



Electronic Circuit Breaker System

VP-50

Operating Manual

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Current as of
software version 21.0

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1 Introduction

This VP-50 Operating Manual contains information about how to use the system. Information regarding setup and test can be found in the VP-50 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.

1.1 Table of Revisions

Change date	Change
12-1-08	Initial release
10-20-09	Added v20 features. See release notes on web.
2-19-10	Added holding ACK button for 1 second as method to clear faults. Added switch 8 as backup for pitch trim when pitch trim fault displayed.

1.2 Hardware Overview

The VP-50 consists of two components: the Control Unit and the Switch Panel.

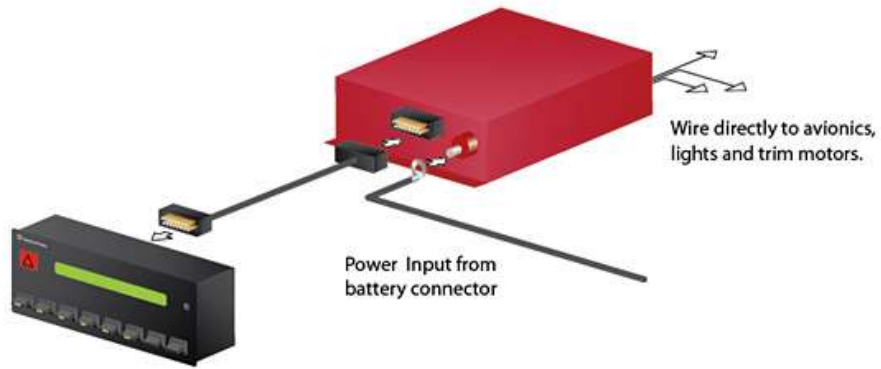


Switch Panel (SP): This unit mounts in the instrument panel. The screen provides electrical system status information and setup information. The unit has eight switches that can be configured (via set-up screens) to control the electrical devices. Stick-on labels are included to label the switches. Each switch has a built in LED light to provide status and/or alert information to you. An ambient light level sensor is recessed in the bezel. The acknowledge button is used for alarms and for the setup screens. The red alarm button is used to clear faults and notify the pilot of alerts.



Control Unit (CU): The central component of the VP-50 is hidden from view and discussed in detail in the VP-50 Installation Manual. It is powered directly from the battery and alternator(s) and powers devices controlled by the VP-50. The CU supplies power and communicates with the Switch Panel through data cables.

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



The pictures below depict the actual screen and the representation of that screen as depicted in this manual:

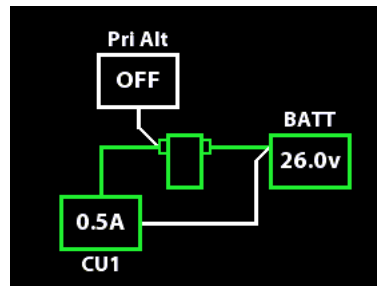


1.3 Electrical System Configurations

The VP-50 supports two different electrical configurations, shown below. Once set up for a certain configuration, the VP-50 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 screens and change the configuration.

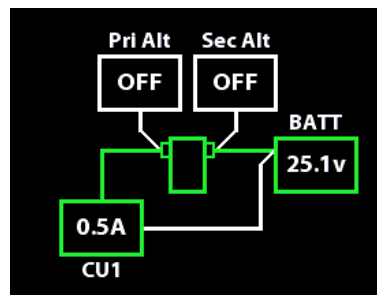
Configuration 1

Single battery
Single alternator, single bus
Single Control Unit



Configuration 2

Single battery
Dual alternator, single bus
Single Control Unit



Additionally, you can monitor the voltage of an independent aux battery.

1.4 System Description

This section describes the user interface components of VP-50.

1.4.1 Switch Panel

The VP-50 includes most of the switches needed to control the electrical devices on your aircraft. External switches, connected to the VP-50, may be installed to control the trim.

An external master switch, flap switch, starter switch and, if needed, external magneto switches are also installed separately from the VP-50.

The switches on the Switch Panel are identified throughout this manual using the following identifiers:



- S1 This is a three position switch with positions ON-OFF-ON. The switch is ON when the switch is either up or down, and off when it is in the middle position. This switch is designed to control the alternator fields, and can also be used to switch avionics and other electrical devices.
- S2 – S6 These are two position switches with positions ON-OFF. The switch is on when the switch is up and off when the switch is down.
- S7, S8 Wig wag, or device control on-off. S8 becomes a pitch trim switch when a pitch trim fault is on the display.
- Alarm Push to clear or reset alarms. Flashes when alarm goes off.
- ACK This is a momentary pushbutton used to acknowledge alarms and navigate screens. Press and hold it for 1 second to reset the alarm or reset the circuit breaker.

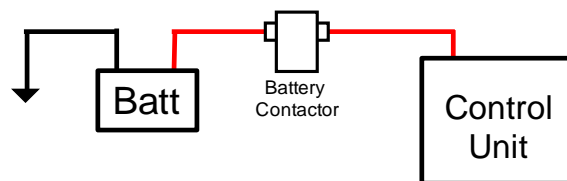
1.5 Alternator Operation

The VP-50 is designed to operate one or two alternators. The alternator is “operated” by providing bus voltage to the alternator field wires (either directly to the alternator or to a voltage regulator).

The alternator is controlled by switch 1. In the up position, the primary alternator is on, and in the down position, the secondary alternator (if installed) is on. Both alternators are off in the middle position. There may be avionics assigned to switch 1 as well.

1.6 Power Bus Architecture

The VP-50 Control Unit receives power from the battery, and is switched via a battery contactor. In some applications, a high-capacity switch is used in place of the contactor.



When the battery contactor is closed (using the master switch), the VP-50 turns on.

1.7 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 are secure and insulation is good. Wires in the engine compartment are easy to check whenever the cowling is off.

1.8 First Flight

If you are installing the VP-50 in a newly-built aircraft, be sure to read the first flight considerations in the VP-50 Installation Manual. Make sure you are familiar with and have completed the ground test procedures in the VP-50 Installation Manual before flying the aircraft.

1.9 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 System Operation

This section describes how to turn on the VP-50 and the electrical devices on the aircraft.

2.1 Power on & main screens

Turn on the VP-50 by turning on the master switch, located separately on the instrument panel.

After turning off the VP-50, wait at least 3 seconds before turning the system back on.

This short delay gives the electronics time to discharge and clear properly.

The system performs a series of checks to ensure that the Switch Panel and Control Unit have the same application version and configuration data, and that the data is valid. If the application is different on each component, the startup process stops and you must reinstall the application via a laptop. If the CU configuration is different from the Switch Panel configuration, it asks if you want to push the configuration out to the Control Unit. See the Troubleshooting section for fault details.

If any of the trim switch inputs are active (ie a trim switch pressed) during startup, the trim circuit shows a fault. You must clear the physical fault (either a stuck switch or shorted wire), then cycle power to the system to clear the fault in the system. Switch 8 acts as a backup pitch trim switch while this fault is shown.

The system status screen appears at startup.

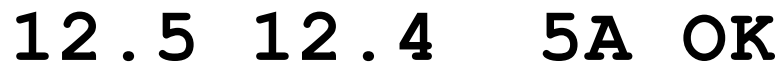


12.4V 0.5A OK

The screen shows bus voltage, current draw through Control Unit, and status. The status shows:

OK	no faults
1 or other number	number of faults in the fault queue

If an aux battery is monitored, the screen shows both battery voltage, the main battery is first and the aux battery is second:



12.5 12.4 5A OK

The screen below shows two faults in the fault queue.



14.1V 7.5A 2

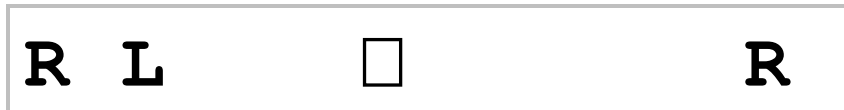
Press the ACK button to cycle through the following screens on the display:

1. System status
2. Pitch trim indicator (if enabled)
3. Roll trim indicator (if enabled)
4. Fault queue – any faults that are in the queue are displayed, listed in order of occurrence

Pitch trim indicator



Roll trim indicator



2.2 Power off

Turn off the VP-50 by turning off the master switch.

When the VP-50 is powered off, the Control Unit remembers the on/off state of each pin. It takes about two seconds after power on for the CU and Switch Panel to synchronize, during which time the CU turns on to the state it was in when powered off. If you turn the system off with any of the switches in the on position, the respective devices will come on when the system is turned back on, even if the switches are now off.

2.3 Turning electrical devices on and off

The VP-50 can be configured to support many types of configurations. Electrical devices can be turned on an off in several ways, shown below.

1. Use the switches on the switch panel. Up is on and down is off. Switches 7 and 8 are momentary action switches and return to center after being moved up or down.
2. Use up to four external switches wired directly to inputs on the Control Unit.

2.4 Trim operation and variable speed trim

2.4.1 Normal operation

The trim operates whenever a trim switch is pressed. The pitch trim operates at a two different speeds, which are controlled by wither an airspeed switch or a flap position switch.

Whenever the trim is running, the display changes to show the current trim position for that axis. When the pitch trim motor is running at normal speed, the pitch trim position indicator is a square box. When the pitch trim motor is running at slow speed, the pitch trim position indicator is an asterisk.

2.4.2 Runaway trim

Runaway trim can be caused by a stuck switch, a shorted wire, or various other causes.



If you discover the trim 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

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
- An alarm message is shown on the screen. WHEN then alarm message is shown, switch 8 controls the pitch trim switch.

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.

If any of the trim switch inputs are active (ie a trim switch pressed) during system startup, the trim circuit shows a fault. You must clear the physical fault (either a stuck switch or shorted wire), then cycle power to the system to clear the fault in the system.

2.5 Landing Light Wig-Wag

Depending on how the system is configured, one or two landing/taxi lights can be configured to pulse (wig-wag) when turned on.

Either switch 7 or 8 can be configured to set these lights to either steady (on) or wig-wag.

To wig-wag, turn the lights on, then momentarily press switch 7 or 8 (as configured) UP to wig wag or DOWN to go steady. The last state is remembered, so if the lights are turned off when wig-wagging, they will start wig-wagging automatically when turned back on.

When first turned on, the lights will remain in a steady ON state for the specified warm-up time period, then begin wig-wagging.

2.6 Switch light indicators

Switches 1 through 6 have an LED light in the tip of the switch. The indicators are as follows:

Off	the switch is off
Green	the switch is on
Red	one or more of the pins assigned to the switch is faulted. You can find the fault in the fault queue if you’ve already acknowledged the fault.

The red alarm button is lighted red when an alert needs to be acknowledged.

Switches 7 and 8 and the ACK button are not lighted.

3 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.

Load shedding is accomplished on the VP-50 by manually turning off switches for loads that you don't want. We recommend that the avionics you want on during load shed are assigned to switch 1, and the ones you don't want on are assigned to switch 2 through 8. That way, you can simply move switch 1 from the primary alternator to the backup alternator, and then turn the other switches off.

Load shedding is typically started when a low voltage condition occurs. When your primary alternator fails, the bus voltage drops below a pre-set alarm level, at which time the low voltage alarm is activated.

4 Electrical Faults

Beyond advisories, the VP-50 will not automatically respond to 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-50 does respond automatically to certain faults that require resolution faster than the pilot is able to respond. The VP-50 responds automatically to short circuits and an overvoltage condition. These are covered below.

4.1 Resetting a Fault

When a fault occurs, it appears on the screen, and the alert light turns red.

A fault is shown with the circuit name first, then the type of fault:

LITE Short Crct

When the fault is displayed on the screen, you can:

1. Reset the fault by pressing the red alarm button OR hold the ACK button for 1 second.
2. Acknowledge the fault by pressing the ACK button. This places the fault in the fault queue. The circuit remains off.



To view a fault that is in the fault queue, scroll to the fault queue (from the main status screen) using the ACK button. When a fault is displayed, you can:

1. Press the red alarm button OR hold the ACK button for 1 second to reset the fault.
2. Press ACK to cycle to the next message in the queue

4.2 Circuit faults (short circuit, over-current, current fault)

LAND Short Crct

TAXI Over Crnt

TAXI Crnt 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.

4.3 Low-voltage alarm

Low Volt Alert

If the bus voltage on the main bus or the aux battery (if enabled) drops below the configured low voltage level for 5 seconds, then a low voltage alarm is activated.

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

4.4 Over-voltage protection

Over Volt Alert

The VP-50 detects when an over-voltage condition exists on the bus, as configured in the setup screens. 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.

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 you can switch to the backup alternator and/or load shed.

4.5 Backup circuits

The VP-50 allows an unlimited number of backup circuits. See the VP-50 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-50 controls power to the device. Turning on a backup switch powers the device independently of the VP-50.

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-50 is shut off. Remember to turn off backup power after it is no longer needed.

4.6 Internal system faults

If the VP-50 detects a substantial internal fault or a software “lock up”, it will reboot itself in an attempt to restore normal operations. You can reboot the Control Unit or Switch Panel by cycling power to the whole system.

If the Control Unit reboots, you will get a temporary CU Communication Loss error message. The CU takes about one second to reboot, and during a reboot the electrical devices will stay in their current state.

CU Comm Loss

In general, if a specific component should fail, the other components should operate normally. For example, the Control Unit will continue to operate (trim, short circuit protection, overvoltage protection) even if the Switch Panel is inoperative.

4.7 Exceeding maximum current ratings

The VP-50 Control Unit is rated for a maximum of 50A continuous current. As a safety measure, the VP-50 will generate an alert when the current reaches 40A.

High Current

When the current reaches or exceeds 50A, the VP-50 will generate an alert.

Maximum Current

The system will not shut off any devices, but the high temperatures caused by the high current draw may cause unreliable behavior. The VP-50 has been successfully tested in conditions beyond its published limits, but it is not recommended you regularly exceed the published limits.

5 Options Screens

The options screens allow you to do the following:

- Set the brightness, contrast, and night/day level for the screen
- View the current draw on each individual pin

If a fault occurs while you are in the Options Screens, the master switch and master warning light will flash red. However, the fault will not be displayed on the screen until you exit.

To enter the options screen, press and hold the ACK button for 2 seconds while at least one of the switches 2 through 6 is on. If switches 2-6 are all off, the VP-50 will go into setup instead. You will see:

Options Screen

Use switch 7 to scroll through the screens. Press ACK to select the sub-screens.

5.1 Adjusting screen brightness, contrast, and day/night settings

To adjust the screen settings, scroll to the screen shown here:

Screen >

Press the ACK button to view the sub screens: brightness, contrast, day level. Use switch 8 to adjust the values for each screen, and switch 7 to scroll to the next screen. Scroll to the save or cancel screen and press ACK to exit.

5.2 Viewing current draw on each device

To view the current draw on an individual pin, scroll to the Device Amps screen, as shown here:

Device Amps >

Press the ACK button to view the sub screens. Use switch 7 to scroll through each assigned pin on the Control Unit. Each screen shows the connector, pin, pin name, and current draw from that pin.

The screen below shows connector J11, pin 2, LAND (landing light) is drawing 2.6 amps. Note: J11 is shown as 1 on the screen, and J8 is shown as 8.

1-02 LAND 2.6

Scroll through all the pins to get to the exit screen. Press ACK to exit to the options screens. Using switch 7, scroll to the exit screen to exit the Options screens and go back to the system status screen.

EXIT >

6 Software Updates

Software update procedures can be found on the VP web site under Support -> Software Upgrades.

7 Troubleshooting

The following issues may occur during normal operation. Additional troubleshooting and configuration information is available in the VP-50 Installation Manual.

System won't turn on.	<ol style="list-style-type: none"> 1. Check that each d-sub cable is secure, and no pins are bent. 2. Verify all power connectors are secure. 3. Verify power on the main power lug when the master switch is turned on. 4. Check the ground wiring. The CU has two ground wires.
Fault codes on startup	<p>Chk Cable</p> <p>a) Check the cabling. The Switch Panel can't talk as expected with the Control Unit.</p> <p>No CU Response</p> <p>a) The CU did not respond to the Switch Panel as expected. Check the cabling</p> <p>Reload Software</p> <p>a) There was a software mis-match. Run the SW Update Application and update the software.</p> <p>Please Import</p> <p>a) There was a database error on the Switch Panel. Load your settings using the SW Update Application.</p> <p>Update CU</p> <p>a) There was a key mismatch between the Switch Panel and Control Unit. Update the CU settings from the Switch Panel by pressing the ACK button.</p>