Electronic Circuit Breaker System

VP-200 Series

VP-200
VP-200 Duo

Operating Manual

May 11, 2011

Current as of
software version 22.1f

Table of Contents

Change log

Change date	Change
12-18-07	Added trim and flap sections
2-10-08	Added fuel gauge section
3-15-08	Changes to reflect v14 updates
4-23-08	Added checklist items to section 1
5-13-08	Added detail about battery contactor failure
6-11-08	Added note about cycling power to system
6-27-08	Added Ongoing Maintenance section, and new power-on sequence (additional integrity checks performed)
7-10-08	Added remote control operation, device flashing at startup, and mag position checking for v16. Added Appendix E. Added section about starter safety at power on.
9-9-08	Added section on switch priorities. Clarified circuit fault behavior.
2-24-08	Added section on Climate Control System. Added data logging feature.
3-16-09	Added warning about powering hydraulic motor while on e-bus.
7-1-09	Added v20 features. See release notes on web site.
8-10-09	Added changes to timing on p-bus failure and changeover to e-bus. Added demo feature.
5-10-10	Added v21 features. See release notes on web site.
10-15-10	Clarified some of the annunciator messages in the table at end of doc.
5-11-11	Added v22 features. See release notes for details.
6-20-11	Added remote key fob battery details.

1 Introduction

This VP-200 Operating Manual contains information about how to use the system. Information regarding setup and test can be found in the VP-200 Installation Manual. We recommend you become familiar with the material contained in this document before wiring and flying your aircraft.

This manual is based on the software version shown on the cover. It will be revised to reflect additional features as they become available in future software releases.

The operating procedures for the VP-200 and VP-200 Duo are similar. Four basic aircraft electrical configurations are supported, and are called out specifically when differences exist.

The VP-200 is protected by one or more US Patents, including 7622818 and 7796054. Multiple patents pending.

1.1 Hardware Overview

The VP-200 consists of four components: the Control Unit (one for the VP-200 and two for the VP-200 Duo), Display Unit, Switch Panel, and remote key fob.

Control Unit (CU): The central component of the VP-200 is hidden from view and discussed in detail in the VP-200 Installation Manual. It is powered directly from the battery and alternator(s) and powers devices controlled by the VP-200. The CU supplies power and communicates with the DU and SSP through data cables.

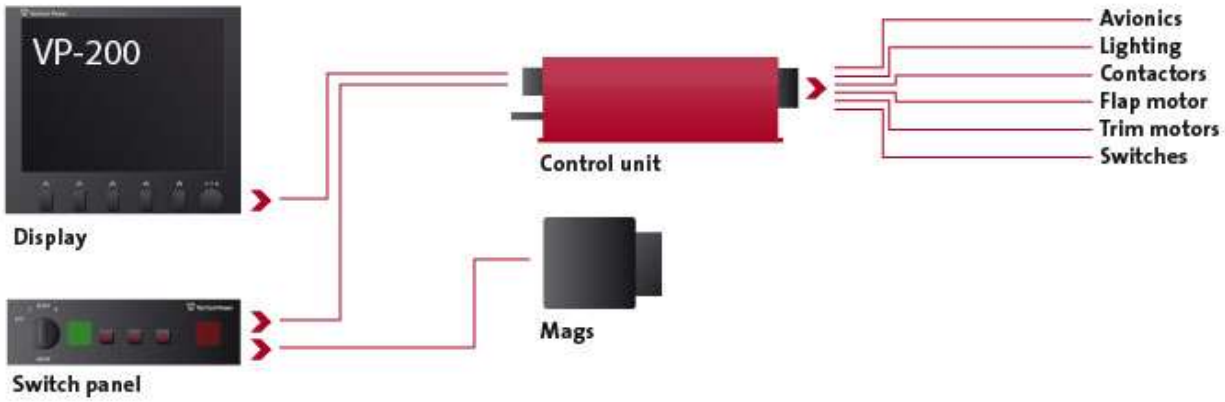
Display Unit (DU): The DU is a panel-mounted dimmable color display with five soft keys and one knob and is the primary user interface. The screen shows status of the electrical system, aircraft configuration (trim, flaps and gear), and engine information. The engine monitor and GPS provide data to the DU through serial connections. An EFIS or similar device can also provide air data to the DU via a serial connection. The left-most button is soft key #1 and the right most is soft key #5. The rotary knob is on the right side and has an integrated push button.

Switch Panel (SP): A pilot accessible panel with a green master switch, red emergency button, three two-position switches with LEDs, a light sensor, and knob for controlling engine ignition (a MAG switch). Note that the magnetos are wired directly to the MAG switch on the SP but are NOT controlled by the VP-200 system.

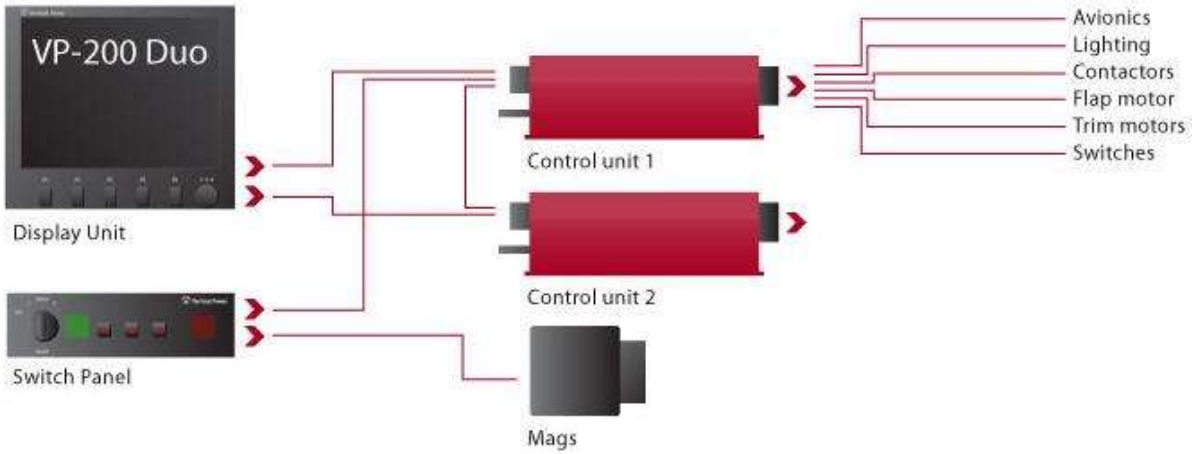
Remote key fob: Used to turn on the VP-200 remotely. You can control electrical devices such as the cabin light or external lights using the key fob. The receiver and antenna are located on CU #1. The CU and one or more remote key fobs are uniquely associated with each other using secure encryption technology. The remote key fob only operates in Pre-flight and Post-flight Modes.

A remotely mounted, momentary ACK (acknowledge) switch is installed and is used to clear checklists and acknowledge alarms. This switch may be mounted anywhere in the cockpit at the builder's discretion.

The Display Unit, Control Unit, and Switch Panel are connected via data lines as shown.



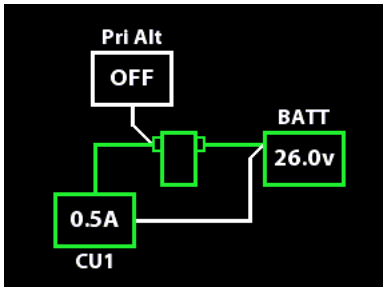
The VP-200 Duo adds another Control Unit, which connects to both the Display Unit and the other Control Unit. The Switch Panel connects to CU #1 in the VP-200 Duo.



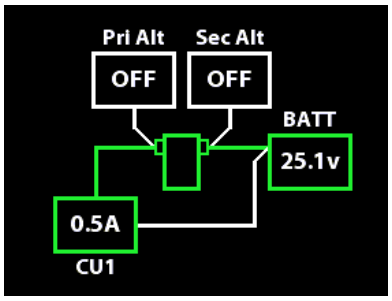
1.2 Electrical System Configurations

The VP-200 supports four different electrical configurations, shown below. Once set up for a certain configuration, the VP-200 then knows how to control the electrical system. If you change your electrical system (for example, add an additional alternator to configuration 1), make sure you go in to the setup menus and change the configuration.

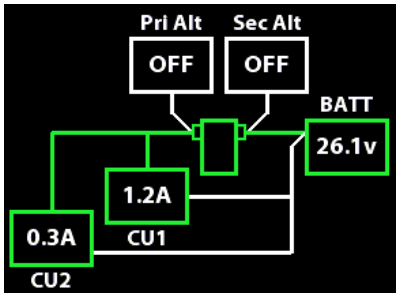
Configuration 1
Single battery
Single alternator, single bus
Single Control Unit



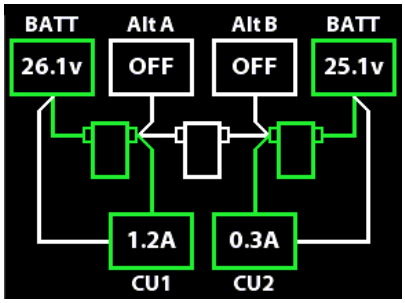
Configuration 2
Single battery
Dual alternator, single bus
Single Control Unit



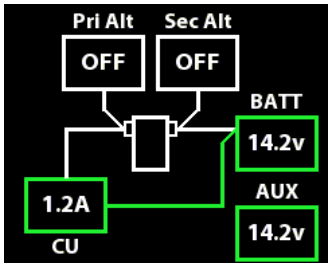
Configuration 3
Single battery
Dual alternator, single bus
Dual Control Unit



Configuration 4
Dual battery
Dual alternator, dual bus with cross-tie
Dual Control Unit



If a second battery is installed, that battery is shown graphically on the display along with the battery voltage.



1.3 Mode Switching Overview

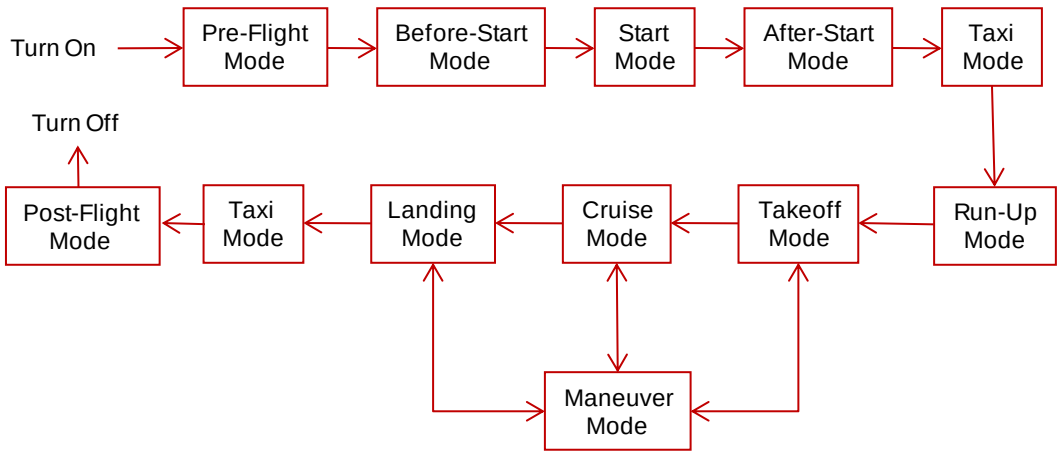
The Vertical Power system operates on what are called modes, each representing a specific aspect of ground or flight operation. Modes give you a smart and simple way to organize all normal operational activities. Using proprietary algorithms, the VP-200 takes inputs from aircraft engine and GPS data to determine which one of 11 modes the aircraft is in. While this may seem like a new concept, you do it every time you fly.

For each mode, you can (using the setup menus):

- Define which devices (lights, radios, etc.) are turned on and off
- Verify that the mag switch is in the correct position
- Configure the display of engine instruments to optimize and de-clutter
- Specify the checklist you would like to see when switching into that mode

You can configure the system to behave the way you want it to. For example, if you want a checklist to appear when you perform a run-up, you can configure that to occur.

The modes and their transitions are shown below. It is important to understand that this chart represents a normal flight, but many variations are possible. For example, during a missed approach or go around, you will sequence automatically from Landing Mode directly into Takeoff Mode. A detailed sequencing chart is shown in Appendix A: Mode Switching Detail.



Details about each mode are described later in this manual.

1.4 System Description

This section describes the user interface components of the Display Unit and Switch Panel.

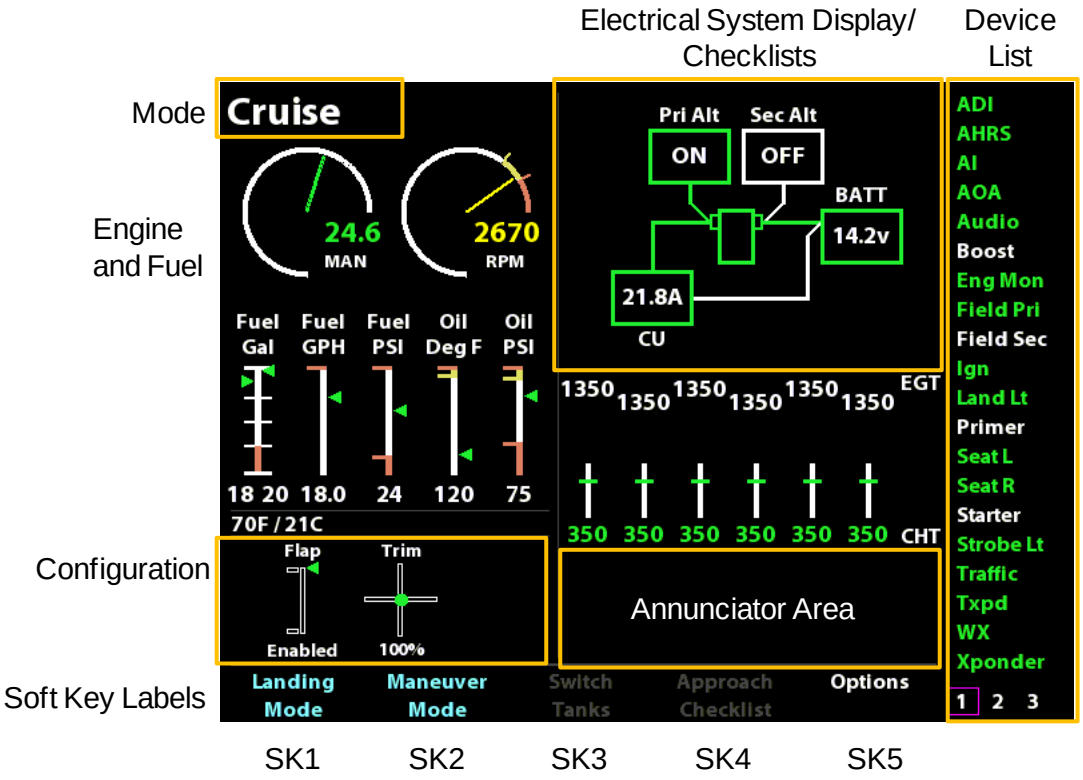
1.4.1 Remote Key Fob

Press the center button to turn on the VP-200. The outside buttons control one or more devices as configured by the user.

Be sure that your remote is uniquely associated with your Control Unit. More information is available in the VP-200 Installation Manual.

1.4.2 Display Unit

The Display Unit has a high resolution color screen, five pushbutton switches (called soft keys), and a rotary knob with push button. The screen is divided into eight areas described below:

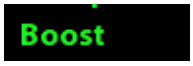


1. Mode name: One of the 11 mode names is shown here. The mode name is normally white. When the mode name is yellow, it indicates that either engine or GPS data is invalid and you must manually change modes using the soft keys.

2. Electrical system display: A color-coded diagram of the aircraft electrical backbone and its status. This area of the screen also displays checklist and status of individual electrical devices if you activate the device list. If a component is white it is inactive. If it is green it is active. Lines between components indicate the wiring connecting them and the white or green colors show whether wire is inactive or active. A yellow or red color indicates a caution or fault. Various numbers indicate current and voltages in the backbone.

The Control Unit can be thought of as the main bus. On the diagram is it labeled as CU. The CU gets power from two sources: 1) the e-bus wire which comes directly from the battery, or 2) the main power wire from the battery contactor. These can be seen graphically on the display. The CU automatically determines the best source of power and switches the battery contactor accordingly. The e-bus is designed to carry a maximum of 12 amps steady load.

***3. Device list**:* This shows the list of all electrical devices that are controlled by the VP-200, and can be up to three pages long. The battery contactor is the only device that does not support direct user control. Devices that are off are shown in white and those that are turned on are shown in green and those that are faulted are shown in red. Pushing the rotary knob will select the top-most item on the device list (on the active page) and allow you to scroll among the devices. Below are the different ways a device may be shown on the device list:

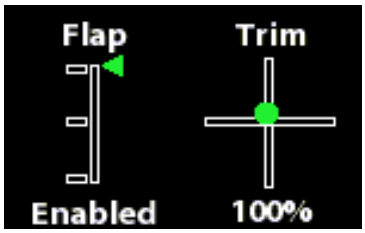
	Boost pump is off, and is switched automatically at each mode change. Magenta border means it is selected using the rotary knob.
	Boost pump is on, and is switched automatically at each mode change.
	Boost pump is on, and is switched on manually by using the device list soft keys. The '>' symbol means it will not be switched at each mode change. Magenta border means it is selected using the rotary knob.
	Boost pump is on, and is switched on manually by using the toggle switches on the switch panel or by a backup switch wired per Method A. The '*' symbol means it will not be switched at each mode change.
	The boost pump turns yellow if one of the following occurs: - The Display Unit is awaiting confirmation from the Control Unit after a device is turned on or off. - The state of the device is not known because of a communication failure between the Display Unit and Control Unit - The starter device is yellow when the starter is disabled.
	Boost pump is faulted and off. When a device faults, the device is automatically selected in the device list.

	The three pages where Device List items are shown. The box shows the current page selected. Use the rotary knob to move from one page to another, when no devices are selected. If one of the devices on a page is faulted, then that page is shown in red.

	A device on page 1 is faulted.

4. Engine and fuel: This area is very configurable through the setup menus. The upper left section shows two round dials that can be configured in the setup menus. Below the dials are bar graphs showing information about fuel quantity and engine performance. To the right of the bar graphs is EGT and CHT information. Cylinder 1 is on the left. CHT is horizontal bar and EGT is the white vertical bar. Use the setup menus to set the limits for engine and fuel parameters.

5. Configuration: This area shows information about trim and flaps. A green box appears around the trim or flap area when those devices are moving.
Flaps: Any intermediate tick marks between the top and bottom marks are stops. The flap switch is enabled when "Enabled" is shown below the flap indicator (currently only shows enabled).
Trim: The green indicator ball shows pitch and roll trim position. A blue circle is used to show yaw trim. The pitch trim motor speed is the percentage shown below the indicator (currently only 100%)



6. Annunciator area: This is a 2 by 4 grid with annunciators showing advisory information. Annunciators may or may not trigger the master warning light, depending on the configuration. further, when an annunciator must be acknowledged, it appears in large letters and covers the entire grid.

7. Soft key labels: These labels vary with the mode, the device list selection, or Options menu. A gray-colored label indicates that the function is inaccessible because it has not been configured by the user or is unsupported by current software.

1.4.3 Switch Panel

The Switch Panel is used to control system power, enter emergency mode, control the magnetos, and control up to three devices or enter VMC/IMC status. The Switch Panel is connected to Control Unit #1 on the VP-200 Duo system.

1. Magneto knob (MAG switch): This knob grounds the p-lead wires running to the magnetos (or electronic ignition equivalents) independent of aircraft power. The wires DO NOT run through the Control Unit and are unaffected by its status. However, the VP-200 will detect the position of the switch and display OFF, LEFT, RIGHT, or BOTH on the status line. Left grounds the right mag p-lead wire, and right grounds the left mag p-lead wire.
2. Master switch: Push the green button to turn on the VP-200. It will illuminate immediately but it will take about 20 seconds for the Display Unit to boot. At any time, push and hold the button for 3 seconds to shut down the VP-200.
3. Toggle switches: The toggle switches can be configured to turn on and off any of the electrical devices. Each switch has two spots to place labels (included) to mark the function of that switch. The LED lights on the tip of the switches show the status of the device controlled. The LED is green if the device is on and red if it is faulted. Your configuration may be different than that shown above.
4. Emergency button: Push the red button to bring up the emergency system. This is discussed later.
5. Light sensor: Detects ambient light conditions and dims the screen and switch lights.

1.5 Turning the VP-200 On and Off

1.5.1 Power On

Press the green master switch or the center button on the remote key fob to turn on the VP-200. If configured, a device (like the nav lights) will flash twice to indicate the turn on.

If the starter solenoid is failed closed on power-up, then the propeller may rotate. This causes the e-bus fuse to blow and remove all power to the system, but prevents the propeller from continually rotating. **Be sure the propeller area is clear and the door/canopy is open before turning on the system with the remote key fob.**

During startup, the VP-200 performs a detailed system checkout which verifies the following items:

-the same software application is on the DU, CU and switch panel
-the same configuration is on all the VP-200 components
-the integrity of the databases on each component

-each of the components can communicate properly
-that the data cables are connected properly.

If a fault is found, the checkout is stopped. Cycle power to the system using the green master switch. If the problem occurs again then we recommend pressing the "Push Settings" soft key.

When a fault occurs, some or all of following soft keys are displayed on the bottom of the screen:

Update software – reinstalls the software application from the external USB flash drive onto the DU, CU, and Switch Panel.

Update settings – reinstalls the settings file from the external USB flash drive onto the DU, CU, and Switch Panel.

Push settings – the settings stored in the DU are "pushed" out to the CU and Switch Panel. You do not need to have the USB flash drive installed to do this.

Ignore – allows you to go to the main screen and use the VP-200 without fixing the problem. This is typically used if there is a communications failure with the Switch Panel. Since devices can be turned on and off manually via the Display Unit, you may want to fly with an inoperative Switch Panel. However, we recommend fixing the problem before flying, but circumstances may dictate otherwise.

Note that in the case of a fault, the error reported may be symptom that masks the real problem. For example, in a single-CU system, if CU#1 is connected to the CU#2 plug on the DU, then the system will show a communications error with CU#1. When a fault occurs, the first things to check are the cabling and CU select switch on each CU. Additional details are located in Appendix E. Be sure to call tech support if you are unsure how to proceed.

When you turn on the VP-200 it will come on in the same state as when it was turned off. If you turn it off in either Before Start, Start, or Post-Flight Mode, it will come back on in Pre-Flight Mode. All other Modes will re-start in the same mode. For example, if you shut it off in Taxi Mode, it will come back on in Taxi Mode.

If the battery contactor is on when the system is shut off, it will turn on the contactor immediately upon turn on. Also, any devices that were manually turned on prior to shutdown will turn on immediately when the system is turned back on.

1.5.2 Power Off

To turn off the VP-200, hold the green button for one second and then release. The system will turn off when the button is released. Or let the auto-shutoff feature (in pre-flight or post-flight modes) count down and turn the system off automatically.

Pressing and holding the green button for three seconds will power off the system if the other methods fail.

After turning off the VP-200, wait at least 3 seconds before turning the system back on.
This short delay gives the electronics time to discharge and clear properly.

1.6 Alternator Operation

The VP-200 is designed to operate one or two alternators. The alternator is "operated" by providing bus voltage to the alternator field wires (through either an internal or external voltage regulator). Alternators operate as follows for each electrical configuration:

Configuration 1: the single alternator is either on or off

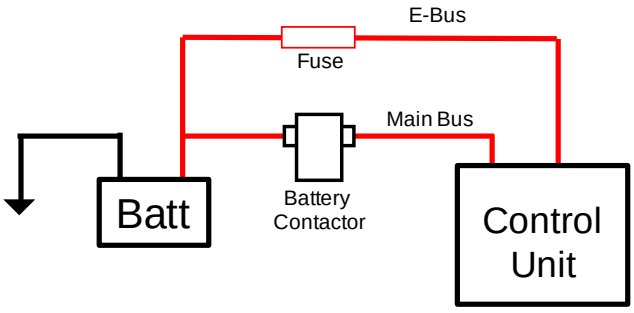
Configuration 2 or 3: Either the primary or secondary alternator is on. The VP-200 will **not** allow both alternators to operate simultaneously. This is to prevent too much current from being drawn from the lower-capacity alternator.

Configuration 4: Both alternators run simultaneously because each bus is independent. If the cross-tie contactor is closed, ensure that one of the alternators is turned off . When the cross tie is closed, both busses essentially become a single bus, and only one alternator at a time should power a bus. The VP-200 currently allows both alternators to be on at the same time with the cross tie closed.

If the VP-200 detects a battery contactor failure (P-Bus failure) then it will only allow the backup alternator to operate.

1.7 Power Bus Architecture

The VP-200 Control Unit has two power inputs from the battery: an endurance bus (e-bus) circuit and a main power bus circuit.



The e-bus provides constant power from the battery for system start, remote key fob receiver power, keep-alive circuit power, and operations under low current loads. The e-bus circuit is protected by a 20A slow-blow fuse; therefore, the VP-200 limits continuous loads to a maximum of 12A. This allows transient loads like the flaps and trim to operate and not exceed the current rating of the fuse.

When the current requirements exceed what can be handled by the e-bus or the VP-200 prepares for engine start, power is switched from the e-bus to the main power bus. The main bus is the normal source of power from engine start to engine shut down.

1.8 Electrical System Care

In order to keep your electrical system operating reliably and safely we recommend certain preventative maintenance and operating techniques. This list is not all-inclusive and should be supplemented by items specific to your aircraft.

- Replace the battery every two years during the annual condition inspection. If you have dual batteries, alternate replacing a battery each year. This will ensure strong engine starting and expected endurance times if running without an alternator. Don't wait for the battery to show obvious signs of degradation.

- Do not take off with a drained battery, or "jump start" your airplane and expect the alternator to charge the battery. Make sure your battery is fully charged prior to each flight, especially after prolonged periods of non-use. If an emergency occurs while airborne and the battery is not fully charged, your battery-only endurance time as well as operations on the primary or backup alternator will be degraded compared with a fully-charged battery.

- Regularly check wires and cables for chafing and other damage. Check that connectors on the Display Unit, Switch Panel, and Control Unit are secure and insulation is good. Wires in the engine compartment are easy to check whenever the cowling is off.

1.9 First Flight

Be sure to read the first flight considerations in the VP-200 Installation Manual. Make sure you are familiar with and have completed the ground test procedures in the VP-200 Installation Manual before flying the aircraft.

1.10 Checklist Items

The following items should be added to a checklist used prior to takeoff:

- ☐ Verify correct operation of a switch panel switch
- ☐ Verify correct operation of trim and flap switches and control surfaces

1.11 Ongoing Maintenance

The connectors should be inspected during the aircraft's annual condition inspection. Make sure that the thumbscrews on the d-sub connectors are snug, and that the power connectors are inserted fully and latched.

2 Turning Electrical Devices On and Off

The VP-200 provides five different ways to switch electrical devices from the instrument panel and additional switching functions using the remote control key fob.

2.1 Switching from the instrument panel

1. **Mode switching**: The VP-200 will turn devices on and off when the mode changes, based on the configuration in the setup menus.

2. **Device List switching:** The Device List, located on the right side of the screen, enables direct control of any of the devices listed. See section 1.4.1 Display Unit for details on to use the Device List. An example is shown below:

Press the rotary knob and scroll down to “Boost.”

For each highlighted device, you can see the pin name, Control Unit connector & pin, circuit breaker value, and real-time current draw.

The soft keys switch the device to auto/on/off or change all devices to auto.

Press the On soft key.

The device turns green. A “>” symbol appears next to the device to show it is manually on (i.e., mode switching will NOT override it).

You can see that the boost pump draws 3.6A.

Press the rotary knob again to exit the device list.

The soft keys operate as follows:

Automatic This device is switched on or off based on how it is configured for each mode.

On Turns the device on and overrides the mode switching setting. It will remain on until manually changed. A ‘>’ symbol appears next to the device. This setting is persistent from one power cycle to the next.

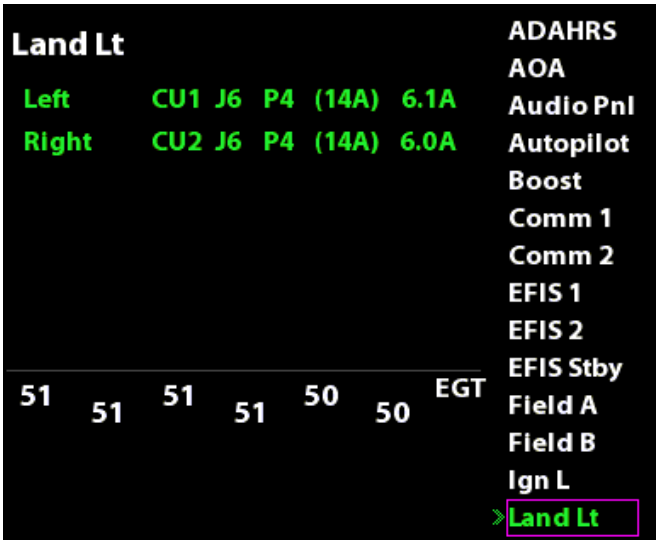
Off Turns the device off and overrides the mode switching setting. It will remain off until manually changed. A ‘>’ symbol appears next to the device. This setting is persistent from one power cycle to the next.

All Auto Sets **all** of the devices to Automatic. Press Yes or No to confirm this choice.

Note: If you select Trim or Flaps, the soft keys read Up/Down or Left/Right rather than On/Off. If you select a dimmable circuit, the soft keys read Dimmer/Brighter.

If a switch on the Switch Panel (see item 4 below) is set to on or off, that selection will override the device list soft keys. For example, if the landing light switch is on you cannot turn it off using the soft keys.

When a device is selected, information about that device is displayed in the electrical diagram window. In the example to the right, a device named Land Lt has two pins assigned to it. Each pin has a name and information about that pin as follows:



Left: name of pin
CU1: Control Unit where pin is located
J6: Connector 6
P4: Pin 4
(14A): Circuit breaker is set to 14A
6.1A: real-time current draw on the pin

3. **Switch Panel switching:** Each of the three toggle switches on the Switch Panel can be configured to switch a device on or off. The switches are two position and can be set to behave in one of the following ways:

- Manual On: Up = manually switched on, down = auto (changes by mode).
- Manual Off: Up = auto (changes by mode), down = manually switched off.
- Manual On/Off: up = manually switched on, down = manually switched off.
- VMC/IMC: Up = IMC, down = VMC.

The LED on the tip of the switch will turn green whenever the device is on and red when the device is faulted.

Note: Switch panel switches in on or off positions always override mode and the soft key controls when turning a device on or off.

4. **External switch switching: A**n external switch wired into a switch input on the CU or DU can be configured to manually switch a device on, just like the Switch Panel switches.

5. **Backup switch switching**: Devices that have backup switches are powered directly from the battery. If you turn on a device with a backup switch, it will be on at all times, even after system shutdown. An annunciator shows if a backup switch (wired per method A) is left on during Pre-flight or Post-flight Modes.

2.2 Dimming

Dimming circuits, if configured, can dim from 5% to 100%. This is done by selecting the device from the device list and pressing Brighter/Dimmer from the soft keys. Pressing Brighter/Dimmer

manually turns the device on or off and pressing Automatic turns the device on or off based on the mode of flight. The dimming percentage is shown above soft key 1.

If a device is set to 40%, for example, it will go to 40% when the mode change turns it on, then turn off when the mode change turns it off.

2.3 Using the remote control

The remote control can be used to turn on the VP-200 and turn individual devices on and off. When pressing a button on the remote, hold it down for at least a second, as the feedback that something is turned on may not be immediate.

Pressing the center button turns the VP-200 on. The VP-200 cannot be turned off using the remote.

Pressing one of the four outer buttons in pre-flight mode or post-flight mode turns one or more devices (which are configured in the setup menus) on manually. The button presses are ignored in other modes. The device will stay on until the remote is pressed again to change the device status back to auto, whereby it reverts to its default setting for that mode (most likely off). The remote will not affect devices that are already turned on or off using the switches or soft keys (ie they have a '>' or '*' symbol next to the device).

When a button on the remote is pressed, the shut-down timer is reset to its starting value.

2.4 Switch Priorities

Not all switches are created equally. The VP-200 treats mechanical switches with a higher priority than switching performed from the display screen. The priority is shown below, with Priority 1 being the highest priority.

Priority 1: Backup switches (shown with a * on the Device List)
Priority 2: Switch panel or external switches (shown with a * on the Device List)
Priority 3: Switching using the soft keys from the Device List (shown with a >>)
Priority 4: Automatic mode switching (no marker next to device)

2.5 External Starter Switch Operation

If an external starter switch is installed, it will function once:
1. the start code has been entered, and
2. the engine RPM is below about 500RPM or the engine data stream is invalid.

The starter soft key on the DU will always function regardless of engine RPM.

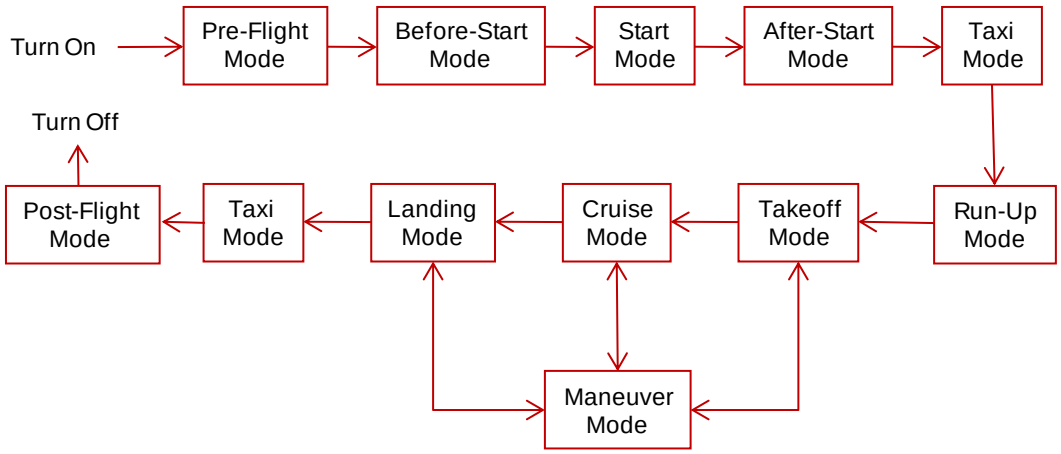
2.6 Timer

A timer can be configured for each device. Selecting the device from the device list will show how much time is left on the timer. The timer starts when the device is turned on and alarms when the timer expires. You can clear the timer by pressing the ACK button or turning the device off.

3 Mode Switching During a Typical Flight

This section describes system operation during a typical flight. Because many of the VP-200 parameters are configurable, the pictures and descriptions may not exactly match your system.

An overview of how the modes change is shown in the diagram below, and a detailed sequencing chart is shown in Appendix A: Mode Switching Detail.



For each mode, certain electrical devices may turn on or off, checklists may appear, and the engine gauges may change based on how you've configured the VP-200 in the setup menus.

The VP-200 allows you to change modes manually at any time. An example of this is wanting to prepare for landing early or switch into Takeoff Mode before the actual takeoff roll occurs. Soft key 1 always shows the next likely mode change it expects. The other soft keys may show other modes as well. See Appendix B: Soft keys for each Mode for soft key detail.

If for some reason you get into the wrong mode, you can manually sequence through the modes to get to the correct mode. If the mode you want is not displayed on the soft keys, manually sequence to the next mode and then see if the mode you want is displayed there.

To go backward in sequence, go forward until you "cycle back" to the desired mode. For example, if you mistakenly change to Landing Mode while in cruise, manually go to Takeoff Mode then to Cruise Mode using the soft keys.

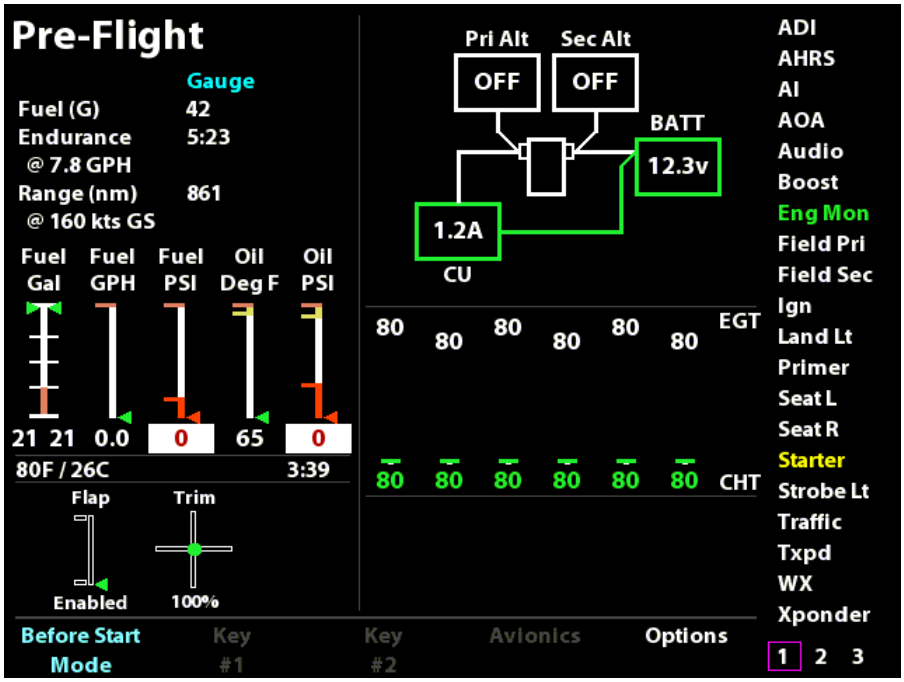
The mode changing algorithms depend on engine data and GPS data inputs to work properly. If either data input is missing, the VP-200 will give you a visual and aural alert. The mode name will change to yellow, and you must change modes manually using the soft keys.

If you have connected the audio output on the Display Unit to your audio panel or intercom, you will hear a chirp sound when a mode change occurs.

The soft keys shown for each mode show the ***action*** that will happen when that key is pressed, not the current status.

The next sections describe operations during each mode in detail.

3.1 Pre-Flight Mode



Mode is entered:

1. Turning system on with the green master switch or center button on the remote key fob
2. Manually from another mode.

Operating Instructions

On startup, the green master switch will light, the LED lights on the tips of the Switch Panel switches will sequence, and after about 20 seconds, the DU screen will come up. The Switch Panel, trim and flaps can be operated while the DU is booting up.

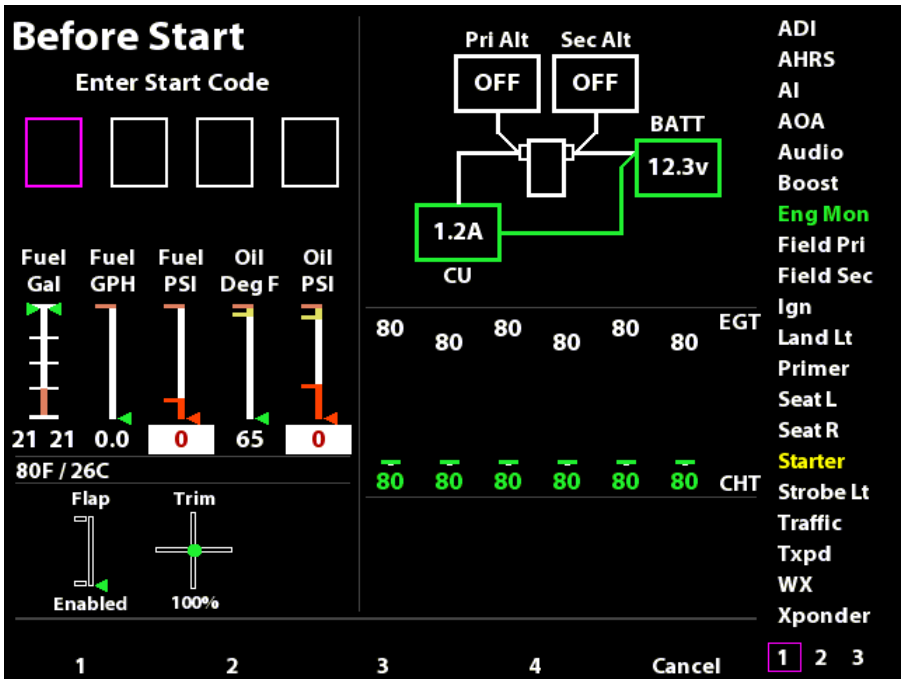
Red X symbols replace the engine instruments until serial data from the engine monitor is valid.

Right below the oil pressure gauge, a countdown timer indicates the minutes and seconds before the VP-200 will turn off automatically. To pause/reset this countdown, go to options/system info or go into Before Start Mode. When the countdown reaches 30-seconds the soft keys change and allow you to shut down the system or defer the countdown.

Soft Keys

SK1: Go to Before Start Mode
SK2: Turns on device (as configured). Press again to set to auto.
SK3: Turns on device (as configured). Press again to set to auto.
SK4:
SK5: Go to Options sub-menus.

3.2 Before-Start Mode



Mode is entered:

1. Manually from Pre-Flight Mode.

Operating Instructions

Enter the four-digit start code using the soft keys. After three invalid attempts the VP-200 will lock the soft keys for one minute.

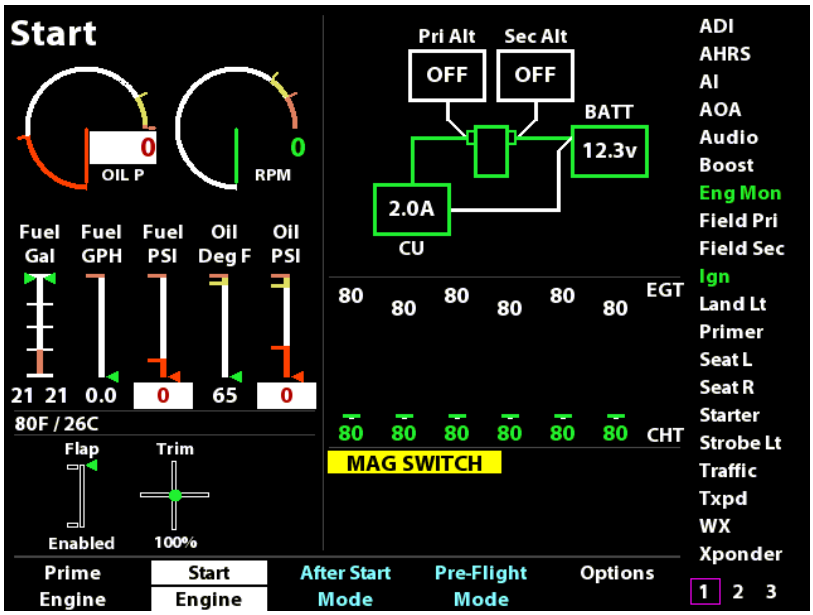
If the start code has already been entered since power-on, you will not be asked to re-enter it.

Note: the starter is inhibited until the correct code has been entered.

Soft Keys

SK1: Start code number 1
SK2: Start code number 2
SK3: Start code number 3
SK4: Start code number 4
SK5: Cancel and go back to Pre-flight Mode

3.3 Start Mode



Mode is entered:

1. Automatically from Before-Start Mode after correct code has been entered.

Operating Instructions

When entering this mode, the battery contactor will close to configure the bus for engine start. The battery contactor will stay closed until you enter either Post-flight or Pre-flight Mode. For Config 4 (dual bus) systems, if enabled, the cross-tie will automatically close while the starter is engaged and appear yellow on the display.

The magneto switch is expected to be in the Both position and will generate an alarm if it is not.

Switches to After-start mode automatically once the engine is running and oil pressure is good.

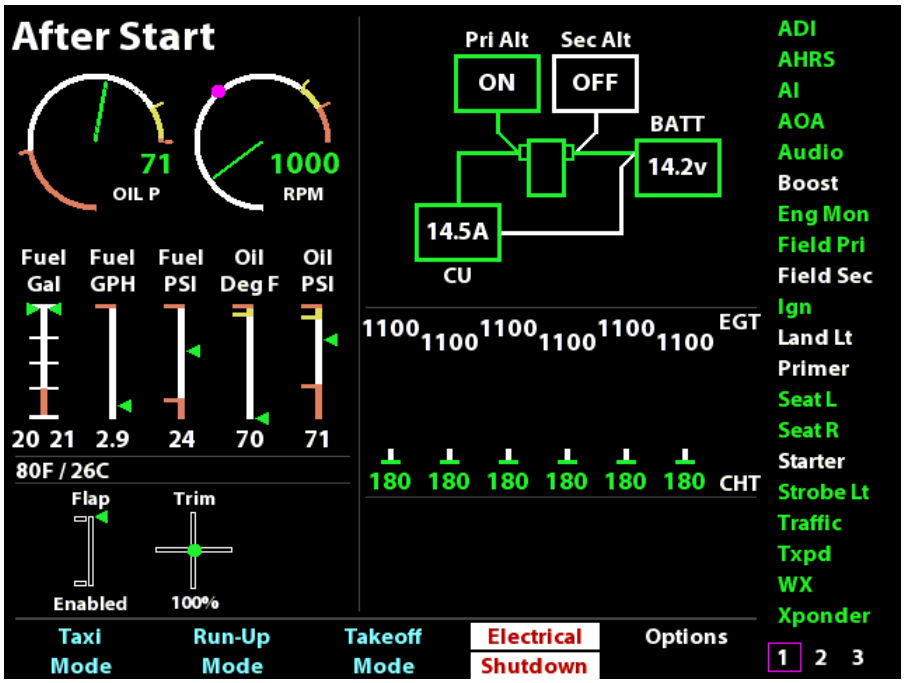
TIP: If you want to taxi a short distance without turning the avionics on, press the rotary knob (which selects a device) right after engine start to keep the system from switching into After-Start Mode. Selecting a device on the Device List inhibits auto mode switching. After engine shut-down, press the rotary knob again to de-select and then manually go into Pre-Flight Mode.

Note: engine data may be invalid during start if the external engine monitor reboots.

Soft Keys

SK1: Momentary switch to prime the engine. Only operates when switch is pressed. Uses boost, boost h, boost l, or primer in that order.
SK2: Momentary switch to start the engine. Only operates when switch is pressed. Or use the external start switch, if installed.
SK3: Manually go to After-Start Mode.
SK4: Manually go to Pre-Flight Mode.
SK5: Go to Options sub-menus.

3.4 After-Start Mode



Mode is entered:

1. Automatically after oil pressure and RPM are in normal range
2. Manually from Start Mode.

Operating Instructions

The alternator field is turned on prior to turning on other electrical devices. With the alternator running, you will see the bus voltage around 14.0v (double for 28v system). For config 4 systems, it is normal for Bus B to show low voltage during ground operations (the accessory mounted alternator cannot generate enough voltage at lower RPM).

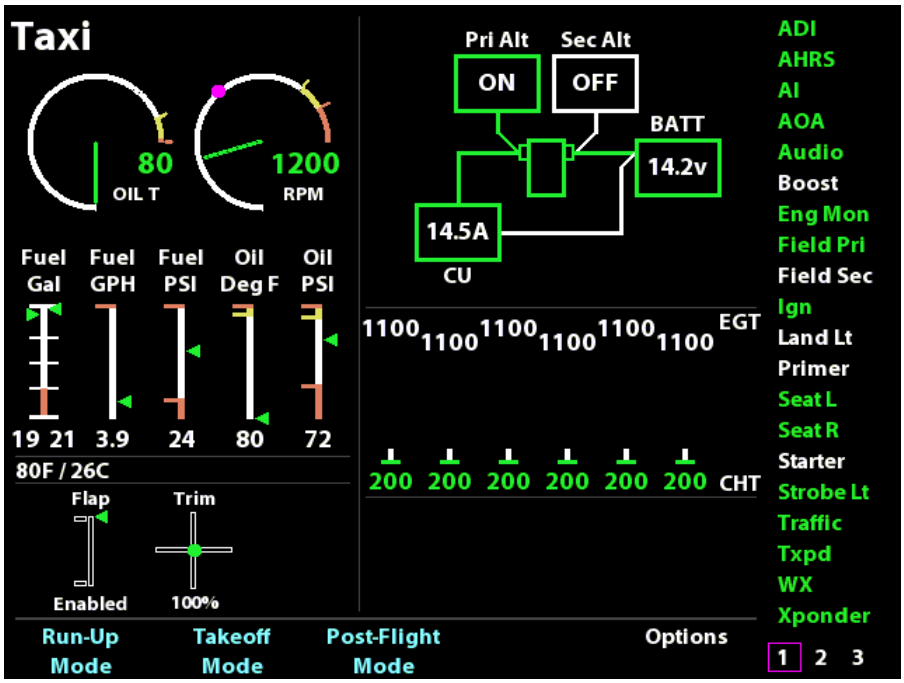
A "No GPS" annunciator may appear until the GPS aligns. Once the VP-200 gets valid GPS and engine data, you hear *Mode Automatic*. It does not switch out of this mode until valid data is received from both the engine monitor and the GPS.

Note that you may hear a some engine-related advisories immediately after engine start as engine data becomes valid and depending on where you have set the alarm levels.

Soft Keys

SK1: Manually go to Taxi Mode.
SK2: Manually go to Run-up Mode.
SK3: Manually go to Takeoff Mode.
SK4: Shut down the electrical system (VP-200). Backup circuits, if on, will remain on.
SK5: Go to Options sub-menus.

3.5 Taxi Mode



Mode is entered:

1. Automatically after forward motion of the aircraft
2. Manually from other modes.

Operating Instructions

Monitor systems during taxi.

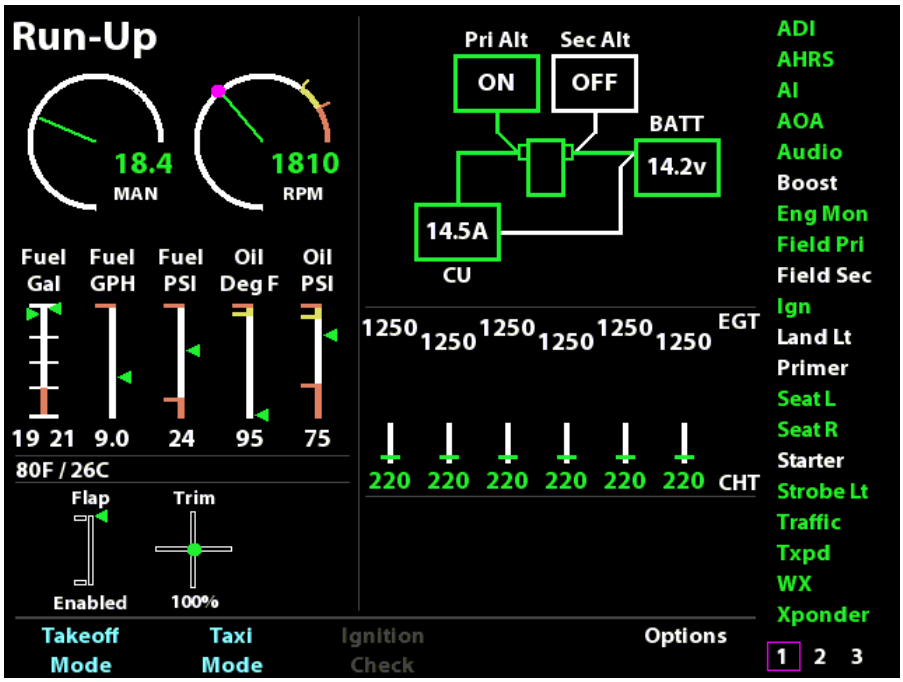
During taxi, the RPM gauge shows a magenta bug (dot) indicating where you have set the run-up RPM in the setup menus.

TIP: If the engine quits during taxi and you don't want to automatically go into Post-Flight Mode (thereby turning off the avionics), press the rotary knob to select the device list (which inhibits auto mode switching). You can then re-start the engine by selecting the Starter device or using the external start switch (if installed).

Soft Keys

SK1: Manually go to Run-up Mode.
SK2: Manually go to Takeoff Mode.
SK3: Manually go to Post-flight Mode.
SK4: Before Takeoff Checks (see section later in this manual)
SK5: Go to Options sub-menus.

3.6 Run-up Mode



Mode is entered:

1. Automatically when within +/- 100 RPM of run-up bug and aircraft is stationary.
2. Manually from other modes.

Operating Instructions

Increasing the RPM to the run-up bug changes the mode to Run-up and you can do your pre-takeoff checks. Once the aircraft begins to move, the VP-200 switches to Taxi Mode.

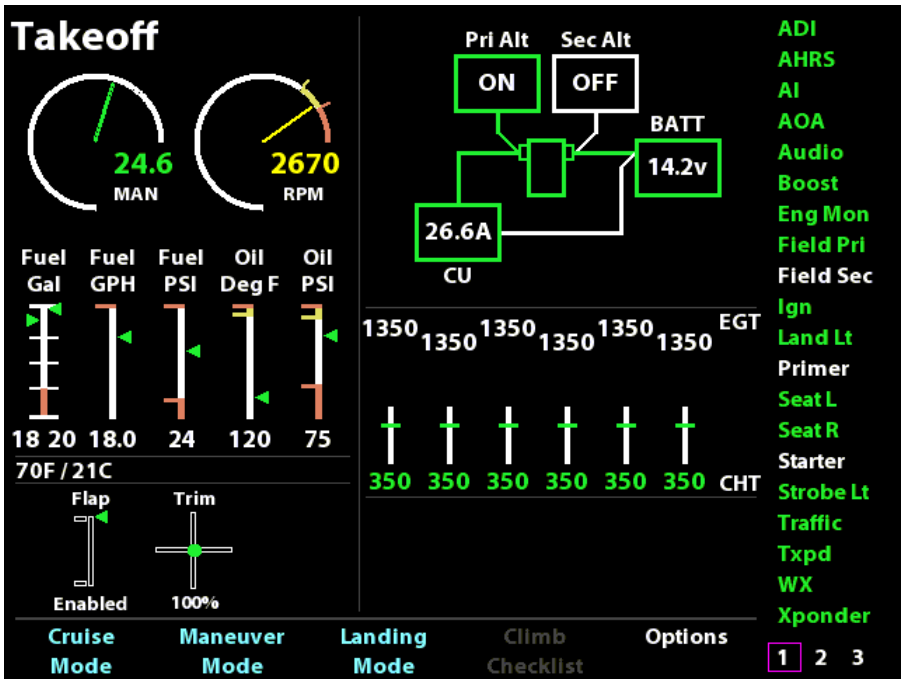
Mag Check Assist™ Function

This function helps perform your mag check, and is detailed later in the manual.

Soft Keys

SK1: Manually go to Takeoff Mode.
SK2: Manually go to Taxi Mode.
SK3: Ignition check (future)
SK4: Before Takeoff Checks (see section later in this manual)
SK5: Go to Options sub-menus.

3.7 Takeoff Mode



Mode is entered:

1. Automatically when high engine RPM and aircraft is moving greater than taxi speed.
2. Manually from other modes.

Operating Instructions

Monitor the engine parameters during takeoff.

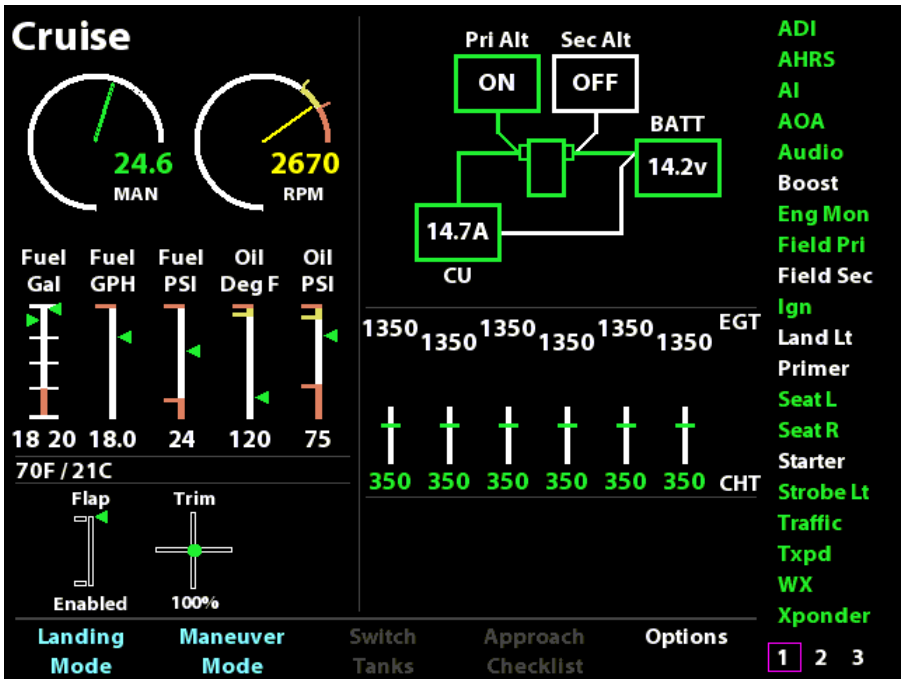
The VP-200 changes to takeoff mode when the aircraft passes through 30 kts. At this time, you hear a *chirp* in the headset, verifying that the mode has changed without having to look at the screen.

You may manually switch to Takeoff Mode from either Taxi Mode or Run-up Mode prior to the takeoff roll by pressing the appropriate soft key.

Soft Keys

SK1: Manually go to Cruise Mode.
SK2: Manually go to Maneuver Mode.
SK3: Manually go to Landing Mode.
SK4: Display climb checklist (if configured)
SK5: Go to Options sub-menus.

3.8 Cruise Mode



Mode is entered:

1. Automatically based on time after takeoff.
2. Manually from other modes.

Operating Instructions

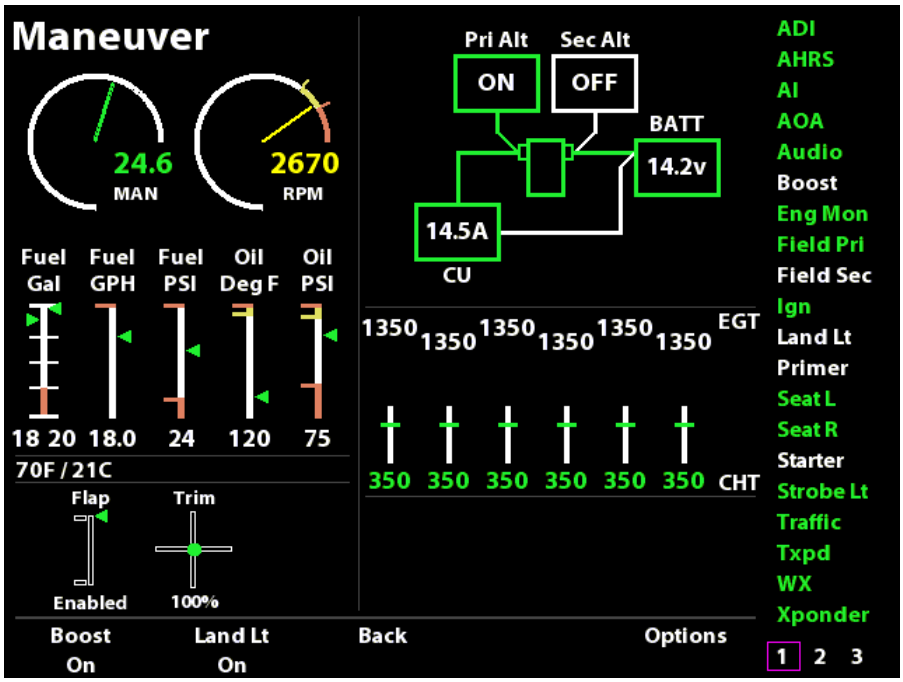
Monitor the engine parameters during cruise.

After you are airborne for a few minutes (configurable), the VP-200 switches to Cruise mode. As before, you can use a soft key to switch sooner.

Soft Keys

SK1: Manually go to Landing Mode.
SK2: Manually go to Maneuver Mode.
SK3:
SK4: Display approach checklist (if configured)
SK5: Go to Options sub-menus.

3.9 Maneuver Mode



Mode is entered:

1. Manually from Takeoff, Cruise, and Landing modes.

Operating Instructions

Once you have manually entered Maneuver Mode, it stays in this mode until you manually exit it. This is intended for air work, acrobatics, and other types of flying that may inadvertently switch the VP-200 into Landing Mode. But, the mode is also useful because it precludes automatic mode switching. For example, if you slow down for in an en route holding pattern or another reason, the VP-200 may see low RPM and speed and switch to Landing Mode even though you are a long way from your destination. Here, you can switch from Cruise to Maneuver and use the mode as a place holder.

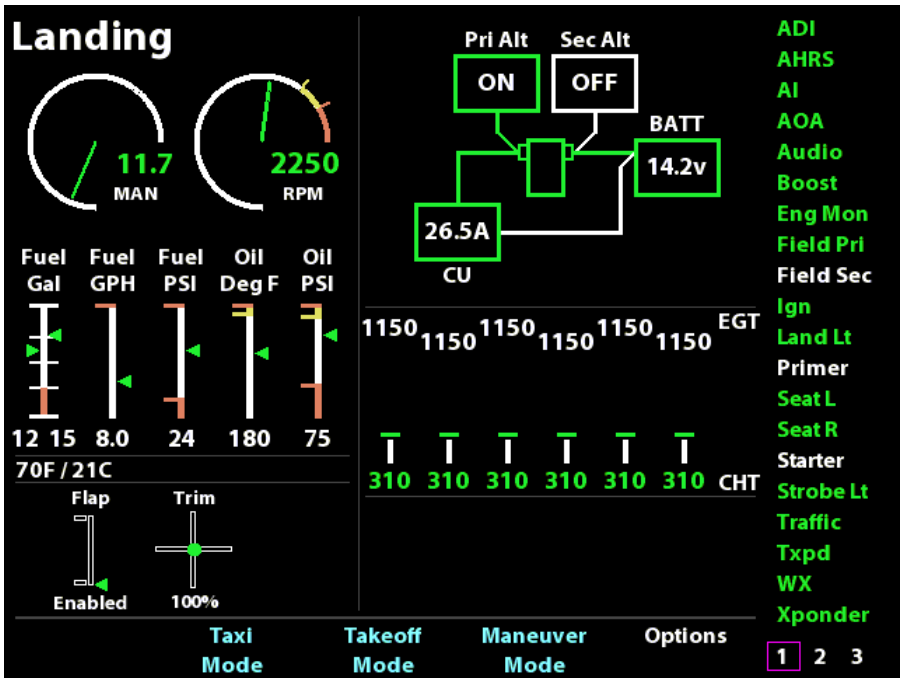
The soft keys are designed so you can easily turn on and off the boost pump and landing lights during maneuvers.

Exiting Maneuver mode returns to the mode from which it was entered.

Soft Keys

SK1: Boost Pump
SK2: Landing Light
SK3:
SK4:
SK5: Go to Options sub-menus.

3.10 Landing Mode



Mode is entered:

1. Automatically based on engine RPM and groundspeed (both configurable).
2. Manually from other modes.

Operating Instructions

Although the rules by which the system switches into Landing Mode are constant, they way you approach the landing pattern is often dependent on many factors. Therefore, it is important to understand that the system will only transition into Landing Mode when a certain set of conditions exist.

Ideally, managing your engine RPM and ground/air speed so that the VP-200 switches prior to entering the landing pattern will set you up for a nice pattern entry. If this is not possible or desired, simply press the Landing Mode soft key to switch manually at any time.

If you are on an instrument approach, consider manually switching into Landing Mode as you near the final approach coarse. Keep the engine RPM above the set RPM limit until you want automatic switching to occur.

During a missed approach or go-around, the VP-200 will automatically switch into Takeoff Mode upon the application of full power. If you do a low-power climb-out, you may need to manually switch to Takeoff Mode by pressing the Takeoff Mode soft key.

Soft Keys

SK1:
SK2: Manually go to Taxi Mode.
SK3: Manually go to Takeoff Mode.

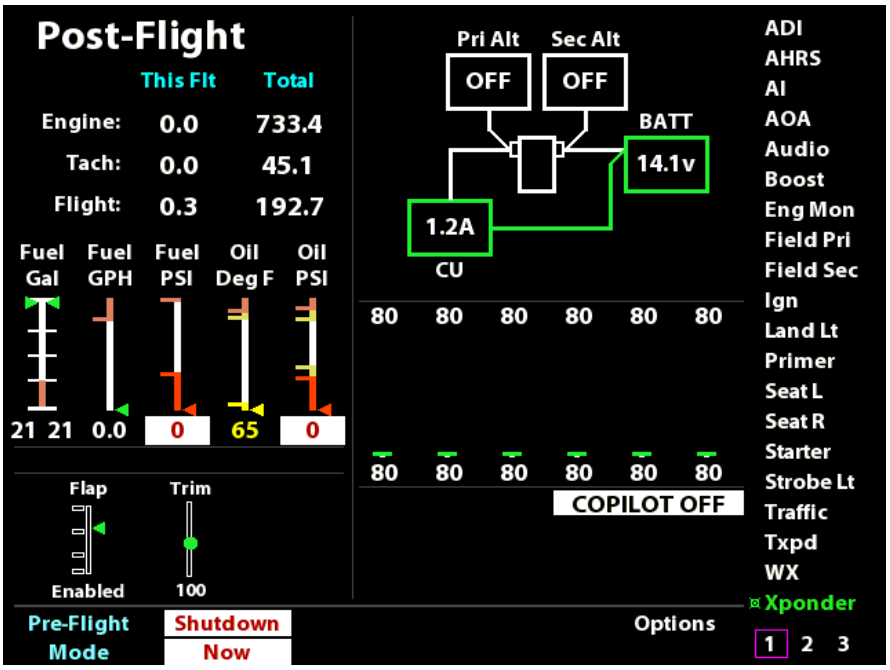
SK4: Manually go to Maneuver Mode.
SK5: Go to Options sub-menus.

3.11 Taxi Mode (post-landing)

After landing, the VP-200 will automatically switch to Taxi mode. There is only one Taxi Mode, and the behavior during this mode is identical to the mode after engine start.

If the VP-200 automatically switches into Taxi Mode during a touch and go (during an extended rollout, for example), it will automatically switch to Takeoff Mode once power is applied and your speed increases.

3.12 Post-Flight Mode



Mode is entered:

1. Automatically at engine shutdown and no movement of the aircraft.
2. Manually from Taxi Mode.

Operating Instructions

Once the engine stops, the VP-200 switches to Post-Flight mode and the countdown timer becomes active and the engine and flight time totals appear. The VP-200 shuts off automatically once the countdown timer reaches zero. You can defer the countdown using the soft keys (they appear at 1 minute to go, or shut the VP-200 off immediately by pressing the *Shutdown Now* soft key or by holding the green master switch in for 1second.

The mag switch is expected to be in the OFF position. The remote key fob becomes active again during Post-flight Mode.

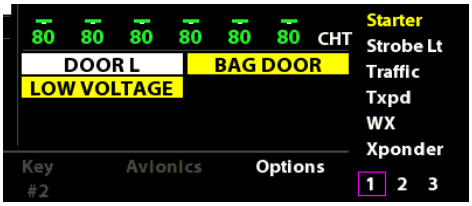
If you have manually turned some devices on or off during the flight, they will remain manually on or off when powering the VP-200 back on for your next flight. If you want them to be switched automatically, remember to select All Auto (press the rotary knob to select any device, then press the All Auto soft key).

Soft Keys

SK1: Go to Pre-flight Mode
SK2: Shutdown Now
SK3:
SK4:
SK5: Go to Options sub-menus.

4 Annunciators

Annunciators are shown on a 2 x 4 grid at the bottom-right side of the Display Unit. They can appear in multiple colors and, depending on the alert, may also trigger the master warning light and audio alert. Certain annunciators are triggered by system events like a low-voltage condition or a trim fault. Other annunciators are user-configurable via the setup menus. Annunciators are shown in the image below:



Annunciators can be set to be ‘active’ only during certain Modes. If an annunciator is not active, then the annunciator will not appear regardless of the status of the condition meant to trigger it. This is to minimize annunciation of things that aren’t meaningful, like ‘canopy’ during Pre-flight Mode.

When the condition is cleared, the annunciator will go black. A new annunciator takes the first available space (from top left to bottom right), and when an annunciator clears the other ones do not move.

A latching annunciator is shown in a large box that covers the entire annunciator area, and clears only when the ACK button is pressed. If the alert still exists when the ACK button is pressed, the annunciator changes to the normal size. It then disappears when condition clears.

Latching Annunciator

Acknowledged but active

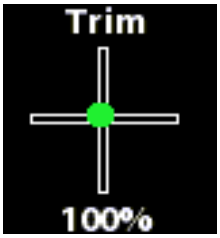
System annunciators are shown in Appendix F at the end of this manual.

5 Trim Operation

Electric trim is controlled by the VP-200.

5.1 Trim Indications

The VP-200 can control up to three trim axes: pitch, roll, and yaw. The trim position is displayed on the trim indicator as shown to the right. The green dot represents the position of the pitch and roll trim, and the yaw axis is shown with a blue circle. The numerical percentage below the trim indicator shows the relative speed of the pitch trim motor.



When the trim is running, a green box surrounds the indicator. The vertical and horizontal lines are normally shown in white, but are displayed in red if the respective trim circuit is faulted.

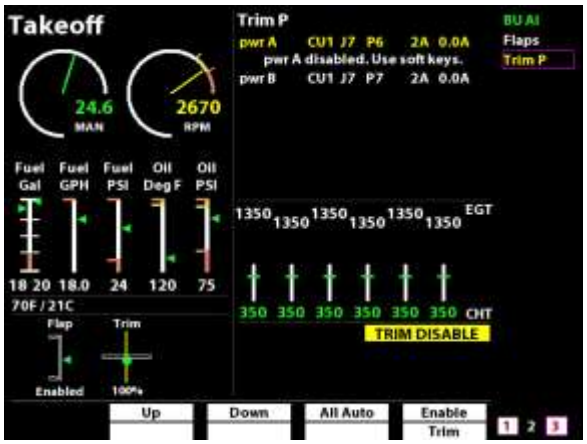
5.2 Runaway trim

Runaway trim can be caused by a stuck switch, a shorted wire, or various other causes. If you discover the trim or flaps running un-commanded, push and hold the opposite button to immediately stop the motor. The input switch pairs are as follows:

Pitch trim:	up	down
Roll trim:	left	right
Yaw trim:	left	right

After 3 seconds, the affected circuit faults and you can release the button. A faulted circuit does the following:

- The input switches for the faulted axis are disabled
- The faulted axis is shown in red
- An aural alarm is played in the headset
- An alarm message is shown on the message window
- The faulted device is highlighted on the device list, and the soft keys change to reflect the actions of the faulted device.



Patent Pending

For backup, you may then operate the trim or flap motor using the device list/soft keys. You can re-enable the input switches using soft key 5, but this is not recommended until you are on the ground.

Note that a switch disable is different from a short circuit. When a short circuit occurs, you cannot operate the trim or flap motor until the short is cleared. When the switches are disabled, you can operate the trim and flaps from the device list.

For example, if the pitch trim begins to "run away," hold down the opposite pitch trim switch (a natural reaction, by the way) until the fault shows on the screen. When it does, the switches are disabled, and you can use the soft keys labeled *Up* and *Down* to move the pitch trim back to the desired position. The soft keys change as shown below for a pitch trim fault:

Up: runs the pitch trim up
Down: runs the pitch trim down
All auto: Sets all of the devices to Automatic. Press Yes or No to confirm your action

Enable trim: enables the disabled input switches. Can only be enabled if the trim inputs are not active (i.e. if the trim inputs are still faulted it will not allow you to reset)

If the flap motor runs for more than a specified amount of time (configured in the setup menus) the VP-200 will turn off the motor and generate a flap fault. This can occur from a variety of factors, and it is best to troubleshoot once back on the ground.

5.3 Trim fault at power on

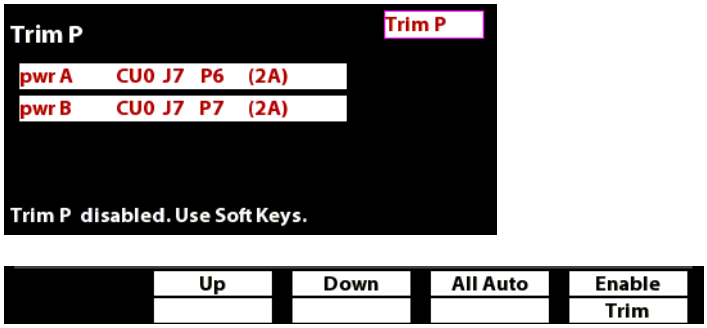
If any of the trim switch inputs are active (ie a trim switch is down) when the VP-200 is powered on, all of the inputs on the respective CU are disabled for safety reasons. You must repair the problem and cycle power to the system to enable the trim circuit or any of the other inputs.

5.4 Backup trim operation

Normally trim is controlled with external switches on the stick, yoke, or panel. You can also control the trim directly from the DU by highlighting the trim device name on the device list and then using the labeled soft keys to control movement.

The trim does not move outside the limits as configured when using the trim switch inputs. Select the trim from the device list and use the soft keys to move the trim while ignoring these limits.

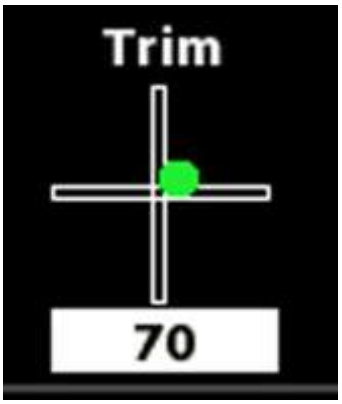
As shown in the screen below, when the trim item is faulted (in this case) or selected, the soft keys change to allow you to adjust the trim position.



For safety reasons, “Enable Trim” only works when none of the trim switches is pressed.

5.5 Trim Speed Control

If enabled, the pitch trim motor can be configured to operate at less than normal speed. If the aircraft speed (currently uses groundspeed) is above the specified value, then the pitch trim motor will run at a specified percentage of full speed. For example, the pitch trim motor can be set to run at 70% of full speed when the aircraft is above 120 knots.



The number below the trim indicator shows the current speed setting of the pitch trim motor. When the value is less than 100, the number is shown on a white background.

5.6 Co-Pilot Disconnect

The Co-Pilot trim and flaps (and entire stick, depending on configuration) can be disabled by pressing Options -> Co-Pilot Disable.

When doing so, the co-pilot inputs are ignored and an annunciator “Co-Pilot Off” is displayed.

Press Options -> Co-Pilot Enable to enable the co-pilot inputs.

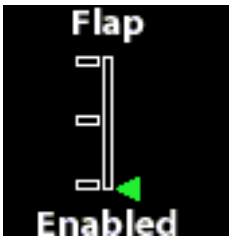
6 Flap Operation

The flaps are controlled by the VP-200, and the flap position is indicated on the display.

The flaps can be configured to operate two different ways, based on the way they are configured in the setup menus:

Momentary	The flaps only move when the flap switch is pressed.
Position	When the flap down switch is pressed, the flaps move to the next position and then stop. Press the flap down switch again at any time to command the flaps to the next position. Pressing the flap up switch brings the flaps all the way up. The flaps may be stopped at any time by pressing the flap switch in the opposite direction.

6.1 Flap Indications



The VP-200 controls the flap motor and read the position of the flaps. The flap position is displayed on the flap indicator as shown to the right. The green triangle represents the position of the flaps. The tick marks to the left represent the top, bottom, and intermediate stops. In this version of software, the flaps are enabled at all times. If the flaps are faulted, the indicator turns red.

An arrow appears on the left side of the vertical indicator to show where the flaps are commanded to move. The indicator appears only when the flaps are moving.

6.2 Flap Overspeed

When configured, the flap overspeed protection is implemented in two ways:

- When above the specified airspeed, the flap DOWN switch is disabled.
- When the flaps are down and the airspeed is greater than the specified limit, the "Check Flaps" alarm sounds.

6.3 Flap Slow Retract

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

6.4 Flap Faults

Several safety features are built into the VP-200 flap system to reduce the chances of motor burnout or conflict between control inputs. When a flap fault occurs, the following happens:

- The flap item on the device list turns red, and is automatically selected
- A message appears on the screen
- The flap indicator turns red
- An aural message is played in the headset

The flaps can be re-enabled by pressing the *Reset Fault* or *Enable Flaps* soft key, which appear when the flap item is selected from the Device List.

The following flap faults exist:

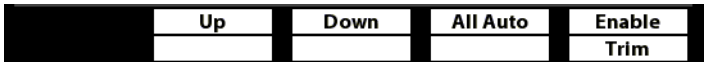
- **Short circuit**: a wire to the flap motor is shorted
- **Control input discrepancy**: a flap up and flap down switch is pressed simultaneously, either from a faulty single switch, or the pilot and co-pilot are pressing opposite switches (where two flap switches are installed). This causes the flap motor to stop, and if the condition exists for three seconds the fault will occur.
- **Excess motor run time**: if the flap motor runs longer than the *max run time* as configured in the setup menus, the motor is turned off and a fault is generated.

- **Flap switch active at power on**. If a flap switch input is active at power on then the flap switches are ignored and faulted.

6.5 Backup flap operation

Normally the flaps are controlled with an external switch on the stick, yoke, or panel. You can also control flaps directly from the DU by highlighting the flap device name on the device list and then using the labeled soft keys to control movement. The flaps run while the switch is pressed, and position sensor inputs are ignored. This allows you to run the flaps in case the position sensor fails.

When you select the flaps from the device list, the soft keys change to those shown below:



6.6 Co-Pilot Disconnect

See Co-Pilot Disconnect under trim section.

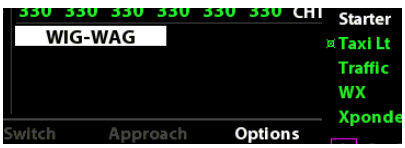
7 General Operations

7.1 Landing Light Wig-Wag

If enabled, the forward lights (landing and/or taxi) can be configured to wig-wag (pulse) when turned on. The wig-wag system incorporates the following features:

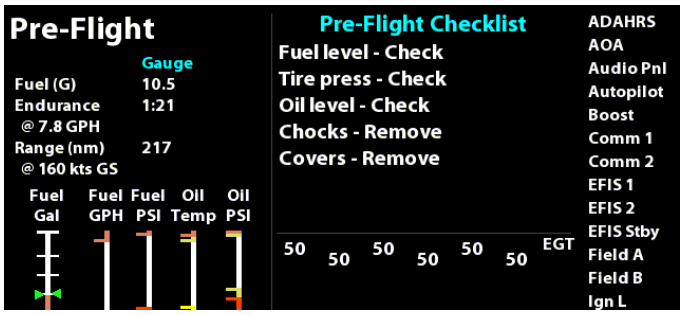
a) Pulsing starts automatically above a specified speed (currently groundspeed), so the lights are steady on the ground but pulsing in the air for increased visibility.
b) Warm-up before pulsing. The lights will remain on steady for the specified period of time before pulsing begins. There is a minimum five-second warm-up period to allow the system to catch any circuit faults.
c) Pulsing can be stopped by pressing OPTIONS -> WIG-WAG STEADY from the options menu. Press OPTIONS -> WIG-WAG AUTO to set back to automatic control.

When one or more lights are pulsing or warming up prior to wig-wag, the ‘WIG WAG’ annunciator is displayed as shown:



7.2 Checklists

Checklists overlay the electrical system diagram. A checklist can be enabled or disabled for each mode change and emergency. If enabled, a checklist appears upon mode change and stays in view until acknowledged by pressing the "ACK" switch or the next mode change.



Additionally, a climb and approach checklist can be displayed using the soft keys during climb and cruise modes.

A checklist can be one or more pages, and can be configured to check off each item individually or by page.

Use the setup menus to modify the contents of checklists and to enable or disable a checklist.

Checklists can be accessed from any mode by pressing Options -> Checklists. Then select the checklist you want to see.

Taxi Mode can automatically show one of three checklists, as follows:

1. Taxi Checklist – shown when entering Taxi Mode after After-Start Mode.
2. Before Takeoff Checklist – shown after being in Run Up Mode.
3. After Landing Checklist – shown after being in Landing Mode.

Be sure to add the following items to one of the checklists used prior to takeoff:

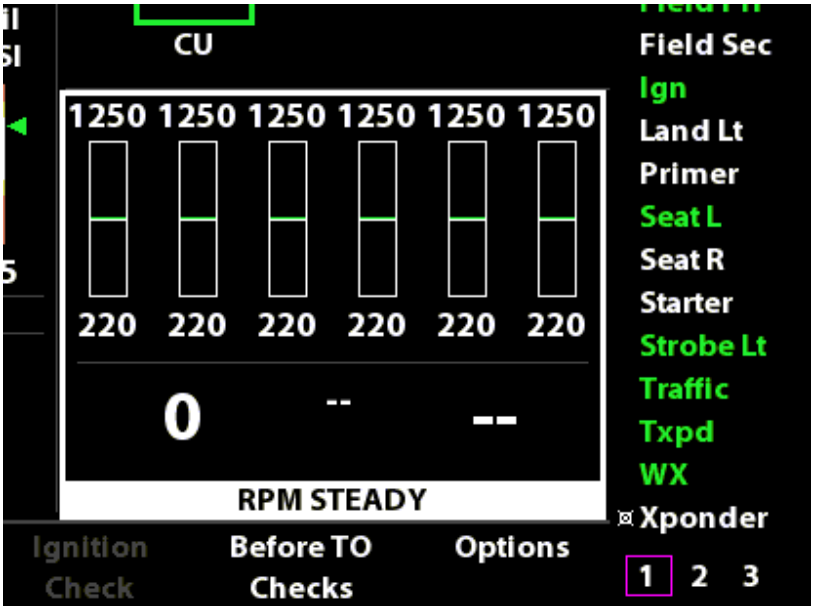
Trim & flap operation - Verify
Switch Panel – Verify (correct operation of one of the three configurable switches)

7.3 Mag Check Assist™

This function is automatically activated once you enter Run-Up Mode, and the following actions happen:

1. The RPM gauge is normalized so the run-up bug is vertical, and the scale is adjusted to +100 RPM and -200 RPM.
2. The EGT gauge is normalized when you turn the mag switch to either L or R. This makes it easy to verify that each cylinder shows a rise in EGT. A drop is shown in red.
3. The RPM drop is calculated from the BOTH setting to either the L or R position.

Wait for the RPM STEADY indicator (and aural tone) before moving the mag switch from the BOTH position. Then wait for the RPM STEADY indicator to show the RPM has stabilized while running on only one mag before moving back to the BOTH position. Repeat for each side. If you move the mag switch prior to the RPM STEADY indicator, the RPM drop will not be calculated. Once the L and R checks are complete, the delta between the two values is shown.



7.4 VMC/IMC Switch on Switch Panel

If a switch on the Switch Panel is configured as the VMC/IMC switch, the following occurs when it is switched to IMC:

- When the system responds to certain emergencies such as alternator failure, it uses the switch position to determine which devices to load shed. If a switch is configured for VMC/IMC, then the VP-200 automatically uses the position of the switch rather than asking the user for IMC or VMC conditions.
- Turns on or off multiple devices when in IMC position.
- When switched to IMC, plays and shows a CHECK BACKUP annunciator to remind the pilot to turn on the backup circuits.

7.5 Autopilot Disconnect Alarm

If configured, the autopilot disconnect alarm sounds three beeps when the autopilot is disengaged.

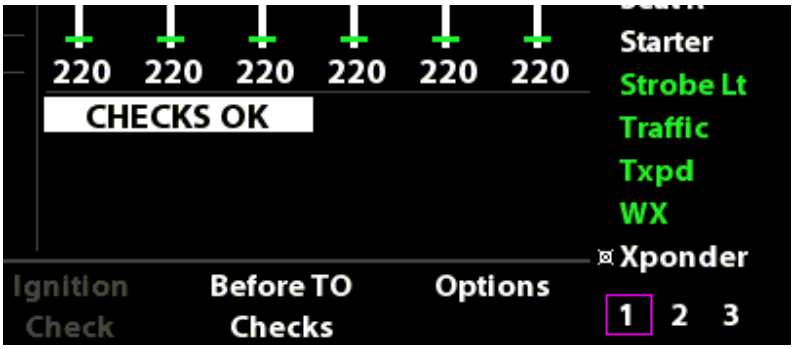
7.6 Before Takeoff Checks

The Before Takeoff Checks function verifies that certain conditions are met when the button is pressed. The button is soft key 4 and appears in Taxi Mode and Run Up mode. Each function must be individually enabled in the setup menus to use this feature.

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

1. Mag switch is in the both position.
2. Trim is in the configured takeoff range.
3. Flaps are in the configured takeoff range.
4. Oil temp is in the normal range.
5. CHT is in the normal range.

If all items are in the correct position then a “CHECKS OK” annunciator appears while the button is pressed. Otherwise an annunciator appears showing the failed item or items.



If the *Before TO Checks* button is pressed in Run Up Mode, the system switches to Taxi Mode.

7.7 Remote Key Fob Operation

The key fob is used to turn the VP-200 on and to control devices.

Press the middle button to turn the VP-200 on remotely.

You can control electrical devices such as the cabin light or external lights using the key fob. The CU and one or more remote key fobs are uniquely associated with each other using secure encryption technology. The remote key fob operates only in Pre-flight and Post-flight Modes.

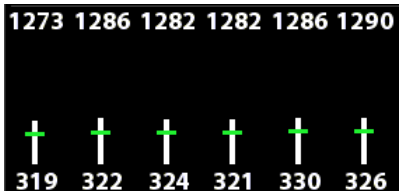
The key fob can toggle a device on or off, or only on while pressed.

7.8 Changing the Remote Key Fob Battery

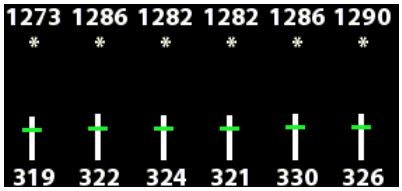
To change the battery, split the case in half using a flat head screwdriver. Touch some metal or ground yourself so you do not “zap” the insides of the remote with static electricity. Slide out the battery and replace with a CR 2032, available at Walgreens, etc.

7.9 Engine Leaning Display (EGT Peak Detection)

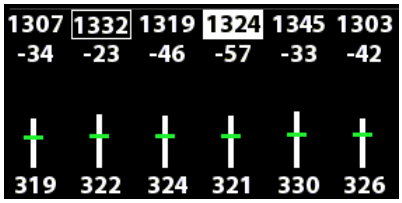
The display shows the EGT values at the top of the bars, and the CHT values at the bottom.



The leaning peak detection function is selected by pressing Options -> EGT LEAN. Asterisks appear below each EGT number, indicating a peak has not been detected.



As you lean the engine, the EGT bars for all cylinders will rise. As each cylinder reaches peak EGT the asterisk will be replaced by a number showing the difference from peak. The first cylinder to peak is highlighted with a box. The last cylinder to peak is highlighted with a white background.



If you start to richen the engine before all cylinders have peaked the unit will detect the EGT drop and display a false peak. The peak detection can be reset at any time by pressing Options -> EGT STD (standard) then Options -> EGT LEAN. When the VP-200 transitions into Landing mode, it automatically changes to EGT STD display.

Consult your engine manufacturer for correct engine leaning procedures.

7.10 Landing Gear Indications and Alarms

The landing gear indicators display the following colors:

Green – down and locked
Yellow – in transition, if configured
Black – not down and locked

When the gear is extended and all indicators are green, a beep-beep audio tone is played.

When in Cruise Mode or Landing Mode, and the airspeed is below the specified limit, and an indicator is not green, then the landing gear warning is sounded.

The circles around each landing gear indicator change color to show the status of the landing gear circuit. If they are green then the circuit is active, white means inactive (gear won't work), or red means a fault on the gear circuit. You can manually select the gear from the device list and

manually change the gear circuit on-off status. For example, to do a gear swing test on the ground you can turn the circuit on manually.

If your aircraft is equipped with a hydraulic pump, do not operate the gear and/or flaps so as to cause the hydraulic pump to operate while the bus is powered via the e-bus circuit.

7.11 Ground Power

If configured, connecting ground power does the following:
- ground power voltage is shown on the electrical display
- ground power annunciator is shown
- all contactors close automatically.

7.12 Boost Pump Reminder

If configured, and altitude reporting is working correctly, and in CRUISE mode, the boost pump reminder sounds when:
- altitude is above 10,500 ft and the boost pump is not on.
- altitude is below 9,500 ft and the boost pump is on.

Note that this does not turn on the boost pump, but rather reminds you to turn it on if it is not already on.

8 Load Shedding

The objective of load shedding is to reduce electrical loads to extend battery time and/or stay below the rated current of the backup alternator. The VP-200 can be configured for two different load shed scenarios – one for VMC conditions and one for IMC conditions.

You must intentionally initiate a load shed during a low voltage condition (which typically occurs because of an alternator or voltage regulator failure). To manually initiate a load shed, press the Emergency button and then either the Alternator Failure soft key or the Electrical Fumes soft key. Each device is then set to be either manually on or off based on VMC/IMC and load shed selections in Setup.

You can fine tune the load shed by further turning devices on or off manually.

Load shedding is described in more detail later in this manual.

9 Electrical Faults

Beyond advisories, the VP-200 will **not** automatically respond to engine and electrical malfunctions unless you command it to do so. This is an intentional design point so the pilot retains the ability to make those decisions based on the situation at hand.

However, the VP-200 does respond automatically to certain faults that require resolution faster than the pilot is able to respond. The VP-200 responds automatically to short circuits, an overvoltage condition, battery contactor failure, and e-bus failure. These are covered below.

In other instances, the VP-200 waits for you to enable a response. When enabled, it turns devices on or off as appropriate for the malfunction. These system commands will **not** override devices already in manual on or off state (via the device list or with an external switch on the Switch Panel).

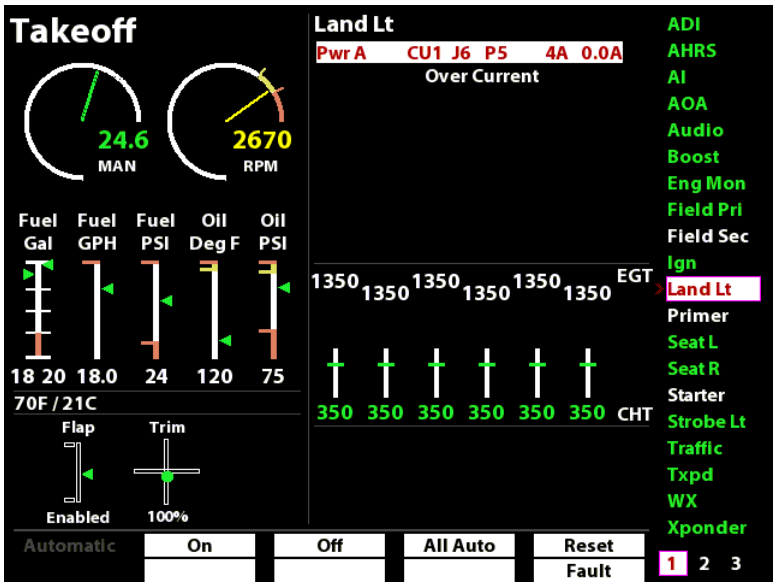
9.1 Circuit faults (short circuit, over-current, or current fault)

A circuit fault can be caused by the following conditions:

- Short circuit: the wire is grounded, either momentarily or permanently
- Over-current: the electrical load exceeds the circuit breaker value
- Current fault: the device is drawing no current for three seconds when turned on

When a circuit fault occurs, the VP-200 performs the following actions:

- The circuit is turned off, and will remain off until reset by the user. If a device contains multiple pins, only the pin that is faulted will turn off. The other pins will remain on.
- A voice alarm is played.
- The device turns red, on the device list and the respective page number (on the bottom right of the screen) turns red.
- The device is automatically selected in the device list, and details are shown for the faulted device.



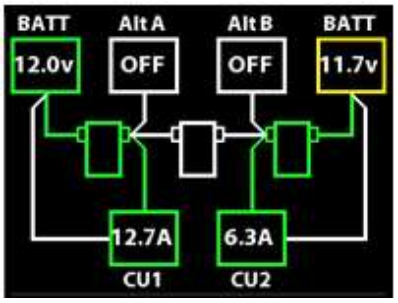
When this happens, you can:

- Clear the fault by pressing the *Reset Fault* soft key. The device is now turned back to automatic, and will turn either on or off depending on how it is configured for that Mode. The device is the de-selected for the device list.
- Ignore the fault by pressing the rotary knob to exit the device selection.

9.2 Low-voltage alarm

There are two low-voltage levels that can be configured in the setup menus. One is for the engine running and one without. Typically, the battery voltage will be 12.5 volts (double for 28v system) without the alternator/engine running, and 14.2 volts with the engine/alternator running.

If the bus voltage drops below the configured low voltage level for at least 10 seconds, then a low voltage alarm is activated. When low-voltage condition occurs, the VP-200 performs the following actions:



- A voice alarm is played in the headset
- A message appears in the message window
- The battery with the low voltage is shown in yellow

An alternator failure or voltage regulator failure is normally detected by a low voltage condition. The low voltage alarm will not automatically initiate the alternator failure emergency or an electrical load shed. These events must be initiated by the pilot.

9.3 Over-voltage protection

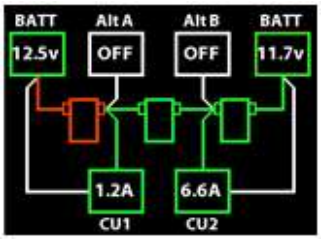
The VP-200 detects when an over-voltage condition exists on the bus, as configured in the setup menus. An overvoltage condition generally occurs because either the voltage regulator or alternator have failed in a manner that allows the alternator to produce higher voltage levels than normal. When an over-voltage condition occurs, the VP-200 performs the following actions:

- Faults (turns off) the active alternator circuit for the faulted bus
- A voice alarm is played, and a message appears in the message window
- Turns the alternator red in the electrical system diagram

You can reset the faulted alternator circuit in the same way you reset any other faulted circuit.

Because the alternator circuit is disconnected, you will shortly get a low-voltage alarm. When this happens, execute the alternator failure emergency if you want to load shed and switch to the backup alternator (and close the cross-tie contactor for a configuration 4 system).

9.4 P- bus/battery contactor failure



If the battery contactor fails, power will be lost on the main power bus from the battery. The VP-200 detects this loss of power and automatically switches to the e-bus circuit, which is powered directly from the battery. When it switches to the e-bus circuit, all electrical devices are turned off, except those which have been configured to remain on (or are on their own internal battery or powered via a backup bus). The transition from the main power bus to the e-bus takes about 1 second, during which time the power is lost to all devices except those on backup circuits.

The e-bus circuit is protected by a 20A fuse, so the VP-200 limits continuous loads to a maximum of 12A. This allows intermittent loads like the flaps and trim to operate and not exceed the current rating of the fuse.

If your aircraft is equipped with a hydraulic pump, do not operate the gear and/or flaps so as to cause the hydraulic pump to operate while the bus is powered via the e-bus circuit.

For any electrical configuration, the VP-200 can use battery power through the e-bus circuit up to its 12A limit; so you can manually turn on electrical devices by using the device list. The VP-200 will protect the e-bus and not allow you to turn on a device that will increase the load above 12A. In determining whether to turn on another circuit, the VP-200 adds the active current draw to the circuit breaker value of the device being turned on. If the total exceeds 12A, the device will not turn on, and an alert message is shown. Note: this may limit your ability to turn on circuits with high circuit breaker values. Turn on critical circuits first.

For a system set up with configuration 4, the VP-200 will automatically close the cross tie contactor to feed power from the other bus, and also turn off the bus B alternator (you can't have two alternators running simultaneously on the same bus). No load shedding occurs. It is up to the pilot to manually load shed as necessary.

A main bus/battery contactor failure is detected when there is no voltage on the CU power lug, when there should be. This can be caused by several things:

1. The battery contactor itself fails in a manner so it can't close
2. The cable from the battery contactor to the CU is loose or not attached
3. The cable from the battery to the battery contactor is loose or not attached
4. The wire that controls the battery contactor is loose or not attached

The battery contactor failure can only be cleared by fixing the problem and turning the system off, then back on. When the battery contactor is failed, the *All Auto* function, which sets all of the devices to automatic, is disabled. Also note that any hard-wired backup circuits that are on will remain on during a battery contactor failure.

9.5 E-bus failure

The e-bus provides initial power for turn-on as well as backup power to the Control Unit.

If the e-bus circuit fails while in normal operation (power is being provided via the battery contactor/power lug wire), then:

- The VP-200 cannot be turned on. The VP-200 Duo will turn on only the Control Unit with a good e-bus circuit, and possibly not the Switch Panel.

- The VP-200 may shut off if running only on the e-bus when the failure occurs. On a VP-200 Duo the remaining Control Unit will provide power to the Display Unit, and generate

a loss-of-communications alert. Devices that are on the failed Control Unit will turn yellow.

- An alarm is generated.
- The VP-200 will continue to operate normally and provide power to electrical devices via the main bus (battery contactor).

Some possible reasons for an e-bus failure include a blown fuse, shorted wire, or damaged wire or connector. A starter solenoid that is failed closed when the system turns on should blow the e-bus fuse for safety. If this happens, please contact VP tech support.

9.6 Starter Safety System

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. The VP-200 will not turn on if the e-bus fuse(s) is blown.

9.7 Backup circuits

The VP-200 allows an unlimited number of backup circuits. See the Installation Manual for wiring details. Each backup circuit has a protected, non-system source of power wired through an independent switch. If a backup switch is turned off, the VP-200 controls power to the device. Turning on a backup switch powers the device independently of the VP-200.

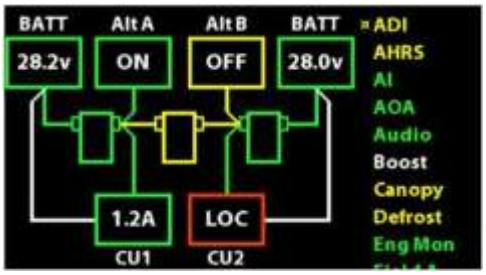
Select and use the backup capability intelligently. For example, if your attitude reference is one of the backup circuits, you can turn on its backup power when flying in reduced visibility (IMC and/or night) and then have an electrical malfunction and the reference stays powered. Note that certain failure modes exist that, although rare, can fault the entire electrical system – including the backup circuits. Care in the construction and maintenance of your electrical system is the best way to mitigate these risks.

The backup switches will provide power to their respective devices even after the VP-200 shuts off automatically. Remember to turn off backup power after it is no longer needed. Backup circuits wired per Method A will be annunciated in Pre-flight and Post-flight Modes if left on.

9.8 Internal system faults

If the VP-200 detects a substantial internal fault or a software “lock up”, it will reboot itself in an attempt to restore normal operations. You can manually reboot the DU by holding down the 5 soft key and then holding the 1 soft key for three seconds. You cannot initiate a reboot of the Control Unit or Switch Panel without cycling power to the whole system.

If the Display Unit reboots, it will take about 20 seconds to recover. During this period, the electrical devices will remain in their current state and flaps and trim will continue to operate normally.



If the communication link between the Control Unit and the Display Unit fails, the display will show a loss of communication (LOC) message. The LOC may be caused by a loose cable, faulty communication chip, or complete failure of the Control Unit. Devices that are connected to the affected Control Unit are shown in yellow. Yellow only means the device state is unknown – it may be on or off. If the Control Unit is in fact functioning, it will continue to operate independently and all switches (such as trim or flap switches) connected directly to it should continue to work.

Data on the display should be deemed unreliable while a comm failure is present and until power can be cycled to the system.

If the Control Unit reboots, you will get a temporary loss of communication (LOC) error message and a CU Reboot alert message. The CU takes about 1 second to reboot, and during a reboot the electrical devices will stay in their current state. Devices connected to a dimmable circuit will turn off during a CU reboot and restore after boot.

If the Switch Panel reboots, you will get a temporary loss of communication (LOC) error message and the SP annunciator will turn red. If the Switch Panel fails because of an internal fault, the master switch, emergency button, and mag switch will continue to operate normally. The three toggle switches and LED lights will be inoperable.

In general, if a specific component should fail, the other components should operate normally. For example, the Control Unit will continue to operate (trim, flaps, short circuit protection, overvoltage protection, and contactor management) even if the Display Unit and/or Switch Panel are inoperative.

9.9 Backup Alternator Over-current Alarm

If configured, a REDUCE LOAD alarm sounds when the total current draw exceeds the capacity of the backup alternator. Turn off devices to reduce the total current draw.

9.10 Exceeding maximum current ratings

Each VP-200 Control Unit is rated for a maximum of 60A continuous current (120A total for two Control Units). As a safety measure, the VP-200 will generate an alert when the current reaches 48A by turning the Control Unit box on the electrical system display yellow. When it reaches or exceeds 60A, the CU box will turn red. They system will not shut off any devices, but

the high temperatures caused by the high current draw may cause unreliable behavior. You can view the CU internal temperature by going to *Options -> System Info*. The normal operating range is between 30°C and 60°C. If the temperature exceeds 70°C you should turn off high current loads, if able. The VP-200 has been successfully tested in conditions beyond its published limits, but it is not recommended you regularly exceed the published limits.

10 Handling Emergencies

The VP-200 allows you to respond to most emergency situations with only the press of a few buttons. Once the emergency response begins, you can focus on flying the aircraft and let the VP-200 handle the specifics.

An emergency is not a specific mode. Rather, the emergencies work "in conjunction" with each mode, and override the mode-specific settings. When an emergency is initiated, the modes will continue to switch normally.

Warning: the pilot in command, and not Vertical Power, is ultimately responsible for the correct assessment and handing of emergency situations. No system can handle every possible emergency and therefore the pilot must exercise appropriate diligence and process when responding to emergencies. Be sure you are thoroughly familiar with the actions performed for each emergency. Each of the automated actions performed by the VP-200 may be overridden by the pilot if necessary.

To initiate an emergency response, press the red emergency button on the Switch Panel.

When the emergency button is pressed, the following occurs:

- The emergency button flashes red, then stays steady red
- The automatic mode switching changes to manual and the mode turns yellow with an asterisk next to it.
- The emergency icon  appears next to the mode name

- The soft keys change to show the emergency conditions to which the VP-200 can respond automatically.

Patent Pending

The four soft keys for emergencies are: engine failure, engine fire, alternator failure, and electrical fumes. To cancel, press the emergency button again. Pressing one the four emergency keys will generate an aural advisory specific for the emergency and, if configured, display a checklist on the DU. You may acknowledge the checklist to reveal the electrical system diagram.

The specific actions that occur during each emergency are described below.

10.1 Engine Failure

When the engine failure emergency is selected, the following occurs:

- The engine failure checklist appears, if enabled
- A voice alert is played verifying the emergency
- The boost pump turns on (ensure the correct boost H or L is configured in the setup menus on a dual-speed pump)
- Power is cycled to the ignition, if installed
- Power is cycled to the alternator field(s).
- The mode changing is set to manual, so you will have to change modes manually while the emergency is active.
- Certain soft keys change to provide the following emergency functions (red on white):

Starter – activates the starter when then soft key is pressed.

Electrical Shutdown – turns off the entire electrical system, except for backup circuits which are directly controlled by their respective switches.

Restore – restores each electrical device to its respective on/off state as it was before the emergency was initiated.

10.2 Engine Fire

When the engine fire emergency is selected, the following occurs:

- The engine fire checklist appears, if enabled
- A voice alert is played verifying the emergency
- The boost pump turns OFF. If one of the Switch Panel switches is set to Boost and it is manually on, then the boost pump will remain on.

- The alternator field(s) are turned off.
- The mode changing is set to manual, so you will have to change modes manually while the emergency is active.
- Soft keys 4 & 5 change to provide the following emergency functions (red on white):

Electrical Shutdown – turns off the entire electrical system, except for backup circuits which are directly controlled by their respective switches.

Restore – restores each electrical device to its respective on/off state as it was before the emergency was initiated.

10.3 Alternator Failure

An alternator failure or voltage regulator failure is normally detected by a low voltage condition, indicated visually or aurally via a low voltage alarm. The low voltage alarm will not automatically initiate the alternator failure emergency or an electrical load shed. These events must be initiated by the pilot.

A summary of how an alternator failure is handled for each electrical configuration is shown below:

Configuration 1: Load shed because your only alternator is off line and you are running on battery power alone.

Configurations 2 and 3: Turn on the backup alternator and load shed as necessary.

Configuration 4: Close the cross tie and load shed as necessary.

For Configuration 1,2, or 3 systems:
When the alternator failure emergency is selected, the following occurs:

- The alternator failure checklist appears, if enabled
- A voice alert is played verifying the emergency
- A determination of IMC/VMC conditions is made by either 1) reading one of the switch panel switches if configured for IMC/VMC or 2) asking the user to select IMC/VMC from the soft keys.

- Power to the primary alternator field is cycled (1 second off, then on again)
- The VP-200 waits 15 seconds for the bus voltage to rise above the low voltage limit. If the bus voltage rises, then the emergency is cancelled.
- If the voltage is still low, the primary alternator field is shut off and the backup alternator field (if configured) is turned on. A voice confirms the backup alternator is on.
- A VMC or IMC load shed is initiated based on the earlier input. A load shed event sets each device to either manual on or manual off, meaning that they will not change (on/off)

as the modes change. You can override this for each device using an external switch or the device list. A voice confirms the load shed is occurring.

- The mode changing is set to manual, so you will have to change modes manually while the emergency is active.
- Soft keys 4 & 5 change to provide the following emergency functions (red on white):

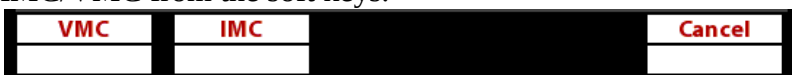
Electrical Shutdown – turns off the entire electrical system, except for backup circuits which are directly controlled by their respective switches.

Restore – restores each electrical device to its respective on/off state as it was before the emergency was initiated. **The alternator fields are not restored and remain in their current state.**

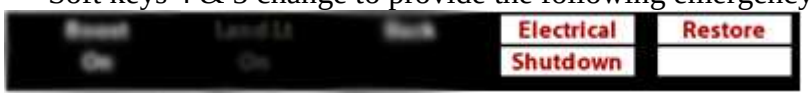
For Configuration 4 systems:

When the alternator failure emergency is selected, the following occurs:

- The alternator failure checklist appears, if enabled
- A voice alert is played verifying the emergency
- The mode changing is set to manual, so you will have to change modes manually while the emergency is active.
- A determination of IMC/VMC conditions is made by either 1) reading one of the switch panel switches if configured for IMC/VMC or 2) asking the user to select IMC/VMC from the soft keys.



- Power to the alternator field on the bus(ses) with low voltage is cycled (1 second off, then on again)
- The VP-200 waits 15 seconds for the bus voltage on the affected bus(ses) to rise above the low voltage limit. If the bus voltage is above the low-voltage limit on both busses, then the emergency is cancelled.
- If the voltage is still low on one or both busses, the alternator field on the affected bus is shut off and the cross-tie contactor is closed. When the cross tie closes, both busses are feeding from the single operating alternator.
- If the bus B alternator fails (smaller alternator), then no load shed occurs, as it assumes most of the loads can be operated from the primary alternator. You can manually turn off additional loads if needed.
- If the bus A alternator fails (larger alternator), then a load shed is initiated. A load shed event sets each device to either manual on or manual off, meaning that they will not change (on/off) as the modes change. You can override this for each device using an external switch or the device list. A voice confirms the load shed is occurring.
- Soft keys 4 & 5 change to provide the following emergency functions (red on white):



Electrical Shutdown – turns off the entire electrical system, except for backup circuits which are directly controlled by their respective switches.

Restore – restores each electrical device to its respective on/off state as it was before the emergency was initiated. **The alternator fields and x-tie (bus cross tie) are not restored and remain in their current state.**

10.4 Electrical fumes

Electrical problems can usually be detected by smell or smoke in the cockpit. One way to turn off the entire electrical system is to hold the master switch down for three seconds (note: backup circuits will remain on if the backup switches are on). However, there are situations where it may not be prudent to turn off everything immediately and you want to incrementally turn off electrical devices. In such cases, you can manually turn devices off using the device list or initiate the electrical fumes emergency.

When the electrical fumes emergency is selected, the following occurs:

- The electrical fumes checklist appears, if enabled
- A voice alert is played verifying the emergency
- A determination of IMC/VMC conditions is made by either 1) reading one of the switch panel switches if configured for IMC/VMC or 2) asking the user to select IMC/VMC from the soft keys.

- The alternator field(s) are turned OFF
- A VMC or IMC load shed is initiated based on the earlier input. A load shed event sets each device to either manual on or manual off, meaning that they will not change (on/off) as the modes change. You can override this for each device using an external switch or the device list. A voice confirms the load shed is occurring.
- The mode changing is set to manual, so you will have to change modes manually while the emergency is active.
- Soft keys 4 & 5 change to provide the following emergency functions (red on white):

Electrical Shutdown – turns off the entire electrical system, except for backup circuits which are directly controlled by their respective switches.

Restore – restores each electrical device to its respective on/off state as it was before the emergency was initiated.

10.5 Canceling and restoring from emergencies

There are two ways you can cancel out of an emergency. Pressing the restore soft key returns devices to their previous on/off state whereas pressing the emergency button leaves everything as-is.

Pressing the Restore soft key returns devices to the on/off state they were in before initiating the emergency (with the exception of alternator fields & x-tie during an alternator failure emergency, which are not restored). The emergency is cancelled and the emergency icon is not displayed.

Pressing the emergency button during the emergency cancels the emergency. All devices will remain in the on/off state they are in when exiting.

If many of the electrical devices are set to manual (a > symbol next to the device name) and you want to set them back to automatic (so they change based on modes), simple press the rotary knob so any device is selected, then press the *All Auto* soft key, then confirm by pressing the *Yes* soft key. All the devices will now be set to automatic.

10.6 Low Fuel Pressure (Auto Boost)

The Auto Boost™ feature automatically turns on the boost pump when fuel pressure drops below a safe level. This feature should be enabled 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.

If the feature is enabled, within one second of detecting fuel pressure in the low red region (as configured) in Takeoff, Cruise, Maneuver, or Landing Modes, the following occurs:

1. the specified boost pump is turned on manually. The fuel pump will not turn on if the device is faulted or in manual OFF or there is a loss of comm between the DU and CU. To turn the electric boost pump off, you must set it back to auto or turn it off manually. If one of the Switch Panel switches is set to control the boost pump, cycling the switch will place the boost pump back into auto.
2. the master warning flashes
3. the voice alarm activates
4. an “Auto Boost” annunciator appears and must be acknowledged.

Note that turning on the electric boost pump when a low fuel pressure condition occurs may or may not restore power to the engine.

11 Engine Alarms

The VP-200 shows visual and aural alarms for both engine and electrical limits. If an engine parameter is out of the normal (green) limits, the following happens:

- The value on the gauge turns red or yellow
- ‘ENGINE’ annunciator is shown.
- Master warning and aural alarm is played in the headset if configured.

The ‘ENGINE’ annunciator clears when the gauge value is a few units away from the red or yellow limit. This prevents the alarm from repeating when the value is on the edge of the limit. Therefore, the ‘ENGINE’ annunciator may be on when the value returns to the green range but is still close to the yellow or red zone.

If the engine data stream is invalid, then the engine gauges change to large red X symbols.

12 Configuration Alarms

The VP-200 can verify that the mag switch, trim and flaps are configured correctly during each mode. These features can be enabled or disabled via the setup menus.

12.1 Mag switch configuration

The mag switch is wired directly to the p-leads on the mags or ignition system. The Control Unit(s) (and hence the processors) do not control the magentos, but they do monitor the position of the mag switch on the Switch Panel. For each mode of flight the VP-200 expects the mag switch to be in the position shown below, and if it is not a “Check Mag Switch” alarm is presented.

Mode	Position
Pre-flight, before-start, run-up	Not checked
Start, after-start, taxi, takeoff, cruise, maneuver, landing	Both
Post-flight	Off

Immediately after a mode change, the system checks the mag switch position and annunciates if the position is different from that in the table above. Once in a mode and the switch is moved to a position different than in the table, the system waits 5 seconds before annunciating the condition.

12.2 Trim configuration

The trim can be configured to activate an alarm if it is out of range for certain modes. When the alarm is active, the following occur:

1. “Check Trim” annunciator is shown.
2. Voice “Check Trim” is played.

The annunciator clears when the trim is moved back in range.

12.3 Flap configuration

The flaps can be configured to activate an alarm if they are out of range for certain modes. When the alarm is active, the following occur:

1. “Check Flaps” annunciator is shown.
2. Voice “Check Flaps” is played.

The annunciator clears when the flaps are moved back in range.

13 Fuel Gauges

The display shows the fuel level readings for left and right fuel tanks. These data are received from an external source that provides fuel level readings, and those readings are displayed exactly as received. There are currently no provisions to calibrate the fuel level gauges (although there will be in the future), so be sure you understand the true meaning of the fuel level readings. **You should never use the fuel level gauges as the sole source for determining the amount of remaining fuel on the aircraft.**

The fuel totalizer functionality is currently not implemented.

14 Climate Control System

The Climate Control System (CCS) is described in the CCS Installation and Operating Manual, available on the VP web site.

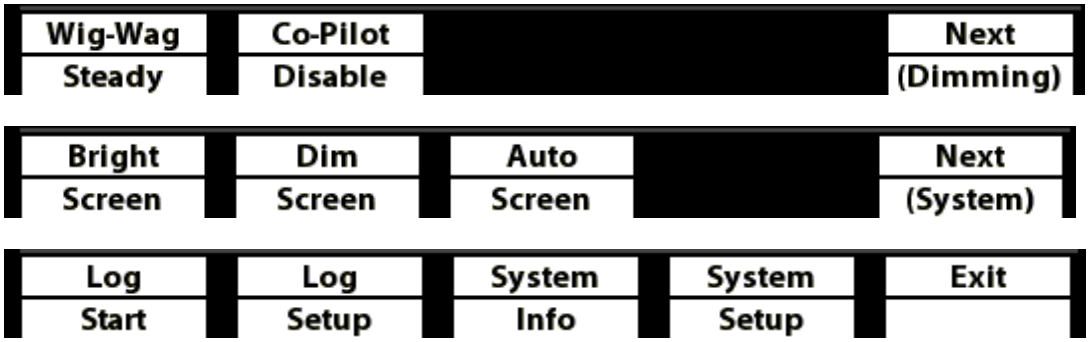
15 Demo System

If you want to demo the system for friends or review functions, there is a built-in demo which can be accessed by pressing Options -> System Info -> Demo. The demo is only available during Pre-Flight Mode. You can step through the screen by pressing the Back or Next soft keys. You must cycle power using the Master Switch to exit the demo.

Note: The Display Unit's other functions are disabled during the demo.

16 Options Menu

In all modes, the *Options* soft key provides access to system information and audio and display dimming control. Setup is accessible only in Pre-Flight, Post-Flight, and Maneuver modes. The diagram below maps the options.



Press the next key (soft key 5) to scroll to the next page. Continue pressing next until the you are back on the main screen.

16.1 System Screen Dimming

Press the Options key twice to get to the dimming soft keys.

Manual dimming: press Bright Screen or Dim Screen to manually control the dimming level of the screen and SP lights.

Automatic dimming: press Auto Screen to use the internal light sensor to automatically dim the screen. When powered on, the VP-200 is set to auto dimming.

16.2 Data Logging

To configure data logging, press the Setup Log soft key from the options menu. You can turn on or off logging for each of the following functions individually:

- Engine data
- Climate Control System data (if installed)

Each of these data sets writes its own data file. The data files are in CSV format, meaning that each data item is separated by a comma. The header in each file contains the name of the data.

Each data file can be configured to overwrite (new file started each flight) or to append (new data is added to old data, so file gets larger each flight). Data logging stops when the USB drive is 90% full.

If a USB drive is installed:

- Data logging automatically starts in After-Start Mode.
- Data logging automatically stops in Post-Flight Mode.
- Data logging can be manually started and stopped using the Options menu

The data is written to a USB flash memory drive when attached to the USB port on the back of the DU. If the USB drive is not attached then data will not be stored.

- Engine and climate data are captured at 1 Hz.
- Raw serial data is captured at full rate.
- DO NOT turn on the raw serial data unless you need to capture data for VP Tech Support. After logging the data, turn the logging back off for that serial port. If you attempt to log raw serial data while flying you may notice significant delays in Display Unit behavior. The raw data inputs are turned off at each power cycle.

If the USB drive is attached, the data writing will automatically begin in After Start Mode and stop in Post Flight Mode. An annunciator “LOGGING” will be displayed when data is being stored. If you see “NO USB” when data logging should start, then the USB drive is not recognized and you may need to try another brand of drive. They can be temperamental.

If you want to start or stop logging manually, go to the Options Menu and press “Start Log” or “Stop Log” soft key.

DO NOT REMOVE THE USB DRIVE WHILE **LOGGING** ANNUNCIATOR IS SHOWN. Wait till the logging stops in Post Flight Mode or manually stop the logging (from the options menu).

Use any common spreadsheet software to view the data file.

17 Software Updates

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.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.

17.1 Application Software

Updated software is available periodically at no charge from the Vertical Power web site (go to Support then Software page). 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, please contact VP tech support first.

Caution! Do not shut off the VP-200 while the software update is in progress.

Go to the Vertical Power web site, under Support->Software upgrades, and follow the instructions in the release notes.

17.2 Export Settings

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

Do not shut off the VP-200 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 to the USB flash drive.**
- ☐ Exit when done.

17.3 Import Settings

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

Do not shut off the VP-200 while the import is in progress.

To import saved settings:

- ☐ Insert a USB flash drive into the USB port on the back of the Display Unit. The settings file must be from the save version that exported the settings file.
- ☐ Press the *Import Settings* soft key. Monitor that the data is importing, then turn off the VP-200 when import is complete. **Do not operate the aircraft if any errors occur.** Cycle power to the VP-200, 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.

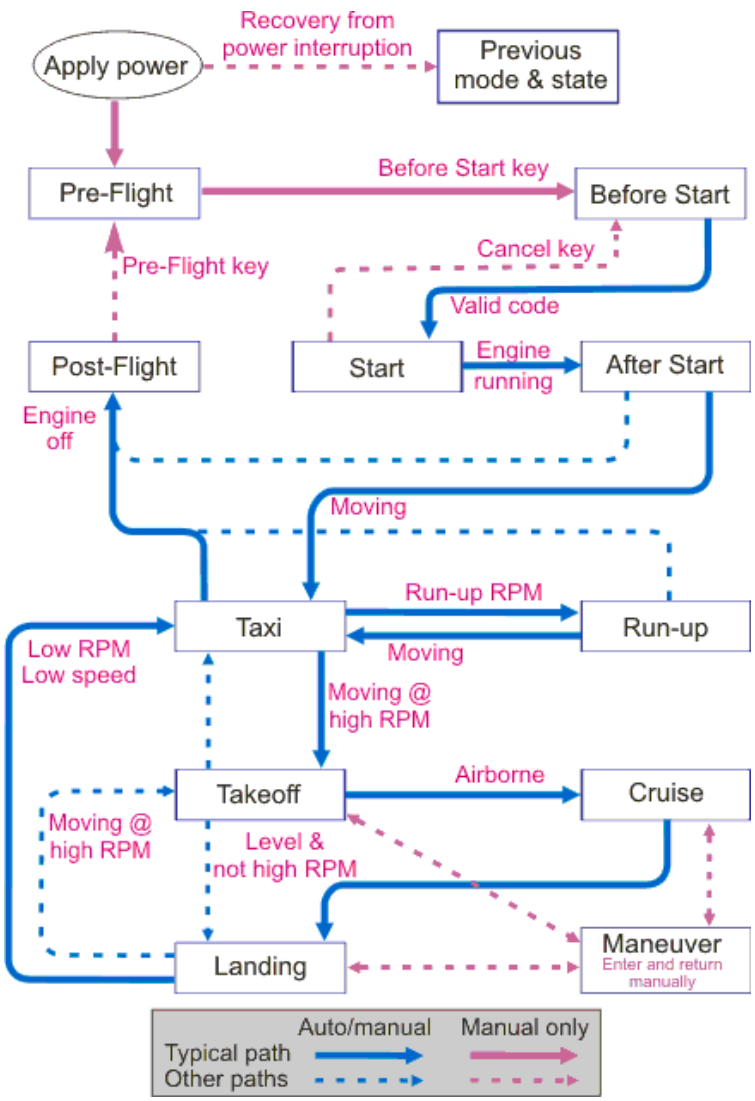
18 Troubleshooting

The following issues may happen during normal operation. **Additional** troubleshooting and configuration information is available in the VP-200 Installation Manual.

System won't turn on.	1. Check that each d-sub cable is secure, no pins are bent. 2. Verify all power connectors are secure. 3. Verify power to the e-bus wire and that the e-bus fuse is not blown. 4. Check the ground wiring. Each CU has three ground wires.
Fault codes on startup	Refer to Appendix E for fault codes.

Display hangs on startup	This is a known bug that occurs rarely. Press soft keys 5 and 1 together to reboot the Display Unit.
Flap faults during operation	1. Check circuit breaker value. Flaps draw more power when under load than when on the ground. 2. Check that the up limit and down limit settings are set a bit before their actual limits. Sometimes slop in the position sensor causes the VP-200 to think it has not reached the end if its travel and therefore runs the flaps continuously until the max travel time is reached.
No engine or GPS data	1. Check that the engine monitor or GPS have power. 2. Check the serial data line continuity. 3. Check the setup menu to verify a data stream is coming in. 4. Check the setup menu to verify the correct data format is selected.

19 Appendix A: Mode Switching Detail



Patent Pending

20 Appendix B: Soft keys for each Mode

Pre-Flight	Before Start Mode	Comm 1 On	Key #2	Avionics	Options
Before Start	1	2	3	4	Cancel
Start	Prime Engine	Start Engine	After Start Mode	Pre-Flight Mode	Options
After Start	Taxi Mode	Run-Up Mode	Takeoff Mode	Electrical Shutdown	Options
Taxi	Run-Up Mode	Takeoff Mode	Post-Flight Mode	Before TO Checks	Options
Run-Up	Takeoff Mode	Taxi Mode	Ignition Check	Before TO Checks	Options
Takeoff	Cruise Mode	Maneuver Mode	Landing Mode	Climb Checklist	Options
Cruise	Landing Mode	Maneuver Mode	Switch Tanks	Approach Checklist	Options
Maneuver	Boost On	Land Lt On	Back		Options
Landing	Taxi Mode	Takeoff Mode	Maneuver Mode		Options
Post-Flight	Pre-Flight Mode	Shutdown Now	Defer 5 Min	Defer 15 Min	Options

21 Appendix C: Setup Menu Diagram

Please reference the VP-200 Installation Manual.

22 Appendix D: Aural Advisories

The following audio advisories are played when indicated.

- *Alternator failure* – User pushed **Alt Failure** key.
- *Backup Alternator* – Backup alternator has just been turned on.
- *P-bus failure* – The VP-200 has determined that the main power line has failed.
- *Check display unit* – Heard after DU resets after a reboot.
- *Check fuel* – Fuel reading below the minimum of any tank or the fuel flow higher than the maximum.
- *Check fuel pressure* - Fuel pressure above maximum or below minimum.
- *Check mag switch* – The mag switch ins in an incorrect position
- *Check oil pressure* – Oil pressure below the top of the bottom yellow or red or above the bottom of the top yellow or red.
- *Check annunciator* – a custom annunciator is active.
- *Check RPM* – RPM above red limit.
- *Low voltage* – Bus volts below the bottom red.
- *Communications failure* – Signal interruption between components. Check status bar on DU.
- *Data input loss* – Data is lost from source of engine, GPS or air data.
- *Check EGT* – EGT out of limits
- *Check CHT* – CHT out of limits
- *Check Flaps* – the flaps are out of the specified range.
- *Check trim* – the trim is out of the specified range.
- *Electrical Fumes* – User pushed **Elect Fumes** key
- *Endurance bus failure* – Endurance bus failure detected.
- *Engine Failure* – User pushed **Eng Failure** key.
- *Engine fire* – User pushed **Eng Fire** key.
- *Flap circuit fault* – System has faulted flap circuit. This may be caused by a short circuit, over-current condition, , runaway flap condition, or continuous operation of the flap motor.
- *High current draw* – CU load > 48 amps.
- *Load shed* – a load shed event is being initiated.
- *Mode automatic* – After Mode automatic, valid GPS and engine data is available.
- *Mode manual* – System does not have valid GPS or engine data so user must change flight modes manually.
- *Over current detected* – A pin is drawing more than its circuit breaker value.
- *Over voltage condition* – An alternator output voltage is too high and the VP-200 has turned off its field.
- *Short circuit detected* – A pin is shorted.
- *Trim circuit fault* – System has faulted a trim circuit. This may be caused by a short circuit or a runaway trim condition.

- *Turn off device* – A system detects a device that is manually on when it tries to turn it off during an automatic emergency response.
- *Turn on device* – A system detects a device that is manually off when it tries to turn it on during an automatic emergency response.

23 Appendix E: System Checkout Fault Codes

Each time the VP-200 is turned on it performs a series of internal checks. The table below lists the faults.

Verifying communications…<list of boxes that failed> - In YELLOW.

a) If stops for some other reason, it's a good indication that a box is OFF, has a disconnected cable, or can't 'talk' the same protocol as the current DU software version
b) If it shows up, but there are no other faults, this warning can be ignored.

Verifying CU #1/#2 link…failed – In RED

a) The link between the DU and CU is broken or the CU can't 'talk' the same protocol.
b) It's may also warn that CU#1 is on the CU#2 port (or vise-versa)

Verifying software version to <version>…failed - in RED

a) The version on a CU or SP is incorrect or is an older version
b) If there was a comm issue earlier, then the unit may be OFF or the link is broken

Verifying <data set>…Key mismatch (DB)

a) The local Display Unit Database key is not as expected

Verifying <data set>…Key mismatch (XU)

a) The Display Unit key and a CU/SP key do not match

Verifying <data set>…No response

a) One of the units did not respond to the verify query. Check cabling

Verifying <data set>…Data set empty

a) The Display Unit was expecting a configuration for a device, flap, trim, or other data set and the CU/SP indicated that it didn't know anything about that data set.

Verifying <data set>…Data set corrupted

a) A CU/SP is reporting that the local data set failed its checksum and that data set has been cleared to a default state.

Updating system states…(letter)(letter)..

a) While updating the real-time state of the system, the DU did not get a particular data set from the CU/SP. Check the cabling.

24 Appendix F: Alarm Annunciators

The following alarms are shown on the annunciator grid. Climate Control System alarms are listed in the CCS Operating Manual.

Alarm	Description
ACQUIRING	GPS signal is acquiring position.
AUTO BOOST	The specified fuel pump was turned on because of a low fuel pressure condition.
BACKUP ON	A backup switch (wired per method A) is in on. Switches wired per backup method B are not monitored. This alarm is active in pre-flight and post-flight modes.
CHECK BACKUP	When changing the IMC/VMC switch to IMC, this is a reminder to turn on your backup circuits. It clears after 5 seconds.
CHECK FLAPS	The flaps are out of the range specified in the Flaps Checks setup.
CHECK TRIM	The trim is out of the range specified in the Trim Checks setup.
CLOSING LOG	The data file is being closed when data logging stops.
CODE INHIBIT	The start code input has been inhibited for one minute because of multiple invalid codes.
COPILOT INHIBIT	The co-pilot trim and flap switches cannot be enabled because one of the switches is active (ie an input is grounded). To troubleshoot, go to Options (3x)->System Info->Input Levels to see the status of all the inputs.
COPILOT OFF	The co-pilot trim and flap switches are disabled, either because the user pressed Options/Co-Pilot Disable soft key, or a co-pilot switch was on when the system was turned on (you must turn the switch off to re-enable the co-pilot trim). To troubleshoot, go to Options (3x)->System Info->Input Levels to see the status of all the inputs.
CU INTERLINK	The CUs cannot talk to each other. A CU may have failed, or the communications chip may have failed, or the cable is unplugged.
CU LINK	The Display Unit cannot communicate with a Control Unit. A CU may have failed, or the communications chip may have failed, or the cable is unplugged. Data on the display should be deemed unreliable while a comm failure is present and until power can be cycled to the system.
CU RESET	The CU performed an internal reset. Report the problem to tech support if this happens on a frequent basis.
Custom	Text and behavior are as configured by user.
E-BUS FAIL	Power the e-bus input pin (CU J4 pin 1) on the Control Unit is not present when expected. This may be caused by a loose wire or blown e-bus fuse. The system will hold the battery contactor closed until the fault is cleared. This condition can only be cleared after a power cycle. Once turned off, the CU cannot be turned on again until power is restored to J4 pin 1.
ENGINE	An engine alarm is active.
EVENT QUEUE	If this appears, please contact Vertical Power tech support. Display Unit performance is likely degraded.
FLAP ACTIVE	If a fault is cleared (by pressing the Enable Flaps button while the flaps item is selected on the Device List), and the input pin is still active, the system will not allow the flaps to be reset.

FLAP DISABLE	The flap input switches are disabled, and the flaps can be operated by selecting them from the device list and using the soft keys. Either both flap inputs were active at the same time, or all inputs are disabled (see I/O DISABLE). Select the flaps device and press “Flap Enable” to clear fault. If it won’t clear, an input pin is still grounded or the I/O DISABLE is still active.
Flap Fault	The flap circuit is faulted because of a short circuit or over-current and must be reset.
GPS ACQUIRING	The GPS has not acquired its position.
I/O DISABLE	The system was powered on while a trim or flap switch input was active on the CU, disabling all input pins on the CU. You must repair the trim switch problem and cycle system power to restore functionality (to discourage flight with a faulted trim system). Trim and flaps can be operated via the soft keys when selected on the device list. The Options/System Info/Input Levels screen is not accurate while this annunciator is shown. Note that if a co-pilot input on the DU is active on startup, a “CoPilot OFF” annunciator is shown rather than the I/O Disable annunciator.
IN PROGRESS	An alternator failure emergency has been initiated and is in progress.
INCONSISTENT	Appears when an error occurs during initial system checks and user selects ‘Ignore’ and proceeds onto the main screen. The system may not operate properly. Flight is not recommended.
INVALID CODE	The starter code entered is invalid.
LOGGING	The system is logging data to the USB memory device plugged into the DU.
LOW VOLTAGE	The battery voltage is below the low voltage limit.
MAG SWITCH	The mag switch is an incorrect position for that mode.
NO GPS	GPS data are either not present or invalid. Modes must be switched manually until both GPS and engine data are present.
NO USB	There is no USB drive inserted into the DU for data logging, so no data logs are written.
OVERLOAD	You cannot turn on a device that may blow the e-bus fuse. If the actual current draw plus the circuit breaker value of the device you want to turn on exceeds 12 amps, the system will inhibit turning on the new device.
OVER-VOLT	An overvoltage condition occurred and the alternator field was faulted to clear the condition.
P-BUS FAIL	Power the main power lug on the Control Unit is not present when expected. This may be caused by a loose power cable or failed battery contactor. Power was switched to the e-bus automatically and a load shed occurred. This condition can only be cleared after a power cycle.
PRI INHIBIT	You cannot turn on the primary alternator when the p-bus is failed.
REDUCE LOAD	Turn off devices to reduce the total current draw. This annunciator appears when the current draw is above the specified maximum limit set for the backup alternator.
SP LINK	The Switch Panel cannot communicate with CU. The CU or SP may have failed, or the communications chip may have failed, or the cable is unplugged. Data on the display should be deemed unreliable while a comm failure is present and until power can be cycled to the system. While SP LINK is active, any devices switched via the switch panel can be switched using the device list and soft keys.

SP RESET	The SP performed an internal reset. Report the problem to tech support if this happens on a frequent basis.
SWITCH INHIBIT	An attempt to change the state of a device (on to off, or vice versa) was inhibited because the device must be switched using one of the external switches. For example, you cannot use the soft keys to turn off a device that is turned on via the switch panel.
TRIM ACTIVE	If a trim fault is cleared (by pressing the Enable Trim button while the trim item is selected on the Device List), and the input pin is still active, the system will not allow the trim to be reset.
Trim Disable	The trim input switches are disabled, and the trim can be operated by selecting it from the device list and using the soft keys. Some faults require a system power cycle to clear.
Trim Fault	The trim circuit is faulted because of a short circuit or over-current and must be reset.

The following alarms are shown on the screen, separate from the annunciator grid.

Alarm	**Description**
CU Comm Loss	CU box turns red. DU cannot communicate with CU. The CU may have failed, or the communications chip may have failed, or the cable is unplugged. Data on the display should be deemed unreliable while a comm failure is present and until power can be cycled to the system.
CU high current	CU box turns yellow. You are close to or have exceeded the CU current limits. Turn off devices to reduce current.
Mode manual	Indicated by the mode name in yellow, and an asterisk next to the name. You must change modes manually when either GPS or engine data are not available or valid. This alarm is active in taxi, run-up, takeoff, cruise, maneuver, and landing modes.
Short circuit or over current	Fault is displayed on the device list. Item turns red.