurate, and airspeed, if enabled is accurate.
- In Cruise or Maneuver Mode, use the device list and scroll to each device (except starter). If the device is not on, turn it on using the soft keys, then back to automatic. Observe the current draw for the expected value.
- Over several flights, you will get a feel for the automatic Mode switching. If the GPS and engine data is valid, the Mode switching will be automatic.
- When appropriate, fly a few instrument approaches, missed approaches, go-arounds, etc. to familiarize yourself with how the system responds during those maneuvers.
- Verify the Air/Gnd indicator operates as expected.
- Verify engine limits are set appropriately, and adjust (on the ground) if needed.

When loitering over a suitable landing field (for safety), execute each of the emergency procedures. At the end of each emergency, press the Restore button. The VP-200 Operating Manual lists the sequence of events that should occur for each emergency.

- Engine failure. Verify the correct boost pump (if you have a Boost L and Boost H configured) comes on and that the engine does not flood and quit. Press Restore to exit if a problem occurs.
- Engine fire.
- Electrical fumes. Note: verify the total draw on each Control Unit is not more than 15 amps when the VMC load shed is completed. More than 15 A may blow the e-bus fuse.
- Alternator failure - VMC. Verify the load shed is configured correctly. Note: turn the primary alternator to OFF to force a low voltage condition prior to executing. Note: after pressing restore, you will need to set the alternator fields back to automatic.
- Alternator failure – IMC. Verify the load shed is configured correctly. Note: after pressing restore, you will need to set the alternator fields back to automatic.
- When the system is back to normal operation, reboot the Display Unit to help you understand system operation in case of a failed Display Unit. Press the soft key buttons 5 and 1 together (in that order). While the DU is rebooting, you should not notice any change with device status. The Switch Panel, avionics, lights, pilot trim, and pilot flaps continue to operate normally.

11 Troubleshooting

11.1 Flap Configuration

Problem	Solution
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<p>Flaps go up, but not quite all the way</p>	<ul style="list-style-type: none"> • Run the flaps using Momentary and verify they operate correctly through the whole range. • If limit switches are installed, adjust them or the linkage so the flaps operate correctly. • If flaps are set to stop at intermediate positions, be aware there is some slop in the position sensor, so you need to compensate for that which can be easily done. The <i>end point extent</i> feature runs the flaps for an extra period of time (configurable) at the up and down limits to make sure they hit their full limits. Use the <i>end point extent</i> setting (under Flap Setup) to run the flaps a little extra, and set the stop limits a bit shy of the ends. For example, if when your flaps are all the way up, it shows the position indicator at 4 (under flap setup). Then set the top limit at 10 and set the end point extent value to 1.0 seconds. This is only an example, but shows that you put some slop in the stop value (10) and then added an extra second of flap motor run time to make sure they go all the way up mechanically.
<p>Flaps run on and trigger the <i>Max Run Time</i> which causes a fault.</p>	<ul style="list-style-type: none"> • If the flaps are all the way up or down, and slop in the position sensor causes the system to think the flaps have not reached their limits, it will continue to run the motor until it triggers the max run time fault (default is 15 seconds). This is designed to keep the motor from running indefinitely and burning out in such situations. See above for solution.
<p>Flaps worked fine on the ground but faulted in the air.</p>	<p>Since the air load on the flaps cannot be simulated on the ground you may have faults in the air until you “dial it in”. Check:</p> <ul style="list-style-type: none"> • Circuit breaker value for the flap circuit. The current draw is much high in the air than on the ground. • Sensor slop which may cause faults mentioned above.

11.2 Electrical Configuration

Problem	Solution
<p>Nuisance trips</p>	<ul style="list-style-type: none"> • Verify with the manufacturer of the electrical device that you’ve used the correct circuit breaker value. Do not increase the CB value over what the wire can support. Use these for guidelines: 14 gauge wire – 18A max 18 gauge wire – 10A max 20 gauge wire – 5 A max • Devices such as landing lights have a large inrush current that can fault the breaker. Try setting the pin to either soft-start or to slow-blow fuse setting in the Device Setup page. • If nuisance trips persist, contact Vertical Power tech support.

11.3 Data inputs/Engine Gauges

Problem	Solution
Engine or GPS data does not come in	<ul style="list-style-type: none"> You can verify GPS data by going to Options, then System Info. The screen displays GPS groundspeed and altitude. Note that not all GPS units provide altitude data. Using an ohm meter, check continuity between the data output pin on the sending device harness and the serial input pin on the Display Unit harness. Verify that the sending device is configured to send data from that serial port. Often, these must be configured by the user and are not set at the factory. Some devices only send data under certain conditions. Check with the manufacturer. For example, some GPS units only output data when a flight plan is active or when the satellites are acquired. In the serial port setup menu, verify the serial input port is set to the correct type of data input. For example, if you are using a Garmin 430, it should be set to Aviation Data Format. Verify that data is coming into the Control Unit by looking at the counter in the serial port setup menu. Under each serial port is a number. That number should be increasing. If it is not incrementing then no data is coming in that can be read.
Red X on engine gauge	<ul style="list-style-type: none"> Gauge may not be enabled under Engine Gauges setup Gauge may not be properly associated with its data source (see Setup-Serial Port Menu-Data Association)

11.4 Mode switching

Problem	Solution																																
Modes do not switch automatically	<ul style="list-style-type: none"> Modes will only switch automatically if both engine and GPS data are valid. You can switch modes manually using the soft keys. The settings that affect mode changes are not correct (see below). 																																
Modes do not switch when expected	<ul style="list-style-type: none"> If you enter the pattern at higher speeds or are flying an approach, you must often manually enter Landing Mode by pressing one of the soft keys. Go into the setup menus (Options->Setup->General Setup) and verify the settings that affect mode switching are configured properly. The standard settings are listed below: <table border="1"> <thead> <tr> <th>Setting</th> <th>Lycoming (RV)</th> <th>Continental (Lancair)</th> <th>Subaru (RV)</th> </tr> </thead> <tbody> <tr> <td>Min running engine RPM</td> <td>600</td> <td>600</td> <td></td> </tr> <tr> <td>Min run time after start</td> <td>5</td> <td>5</td> <td></td> </tr> <tr> <td>Max speed in pattern</td> <td>120</td> <td>140</td> <td></td> </tr> <tr> <td>Max RPM in pattern</td> <td>2300</td> <td>2300</td> <td></td> </tr> <tr> <td>Max normal taxi spd</td> <td>15</td> <td>15</td> <td></td> </tr> <tr> <td>Max normal idle RPM</td> <td>1250</td> <td>1400</td> <td></td> </tr> <tr> <td>Transition to Cruise Mode</td> <td>3</td> <td>3</td> <td></td> </tr> </tbody> </table>	Setting	Lycoming (RV)	Continental (Lancair)	Subaru (RV)	Min running engine RPM	600	600		Min run time after start	5	5		Max speed in pattern	120	140		Max RPM in pattern	2300	2300		Max normal taxi spd	15	15		Max normal idle RPM	1250	1400		Transition to Cruise Mode	3	3	
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Transition to Cruise Mode	3	3																															

11.5 Trim faults

Problem	Solution
Trim faults at power on	The trim is designed to fault if any of the trim switches are on at power on. <ul style="list-style-type: none">• Verify that none of the trim switch input wires are shorted to ground.• Verify that none of the trim input switches are closed.
Cannot clear a trim fault	<ul style="list-style-type: none">• A trim switch input line is still grounded. You must un-ground the input and re-cycle power to the system.

12 Appendix A – Device Names

There are three types of device names: 1) reserved names, 2) standard names, 3) custom names. Using the setup menus, you will be asked to assign a device name to each group of pins. The device name appears on the right-hand side of the screen in the device list. There are no restrictions for naming the pins for each device.

Reserved names:

The reserved names must be used for that specific function. Do not use a custom name in place of a reserved name. For example, do not create a custom name such as “Fuel Pump” in the place of “Boost”.

Certain names should be used based on your electrical system configuration. “Field” should be used if you have only one alternator (configuration 1). “Field Pri” and “Field Sec” should be used if you have one primary alternator and one backup alternator (configuration 2 or 3). “Field A” and “Field B” should be used if you have a dual bus, dual alternator (configuration 4).

If you are using a single pressure fuel boost pump (typical for Lycoming engines), then use “Boost”. If you are using a dual pressure fuel boost pump (typical for larger Continental engines), then use “Boost H” and “Boost L”.

“Ign L” or “Ign R” should be used for the power lead going to an electronic ignition such as an e-mag, p-mag, Lightspeed, Lasar, etc. If you are using a traditional mag on one side, and an electronic ignition on the other, then you will only need to configure the electronic ignition side (as no power lead is needed for traditional mags).

See tables on next page.

The following are **Reserved Names** and should be used whenever that function is configured in the Device Menu.

Primer	Field	
Boost	Field Pri	
Boost L	Field Sec	
Boost H	Field A	
Pitot	Field B	
Strobe Lt	Gear	
X-tie	Ign	
Starter	Ign L	
Climate	Ign R	

Standard names:

These names are pre-defined in the device name menu selections and can be modified to your liking. The system does not place any relevance on the name.

MFD	Seat L	Headsets
PFD	Seat R	Fan
BU AI	ADI	Fan 1
EFIS	AOA	Fan 2
EFIS 1	Comm1	AHRS
EFIS 2	Comm2	AutoPilot
EFIS BU	Xponder	Traffic
Audio	Txpd	WX
Defrost	Pwr Plug	Taxi Lt
Aux	Turn Coord	Land Lt
AI	Nav Lt	Hobbs
EIS	Eng Mon	Nav Lt
		Land Lt
		Taxi Lt
		Pnl Lt
		Cabin Lt
		Instr Lt

13 Appendix B - Alarms and Annunciators

Please see the VP-200 Operating Manual.