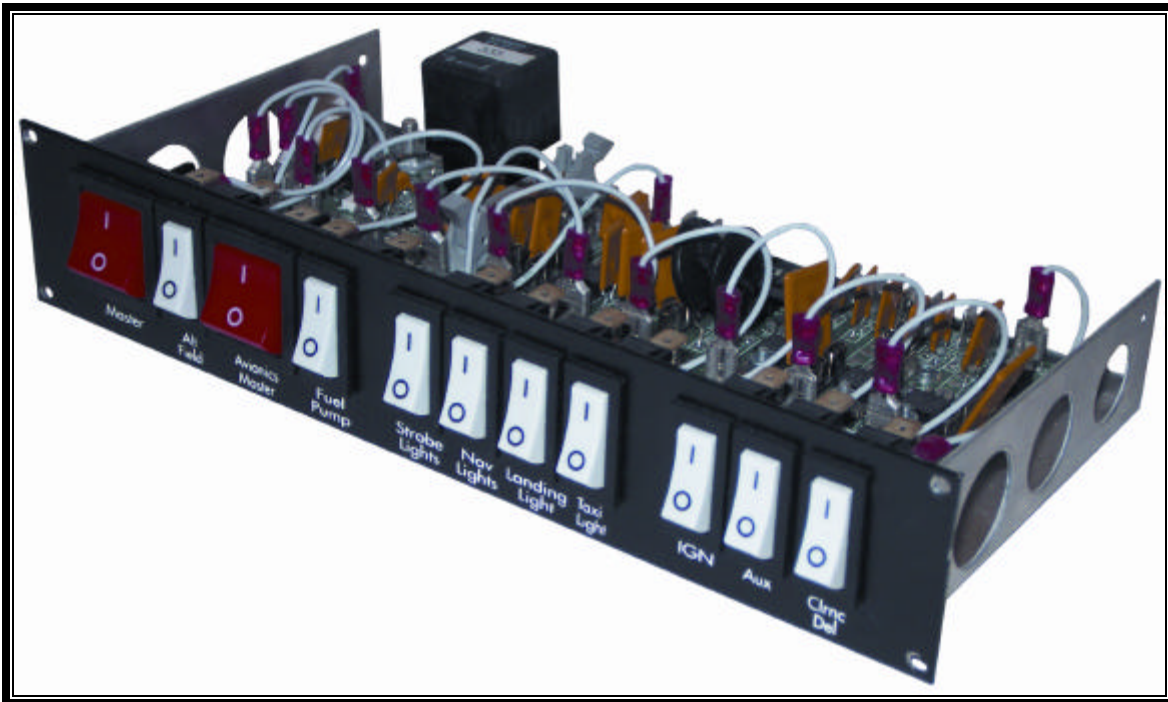


# Exp BUS

DC Load Center



## Installation Instructions

Control Vision

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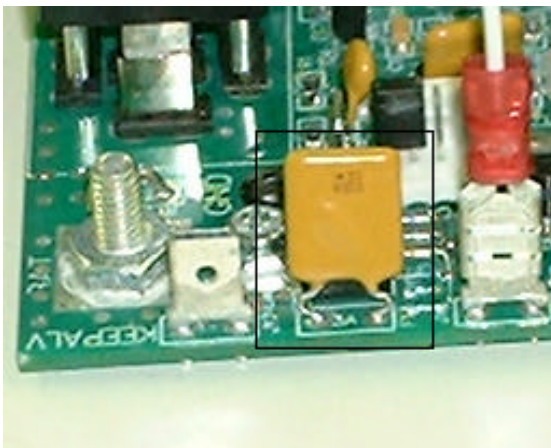
# INSTALLATION INSTRUCTIONS

## OVERVIEW

The Exp-BUS DC Load Center replaces the master solenoid, all but one circuit breaker, the master switch function, and the avionics master switch function. The avionics output bus provides six overload protected, power output circuits. Switched outputs include the alternator field output, Beacon/Strobe output, nav light output, aux fuel pump output, and two LDG light outputs. All outputs are overload protected, eliminating the need for fuses or circuit breakers, and saving the labor of installing and wiring them up.

## CIRCUIT OVERLOAD SYSTEM

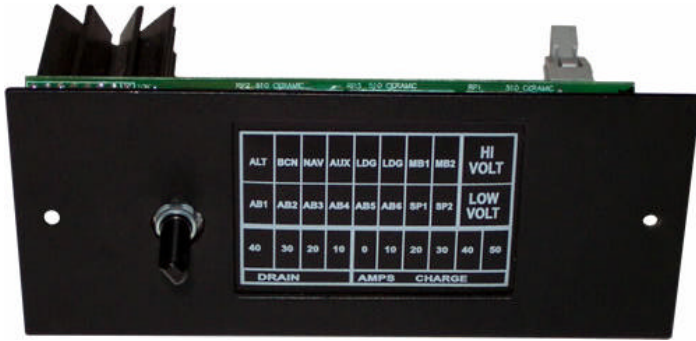
The EXP Bus product uses solid state current limiting devices known as PTC current limiters, and commercially by the trade name POLY SWITCH®. These devices have unique advantages, and important differences when compared to fuses and circuit breakers. Like a fuse, the PTC device “blows” when too much current is drawn by an offending circuit, however, like a circuit breaker, the PTC can be reset, and does not need to be replaced after one use. Unlike a circuit breaker, there are no moving parts in the PTC, the device is totally solid state. (See Figure 1) Also unlike either a fuse or a circuit breaker, the PTC resets automatically when the load is COMPLETELY removed.



In the past, one could obtain “self resetting” thermal circuit breakers, however these were very undesirable for aircraft use. Old style self resetting breakers would reset themselves automatically after a short delay, even if the circuit were still overloaded. In the event of a serious electrical short, such as would be caused by a frayed or loose wire contacting chassis ground, this would likely cause a periodic arcing as the breaker reset

**Figure 1**

and tripped. PTC breakers trip once, AND STAY TRIPPED, until the load is completely removed. With a PTC breaker, a small, harmless amount of current “leaks” through when the devices are tripped. This current passing through the PTC device, keeps the breaker hot, thus keeping it tripped. The small current passed poses NO risk of fire or damage to the wiring or avionics, but only serves to keep the device from resetting. To reset the PTC, simply remove the entire load, by turning off the radio, light, or accessory being powered by the device. After about ten to fifteen seconds, the PTC will cool down, reset, and be ready for use again. The PTC can be tripped thousands of times without damaging the device. If a circuit were to trip, there is no positive indication, other than the failure of the circuit in question. Many wise people feel quite strongly that if any system fails in flight, the first action to be taken is to land, then investigate the problem once safely on the ground.



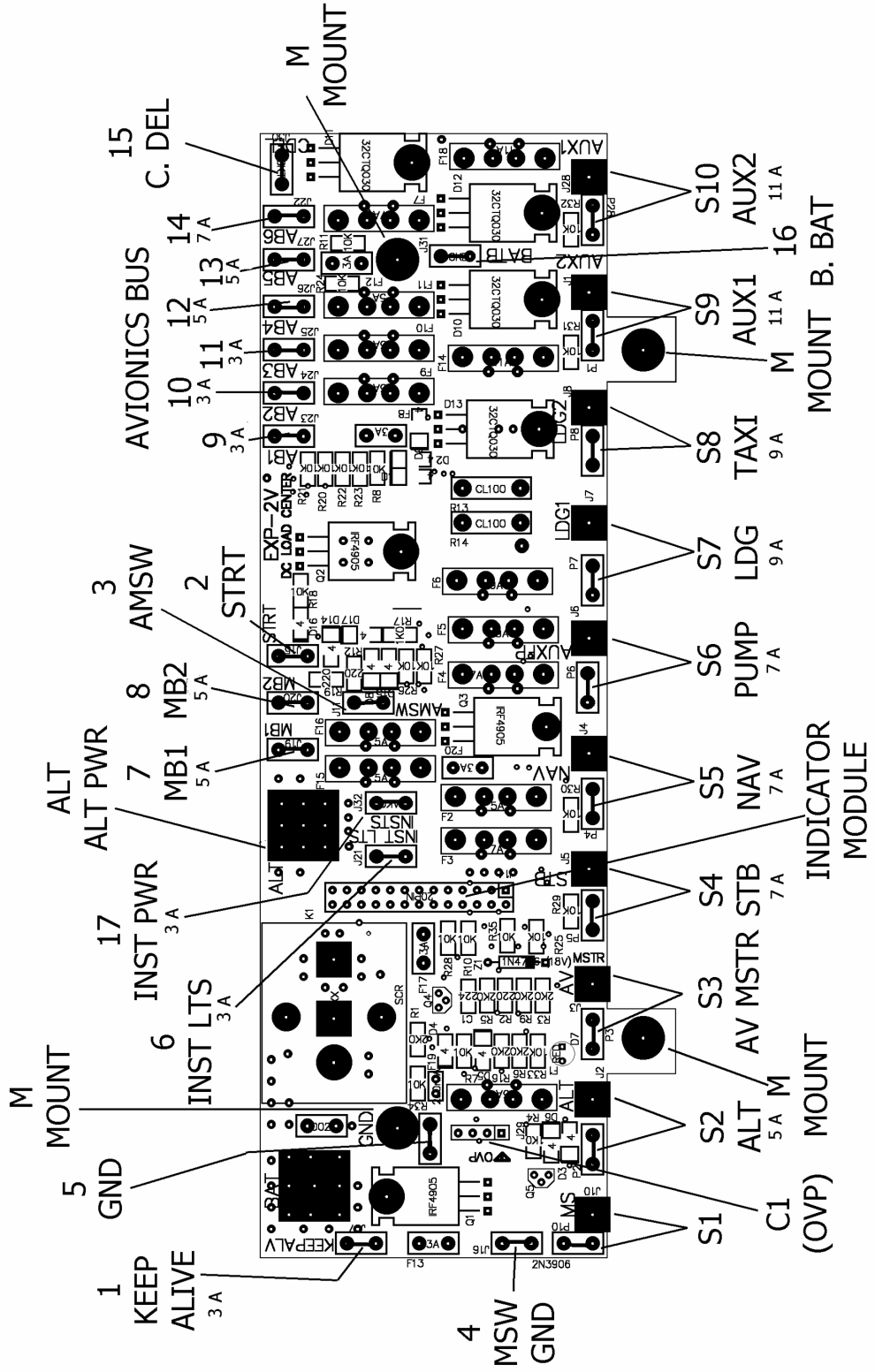
**Figure 2**

A companion piece of equipment to the EXP BUS Load Center is the INDICATOR module. This device is an annunciator panel that provides a warning light for each circuit in the system. When a circuit fails, the light illuminates. A dark panel indicates no problems. Call or write for more information on the indicator panel.

The PTC devices are an ideal fusing system for aviation, however the output is currently limited to 11 amps maximum. Some accessories, such as pilot heaters, hydraulic power units, and large landing lights may exceed this amperage. Such accessories must be connected to a traditional bus bar, using external circuit breakers. In the past, it has been traditional to use circuit breakers that are greatly oversized. For a radio that draws 4 amps, a 10 amp breaker is often used. This was generally done because we used just a few different sizes of breakers. One, three, five and ten amps were the common values used. Thus, anything that might draw just over 5 amps, would general be used with a 10 amp breaker. PTC's can be applied more precisely. 100W landing lights draw about 7.5 amps of current at 14Volts. These devices are generally fused with 20 amp breakers. On the EXP BUS, we use 9 amp PTC's for these lamps. When determining the requirements of your equipment, check the current draw. Connect the equipment to a PTC protected circuit that is rated for at least that much current drain.

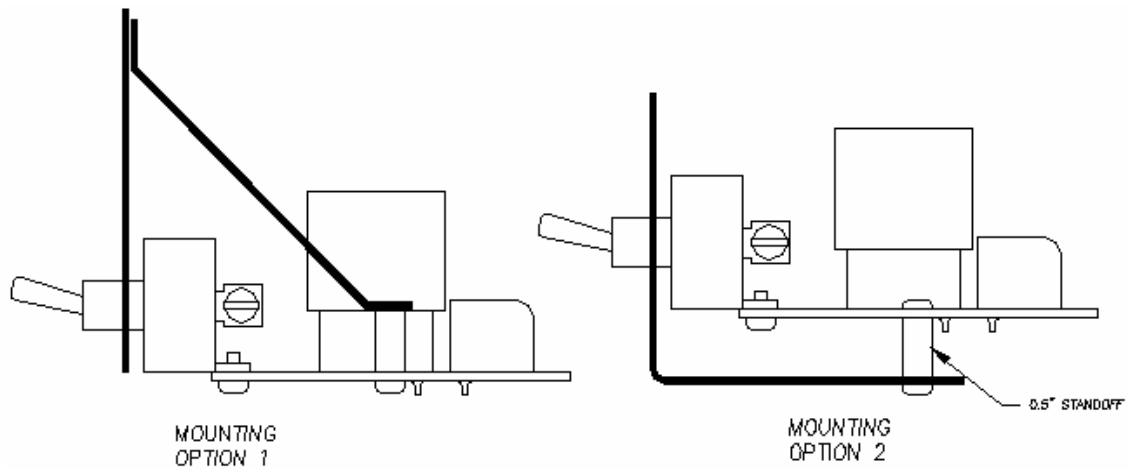
## **MOUNTING AND INSTALLATION**

Figure 3 shows a drawing of the EXP-BUS PC Board. The switches and terminals are numbered and described. The EXP PC board offers many flexible mounting and wiring options to the homebuilder. The switches provided are simply mounted to the PC board using screws. The unit may be installed with the supplied switches, optional rocker switches and plate (Figure 4), or with user supplied switches. The aircraft may either have a master solenoid, or use the onboard master relay. The board may even be mounted with the components facing down, and the switches on the top of the pcb. In an extremely crowded panel, or in an airframe with unusually high vibration levels, the switches may be panel mounted, and wired to the PC board which may be remotely mounted in any convenient location. There is a 26 pin connector on the board to connect to the optional panel mounted INDICATOR board, allowing over and under voltage annunciators, as well as a positive indication of each breaker on the PC board.



ELECTRICAL CONNECTIONS  
 EXP2V PC BOARD REVISION 1.1 AND 1.2

Figure 3 (Diagram for EXP2V Rev 1.3)



EXP BUS PC BOARD MUST BE MOUNTED AND SUPPORTED TO PROTECT THE ASSEMBLY AGAINST VIBRATION.  
 OPTION 1 ILLUSTRATES MOUNTING THE PC BOARD USING OVERHEAD SUPPORT  
 OPTION 2 ILLUSTRATES SUPPORT FROM THE INSTRUMENT PANEL SILL.  
 ANOTHER OPTION - REMOTE MOUNT THE PC BOARD IN A HANDY LOCATION,  
 THEN MOUNT THE SWITCHES IN ANY LOCATION DESIRED

**Figure 4**

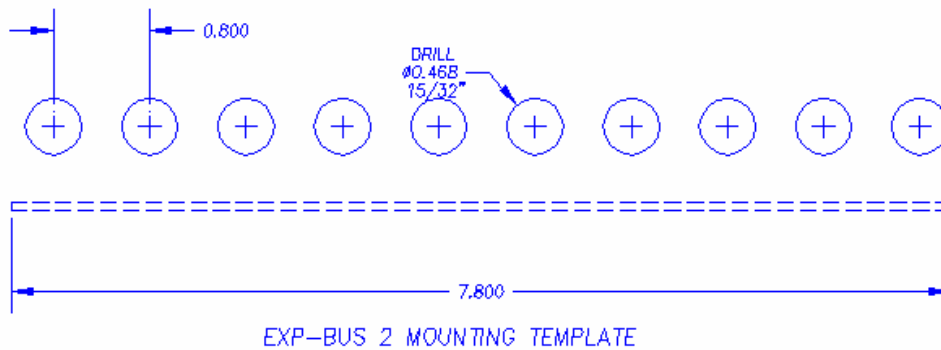


Figure 4 shows the mounting options for the PC board, should it be used with the switches attached. In this configuration, it is critical to support the PC board, to provide protection against vibration induces fatigue failures. An unsupported PC board will almost certainly result in rapid failure of the switches. Optional mounting brackets are also available from Control Vision. Shown in Figure 5. Call for pricing.

**Figure 5**

**BOARD CONNECTIONS**

Figure 6, shown below is a mounting template for drill locations of the EXP2V toggle switch option. This template is not to scale.



**Figure 6**

## SWITCH OUTPUTS:

See figure 3 for switch locations

<b>S1</b> MASTER	This serves as the master electrical switch for the entire system. When used with the onboard master relay, this switch removes power from all outputs except terminal #1, the keep alive output. When using an external solenoid, (grounding type) connect the terminal J10 to the solenoid input terminal.
<b>S2</b> ALT FIELD	Connect this output to the power wire for the voltage regulator. If using an alternator/regulator that has no field input, this may be used for any 5 amp accessory desired. This switch output will be disabled if the bus voltage exceeds 18V.
<b>S3</b> AVIONICS MASTER	This switch enables the avionics bus through the avionics relay. This switch should connect <b>ONLY</b> to the PC Board terminals provided.
<b>S4</b> STB	7 amp output for the rotating beacon or strobes.
<b>S5</b> NAV	7 amp output for the nav or position lights.
<b>S6</b> AUX FP	7 amp output for an AUX pump or other accessory.
<b>S7</b> LDG 1	9 amp landing light output with a soft start circuit. Use with 100Watt lamp maximum at 14Volts
<b>S8</b> LDG 2	9 amp landing light output with a soft start circuit. Use with 100Watt lamp maximum at 14Volts
<b>S9</b> AUX1	11 amp output circuit that may be used for any purpose. With the backup battery option installed, this switch output is dual sourced, and will draw power from either the backup battery, or the master battery automatically using the strongest power source. The AUX 1 and AUX 2 circuits are very good for powering automotive engine components that must be powered to insure engine operation.
<b>S10</b> AUX2	11 amp output circuit that may be used for any purpose. With the backup battery option installed, this switch output is dual sourced, and will draw power from either the backup battery, or the master battery automatically using the strongest power source.

## MAIN PC BOARD CONNECTIONS:

Note: These connections are made using AMP STA-CON press on terminals

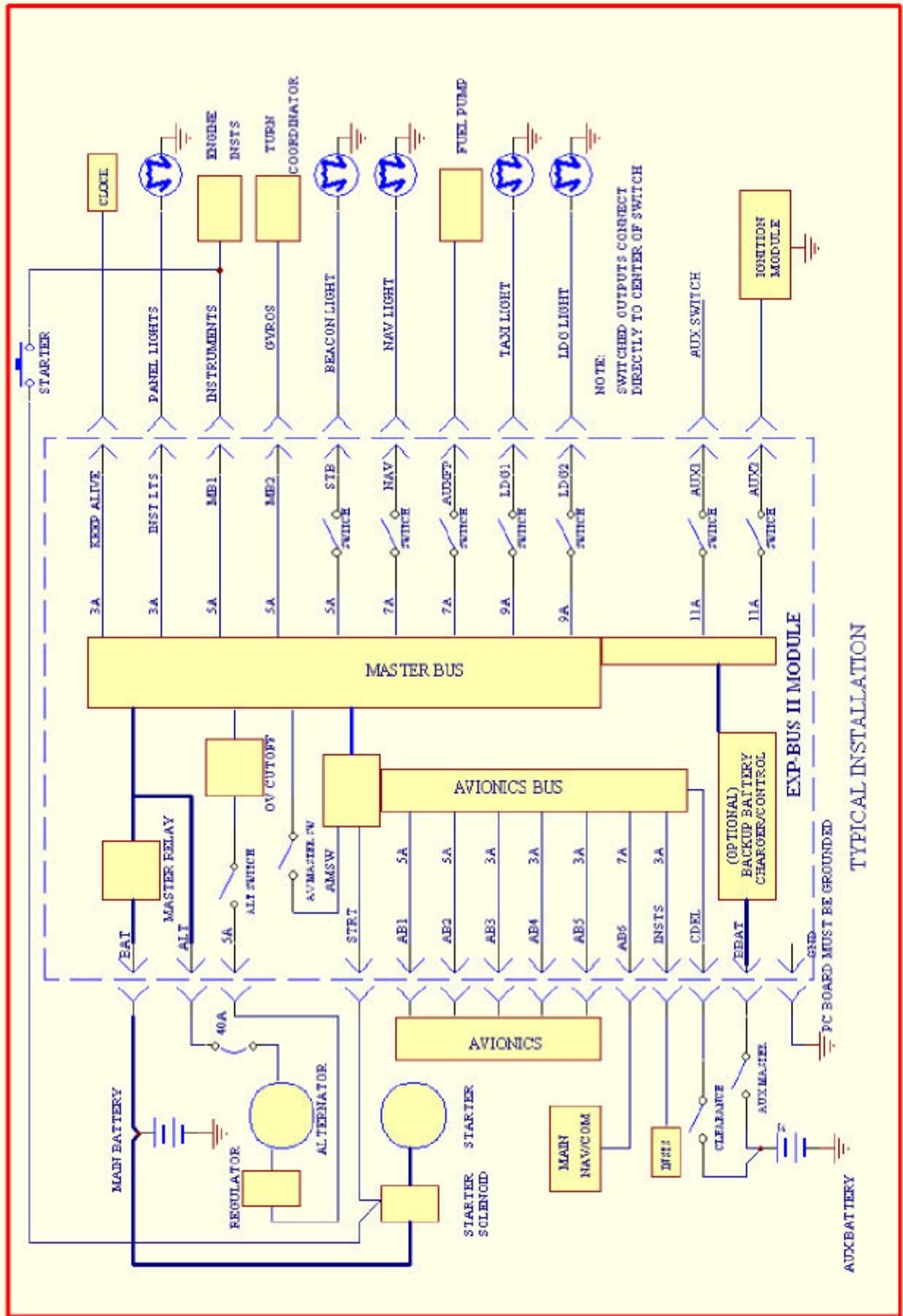
See figure 3 for terminal locations

<b>1</b> KEEP ALV output	Use to power accessories such as a clock that needs power even when the master switch is off. When the unit is installed with an external solenoid, this terminal is switched off when the master is off, but when using the onboard master relay, this terminal is always "ON". (Powered from Main Bat Terminal)
<b>2</b> STRT input	Connect to the starter switch. When power is applied to this terminal, the avionics bus is shut down, even if the avionics master switch on "ON". This can prevent damaging radios with power surges during engine start.
<b>3</b> AMSW Special use	This terminal should connect directly to the center terminal on the avionics master switch (S3). No other connection should be made to this terminal.
<b>4</b> GROUND Special use	This terminal should connect to the center terminal of the MASTER SWITCH, S1.

<b>5</b> GROUND Input	This terminal should be attached to the aircraft chassis, battery (-), or ground block in the aircraft. This terminal provides ground to the EXP PC board, and is not intended to be used as a grounding point for other accessories (lights, pumps, avionics, etc) in the aircraft.
<b>6</b> INST LTS Output	This terminal provides up to 3 amps of power output, always on when the MASTER SWITCH is on. The indicator module provides a variable voltage output to this terminal, adjustable with the lamp dimmer circuit. If not using the INDICATOR module. This terminal will then provide up to 3 amps at 14 volts, switched on with the master.
<b>7</b> MB1 output	5 amp output, on with the master, unswitched
<b>8</b> MB2 output	5 amp output, on with the master, unswitched
<b>9</b> AV Bus output	AB1 - 3 amp output, switched on when the avionics bus is on.
<b>10</b> AV Bus output	AB2 - 3 amp output, switched on when the avionics bus is on.
<b>11</b> AV Bus output	AB3 - 3 amp output, switched on when the avionics bus is on.
<b>12</b> AV Bus output	AB4 - 5 amp output, switch on when the avionics bus is on.
<b>13</b> AV Bus output	AB5 - 5 amp output, switched on when the avionics bus is on.
<b>14</b> AV Bus output	AB6 - 7 amp output, switched on when the avionics bus in on.
<b>15</b> CDEL Clearance delivery input	When 12Volts is applied to this terminal, the AV6 output terminal (intended for the main NAV/COM radio) is powered up, regardless of the state of the master switch. To provide a simple clearance delivery circuit, connect this terminal to the KEEP ALV terminal with a switch.
<b>16</b> BBAT Backup battery input	This terminal may be connected to a backup battery, such as a 3 or 6 amp hour GEL-CELL type battery. The battery should be connected to this terminal through a switch, as shown in figure 7. When the alternator is charging, this battery will be charged by the alternator, when the master bus is shut down for whatever reason, this battery will continue to provide power to S9 and S10. To power the NAV/COM off of the backup battery as well, connect this terminal to the CDEL terminal through a switch, instead of connecting CDEL to KEEP ALV.
<b>C1</b> alternator over voltage control	The over voltage recover switch is connected here. See Figure 3(C1).

### **BATTERY/ALTERNATOR TERMINALS:**

ALT ALTERNATOR Input	Large square terminal labeled ALT The alternator output cable should connect to this terminal. This cable provides all charging to the electrical system. One should always place a circuit breaker between this terminal and the alternator. For a 40 amp alternator, use a 40 amp breaker, and #8 or #6 wire. It is a good idea to use a pullable type circuit breaker, to allow one to isolate the EXP BUS from the alternator, if this should prove necessary.
BAT BATTERY Input	This pad is for connecting the battery to the system. Run at least a #8 wire from the battery to this terminal on the PC Board. If using an external solenoid, connect this terminal to the switched side of the master solenoid. If the battery is located more than 3 feet from the PC board, you may need to increase the wire size.



TYPICAL INSTALLATION



Figure 7

## ELECTRICAL CONFIGURATIONS

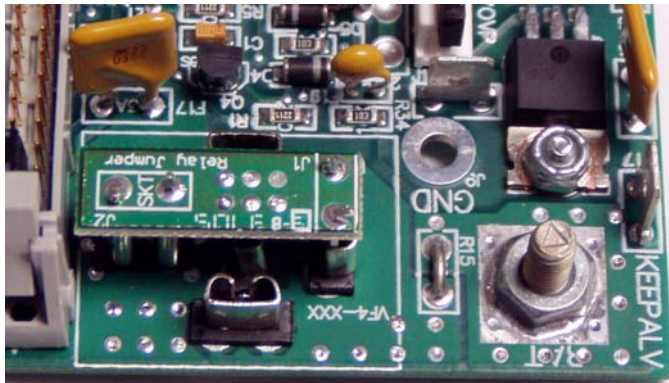
Figure 7 is a typical wiring diagram for a light sportplane.

### USE OF MASTER SOLENOID

In general, it is a good idea to use the master solenoid on larger, more complex aircraft, while on light VFR only aircraft, the onboard relay should be adequate.

### CONNECTION WITH MASTER SOLENOID

- You may wish to use a master solenoid in your project if:
- The battery is more than three feet from the EXP BUS board; or
- Heavy IFR use is anticipated or
- The aircraft will cruise at high speeds, and/or very high altitudes.



The chief advantage of a master solenoid is the fact that it is generally located very close to the battery. This minimizes the length of the unswitched lead. This is a valuable safety consideration. If the External master solenoid is to be used, the relay K1 should be unplugged and replaced with the relay jumper provided by the manufacturer. (See Figure 8)

Figure 8

When using a master solenoid, the coil terminal of the solenoid should be connected to terminal P10, on the EXP board. P10 is a STA-CON type spade located right next to the screw holding the master switch to the PC board. When the master switch is ON, this terminal is connected to GND. This will pull in a master solenoid. The switched power side of the solenoid, should be connected to BAT on the EXP bus. When connected in this configuration, the KEEP ALIVE output is switched on and off with the master switch.

### CONNECTION WITHOUT MASTER SOLENOID

You may not wish to use an external master if:

- Your alternator output is less than 40 amps; and
- Your project is intended primarily for VFR use; and
- Your battery is located within 3 feet of the PC board.

In simple VFR aircraft, with less than a 40 amp alternator, it is possible to wire the aircraft without using a master solenoid. The EXP 40 amp model has a master relay located onboard, good for switching up to 40 amps of load. In many applications, this is adequate for the electrical demands of the machine. The chief advantage of this configuration is ease of installation. The battery is connected directly to BATTERY, and the alternator is connected to ALT, through a suitably sized circuit breaker.

## **RECOMMENDED WIRING PROCEDURES**

### **• Starter Connections:**

The starter should be connected to an external starter solenoid, which is connected directly to either the battery, the master solenoid, or the battery terminal on the EXP-BUS circuit board. Starters typically draw more than 60 amps of current, and under no circumstance should the starter draw power from or through the PC board. The external starter solenoid can handle the current load of the starter. Most starter solenoids are switched on with a positive voltage, from either a mag switch or a starter pushbutton. In either case, if a wire is connected from the starter switch to the EXP terminal strip STRTR, the avionics bus will automatically shut down if the starter is engaged. If not using this feature, leave the terminal unconnected.

### **• Master bus connections:**

Connect all accessories that are to be on whenever the master switch is on to terminals MB1 and MB2 of the PC board. Generally, one would use one of these terminals to power a turn coordinator, and the other to run electronic instruments, and/or the starter solenoid.

### **• Avionics Bus Connections:**

Connect all avionics power leads to terminals AB1 through AB6 on the PC Board. All avionics grounds (returns) should be chassis grounded, or connected to a grounding block in non-conductive airframes.

### **• Instrument Lights**

The INST LTS terminal on the PC board provides a 3 amp protected output that stays on whenever the master switch is on. If an indicator board is installed, this terminal is connected to the light dimming controller that allows for light dimming. If not using an indicator module, an external rheostat could be connected to this terminal for light dimming purposes.

### **• High current Accessories**

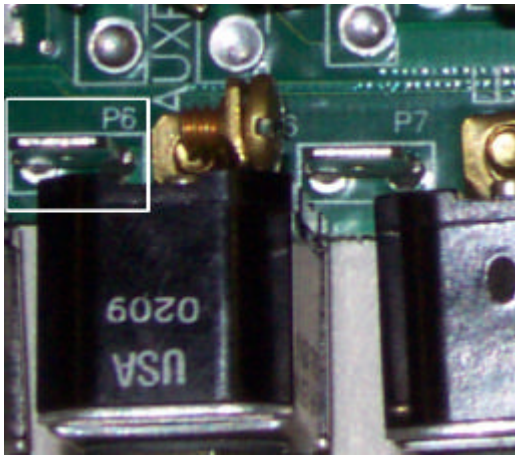
High current accessories should be connected to a separate bus, using conventional breakers. These may be bussed together with the alternator breaker, which is on the master bus.

### **• Alternator/Battery Wire Connections**

Install the main battery and alternator cables to the large square pads BAT and ALT using a 1/4" bolt and vibration resistant nut. You may wish to double nut the bolt, placing the ring terminal between the two nuts. Be sure to insulate the barrel of the ring terminal with heat shrink tubing, or a plastic sleeve. It is also a very good idea to secure these wires off the board so that they cannot loosen under vibration and come in contact.

## **REMOTE MOUNTING THE PC BOARD**

The PC board may be remote mounted in any convenient location by simply removing the switches from the PC board using the machine screws. In this configuration, any switch spacing or grouping can be used. Attach wires to



**Figure 9**

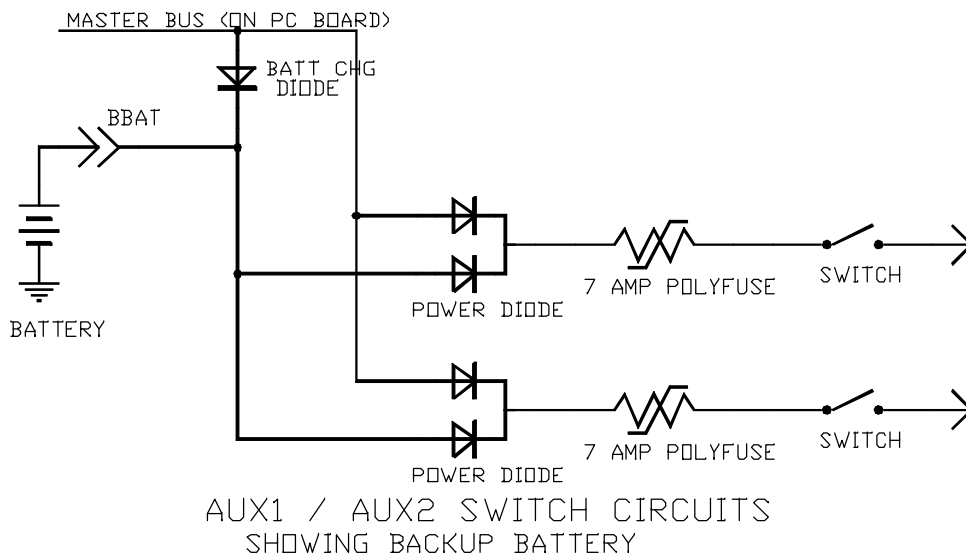
the STA-CON spades located immediately to the left of each switch mounting screw hole on the PC board, (see Figure 9) and run these wires to either terminal of the switches. Simply connect the loads to the unused switch terminal.

10  
The center terminal of both the master switch, and the avionics master switch are connected back to terminals on the PC board. On these switches it is important to run these extra wires back to the PC board as well.

### USE OF BACKUP BATTERY

The backup battery can be connected to the BBAT terminal on the PC board. The backup battery requires optional circuitry to be installed on the board – existing boards may be upgraded for a nominal fee. The backup battery allows switches AUX1 and AUX2 to have an independent power source for their operation. Diodes on the EXP board automatically charge the battery, and route power to the AUX switches individually from the “Hottest” battery. Figure 10 shows the electrical circuit involved.

If the backup battery is being used to power flight critical components such as ignition modules or fuel pumps, it is essential that this system be tested prior to each flight by briefly switching off the master switch at some time during preflight checks, to insure that the engine continues to run on the standby circuits. It is the builders and the pilots responsibility to include such a test in the preflight checklist for the finished aircraft. It would also be a good idea to incorporate a voltage meter or low voltage warning light to warn the pilot of a low backup battery voltage.



**Figure 10**

## IMPORTANT PRECAUTIONS

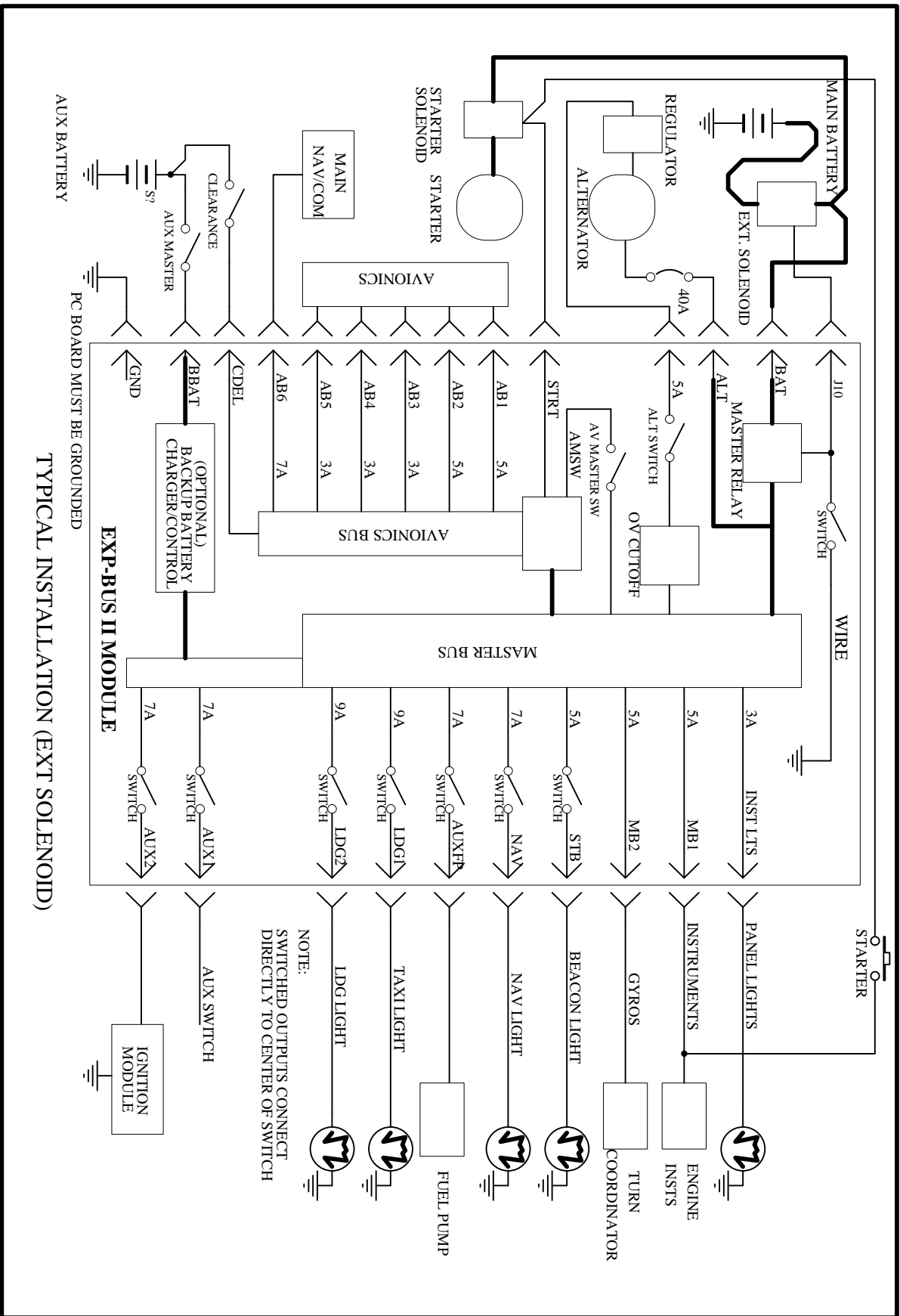
Important — read carefully and call our tech support line toll free if you have any questions at 800/292-1160 in the US, 001-316-231-6647 worldwide.

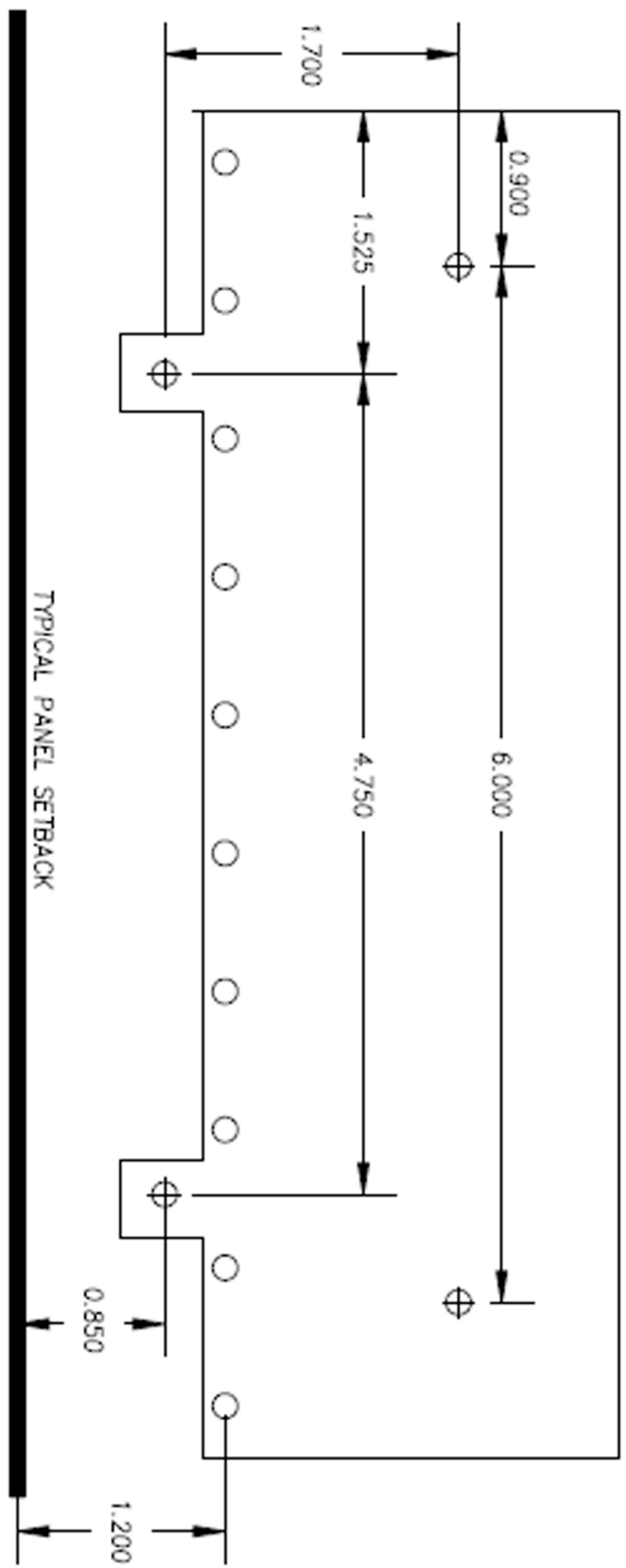
- ✍ Remember to only use vibration resistant hardware when mounting the wires to the pc board terminals.
- ✍ Secure all wires so that they cannot work against each other, even if the connections do loosen.
- ✍ Insulate all crimp on terminals to insure that a loose terminal cannot short to a nearby terminal. These two precautions are a very important matter on the heavy alternator and battery cables.
- ✍ Be sure to use a circuit breaker in series with the alternator. Do not connect the alternator directly to terminal ALT.
- ✍ Be sure to support the pc board properly. See Figure 3 for recommended mounting practices. If your aircraft vibrates severely, it is a good practice to support the front of the PC board with additional standoffs. There are two additional mounting holes, one in the center of the board, and one located between the battery and alternator holes.
- ✍ If you are planning to use electronic ignition modules requiring battery power, or if you are using an automotive engine requiring battery power, remember **that it is essential to connect these devices directly to the battery**, and to provide a back up power source in the form of a second battery. **Be sure to wire your aircraft so that the engine will continue to run even with the master switch OFF**
- ✍ **DO NOT MOUNT THE PC board** directly to any fuel tank, or within 12 inches of any fuel tank. The possibility of an electrical malfunction causing a spark always exists in any electrical product. Obviously, fuel and sparks do not belong in the same cockpit together.
- ✍ **NEVER** bundle electrical wiring and fuel, oil or brake fluid lines together. Vibration can (and has!) caused the wiring insulation to abrade, eventually striking an arc on the metallic fuel line with spectacular results. Always keep the fuel and the electrical system components completely isolated when wiring and plumbing up the aircraft.
- ✍ **If you have any questions concerning the use of this product, call toll free 1-800-292-1160, between 8 am and 5 pm, central time zone and ask for technical assistance. ,The international number is 001-316-231-6647. Our fax is 316-2311-5816.**

### ✍ Important Notice

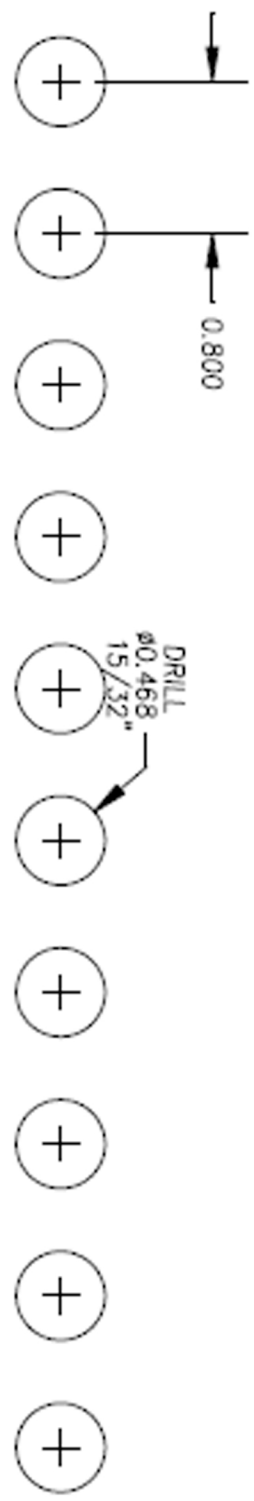
Control Vision Corporation (seller) warrants this product to be free from defects in materials and workmanship for one year from the date of purchase, or one year from the date of issuance of the airworthiness certificate in the experimental aircraft in which this product is originally installed, whichever is longer. This warranty is limited to replacement of the product or refund of the purchase price of this product only, and under no circumstance shall seller be liable for any incidental or collateral damages caused by the use of this product.

Each experimental aircraft is unique, and the builder assumes full responsibility for the safety and reliability of their aircraft. Control Vision Corporation cannot assure the suitability of this product for every installation, nor can we evaluate each individual application of this product for safety and reliability. The buyer's installation and use of this product in their experimental aircraft constitutes acceptance of the terms and conditions of this warranty agreement.. The builder may return the product for a full refund if the terms of this warranty are not acceptable.

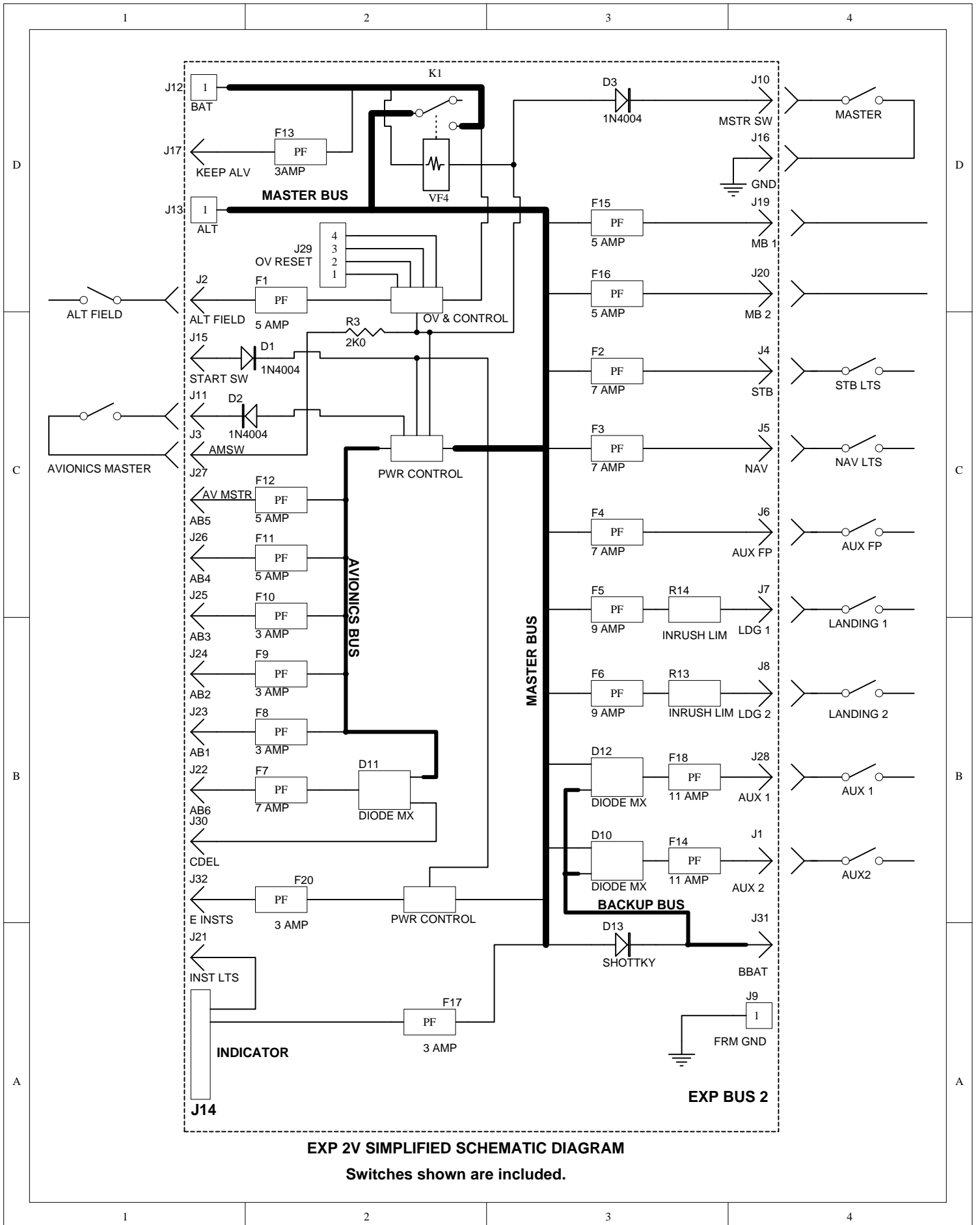




TYPICAL PANEL SETBACK

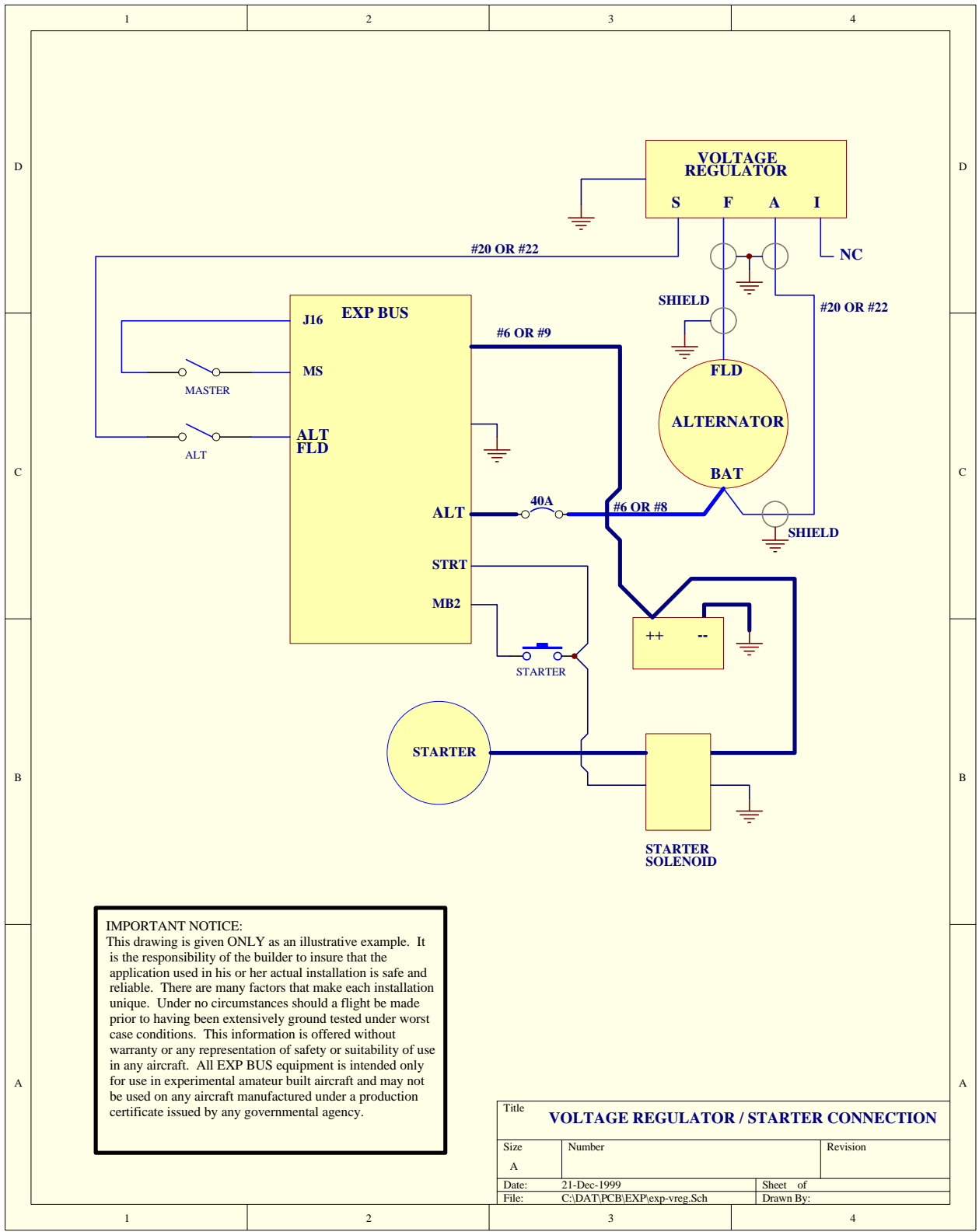


EXP-BUS 2 MOUNTING TEMPLATE



**EXP 2V SIMPLIFIED SCHEMATIC DIAGRAM**

Switches shown are included.



**IMPORTANT NOTICE:**  
 This drawing is given ONLY as an illustrative example. It is the responsibility of the builder to insure that the application used in his or her actual installation is safe and reliable. There are many factors that make each installation unique. Under no circumstances should a flight be made prior to having been extensively ground tested under worst case conditions. This information is offered without warranty or any representation of safety or suitability of use in any aircraft. All EXP BUS equipment is intended only for use in experimental amateur built aircraft and may not be used on any aircraft manufactured under a production certificate issued by any governmental agency.

Title		
<b>VOLTAGE REGULATOR / STARTER CONNECTION</b>		
Size	Number	Revision
A		
Date:	21-Dec-1999	Sheet of
File:	C:\DAT\PCB\EXP\exp-vreg.Sch	Drawn By:



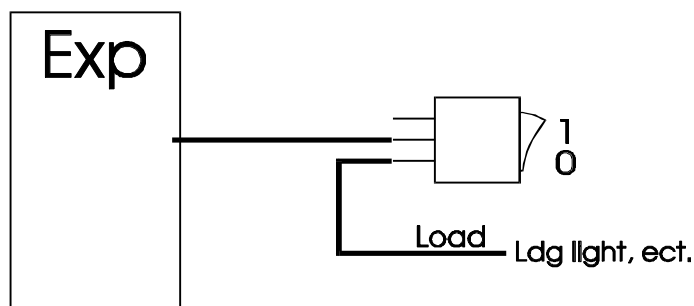


## Rocker switch installation instructions

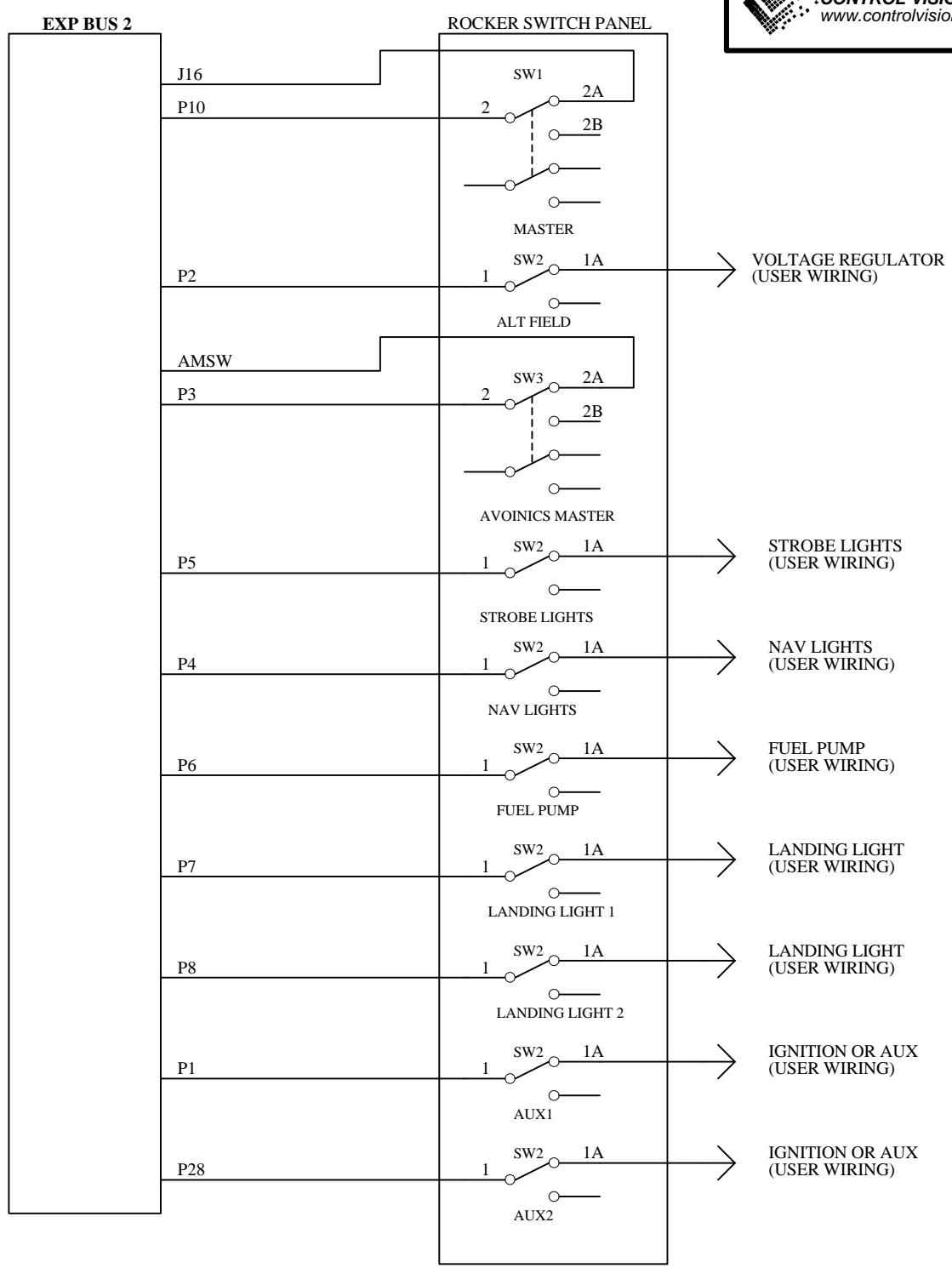
Installation of the rocker switch accessory requires removing the toggle switches (if applicable), then fabricating 12 wires to connect the switches to the respective terminals on the EXP BUS PC board. One wire will run from the pc board to each switch. The master switch, and the avionics master switch will have two wires connected to them.

The master switch connects to the terminals P1 and J16 on the EXP PC Board. These terminals are located near the KEEPALV terminal on the PC board. Use a standard STA-CON type spade connector for the connection. Connect P1 to the center pin of the master switch, and J16, which is a ground connection to the bottom terminal of the master switch. The red master switch supplied has six terminals on it, but only two are used. Use terminals on either the right or left side of the switch only.

The avionics switch connects to terminals P3 and AMSW on the EXP PC board. The terminal P3 is near the label AV on the PC board, and AMSW is located near MB2 on the PC board. Connect P3 to the center pin of the avionics master switch, and AMSW to the bottom pin of the avionics master.

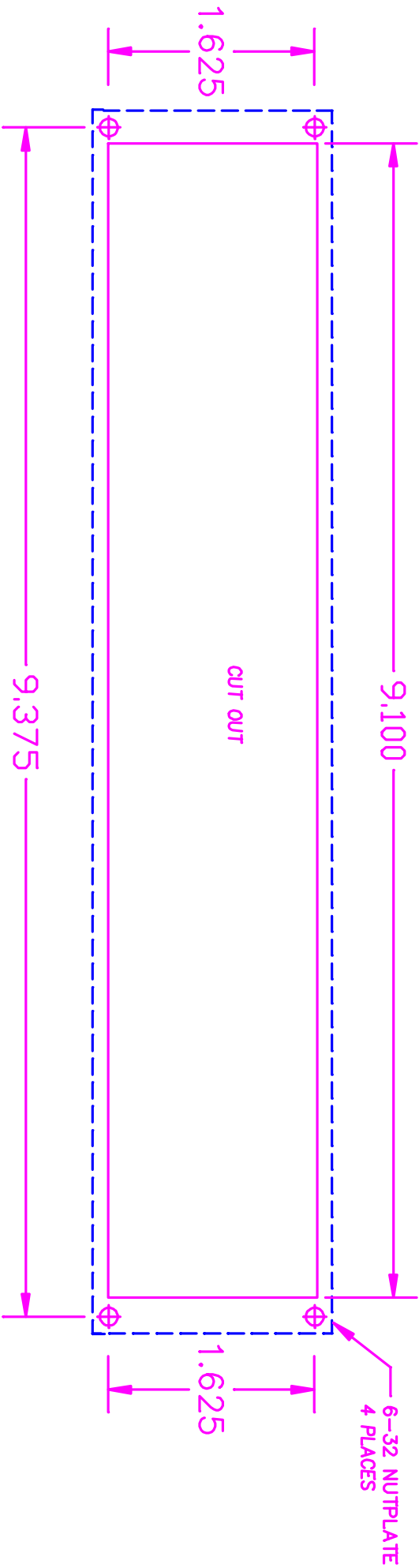


The center terminal of all of the remaining switches connect directly to the switch terminals on the EXP PC Board, (ALT, NAV, STB, AUXFP, LDG1, LDG2, AUX1 and AUX2). The load then connects to the bottom terminal of each switch, as shown above.



**NOTE: ALL CONNECTIONS MAY BE MADE WITH STA-CON TERMINALS**

**EXP BUS 2 - ROCKER SWITCH CONNECTIONS**



EXP MOUNTING TRAY  
PANEL CUTOUT DIAGRAM