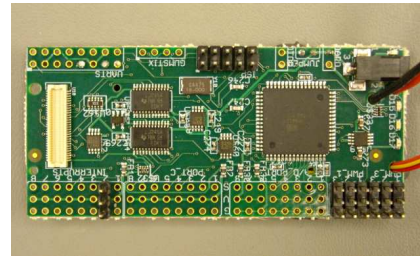


**External I/O Board**



**FEATURES**

- **4 Servo Ports (Kestrel Servo Expansion)**
  - Resolution: 0.5  $\mu$ s (about 0.05°)
  - Range: 900-2100  $\mu$ s
  - Pulse Rate: 50 Hz
- **RPM Sensor Port**
- **PCB Size: 3.2" x 1.45" x 0.06"**
- **Low Current Draw: 5 mA (Average)**

**APPLICATION**

- **Gimbal Azimuth, Gimbal Elevation, Gimbal Retract**
- **Parachute, Waypoint Servo, Flaps, Flaperons, RPM Sensor**
- **Auxiliary channels for payload deployment and landing gear.**

**DESCRIPTION**

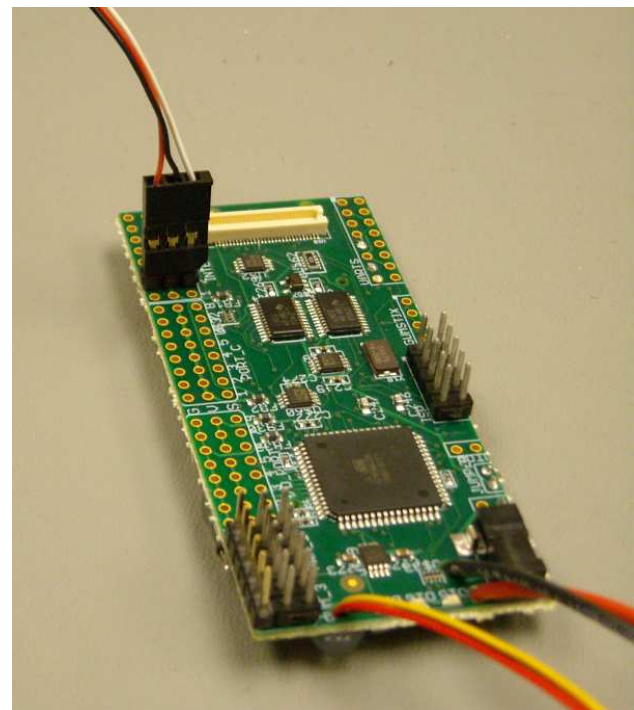
The External I/O Board supports up to 4 servo channels (servo expansion for Kestrel autopilot) and an RPM sensor. The device is controlled and powered through a Kestrel serial port and can easily be enabled through the Virtual Cockpit. The servo power is separate from the device power allowing high current servos to be powered through a separate power regulator.

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**PORT DESCRIPTIONS**

This section describes the pin out on the External I/O Board, including servo mapping between I/O ports and Kestrel autopilot channels. As shown in Figure 2, the Kestrel autopilot connects to the External I/O Board through a simple serial connection. The External I/O Board also requires separate servo power (4.8-6 V) which is connected via the two-wire connection shown in the upper left.

**Servo Ports:** Three pin servo ports. Each port contains a ground (black), power (red), and signal (yellow) pin. All ground pins are tied together and to the PCB common ground. All power pins are connected together through the PCB. Ground pins lie near the PCB edge. Signal pins lie on the inside of the board. These ports, shown in Figure 2, are labeled according to their channel assignment. The External I/O Board currently supports a parachute servo (on Ch 9) and three additional servos to drive a gimballed camera (with retract configurable on Ch 6). These servo ports can be configured for other options using the Procerus Virtual Cockpit. Users should consult the Installation and Configuration Guide for details regarding how to properly configure the External I/O Board for use with the Kestrel autopilot. Currently, channels 7 and 8 are not supported, but plans are to provide those in the future for additional functionality.



**Figure 1 Correct Placement of the RPM Connector**

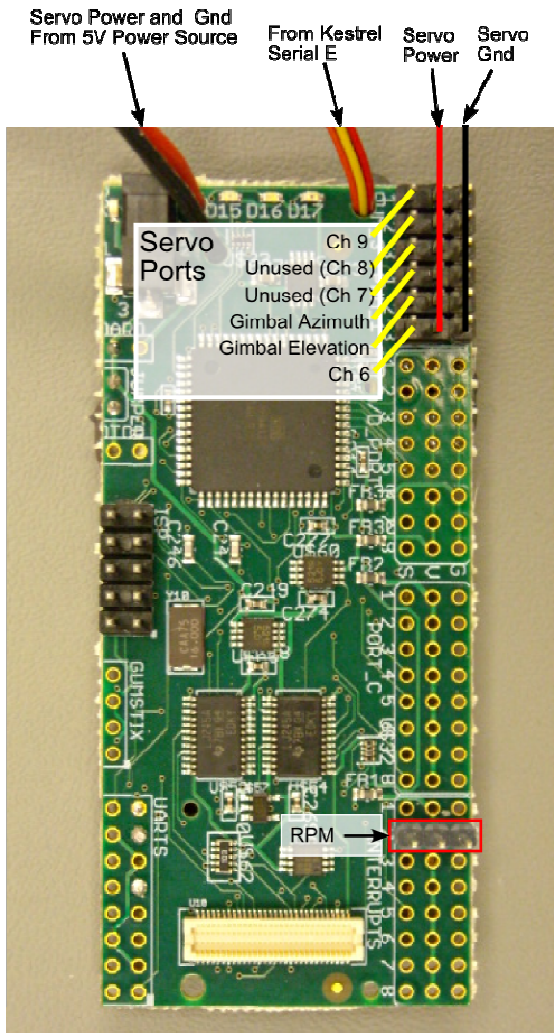


Figure 2 External I/O Board Pinout

**Servo Power and Ground:** Power for the servos must be provided separately from the serial power. Procerus provides a pigtail cable to connect the servo power and ground lines from the autopilot to the servos on the External I/O Board. Servo Power and Ground can be connected to the rudder port on the autopilot using a “Y” harness. This allows the I/O servo power and Kestrel servo power to draw from the same supply. The voltage supply for the servos must be capable of sustaining the current draw for all attached servos. Not more than 1A of current should be pulled through the autopilot rudder channel port.

**Serial Connection:** The External I/O Board receives commands from the Kestrel autopilot through a serial connection to the Kestrel’s Port E. The Kestrel should have its serial E jumper set to 5.0 volts (see the Installation and Configuration Guide for further details).

**RPM Port:** The RPM sensor is connected using a 3-pin connector to the port towards the bottom of Figure 2. This figure shows the correct placement of the connector (note that the red wire is towards the outside of the board). Currently, the External I/O Board can read RPM sensors based on the Hall Effect. This effect provides a high-to-low output during exposure to a high magnetic field. Soon, a non-hall-effect sensor will also be incorporated for use with brushless motors. Mounting instructions for the RPM sensor are included in the Installation and Configuration Guide.

## ABSOLUTE MAXIMUM RATINGS

Input Supply Voltage..... 6V  
 DC Current per I/O Pin ..... 40mA  
 Operating Temperature Range..... -55°C to 125°C  
 Storage Temperature Range ..... -65°C to 150°C

Stresses above those listed under the Absolute Maximum Ratings may cause permanent damage to this device. This is a stress rating only; functional operation of this device at these or any other conditions above those indicated in the operational section of this specification are not implied and may cause permanent damage.

## ELECTRICAL CHARACTERISTICS

Parameter	Conditions	Min	Typ	Max	Units
<b>Power</b>					
Input Voltage	No loading on I/O	4.5	5.0	6.0	V
Current Draw			5.5		mA
<b>Servo Signal Output</b>					
V <sub>HO</sub> (High Voltage)		4.2		0.7	V
V <sub>LO</sub> (Low Voltage)					V
I (Sink/Source Current)			40		mA
<b>RPM Sensor Input</b>					
V <sub>HI</sub> (High Voltage)		3.0		5.5	V
V <sub>LI</sub> (Low Voltage)		-0.5		1.0	V

## LED BEHAVIOR

**Yellow LED:** When the autopilot is on and the serial connection is properly connected, the yellow LED will hold solid, indicating that Kestrel Communications have been received in the recent past. If communications are lost for the dead-man timeout period (currently about 1.5 seconds), the light will turn off. If the External I/O Board has been configured for dead-man parachute, the parachute will be deployed at this point.

**Blue LED:** This LED indicates that the board is sampling the RPM sensor. It may flash even if the sensor is not connected.

**Red LED:** This LED indicates that servo commands are being received from the Kestrel autopilot.

## TYPICAL APPLICATION

The power diagram for a typical application using the External I/O Board is shown in Figure 3. The BEC is often included in the speed controller of electric motors. Power for the External I/O Board can come from the Y-Pigtail connected to the rudder port (as pictured) or directly from a 5-volt regulator such as the Sport BEC. Attention should be paid to current limitations imposed by the regulator.

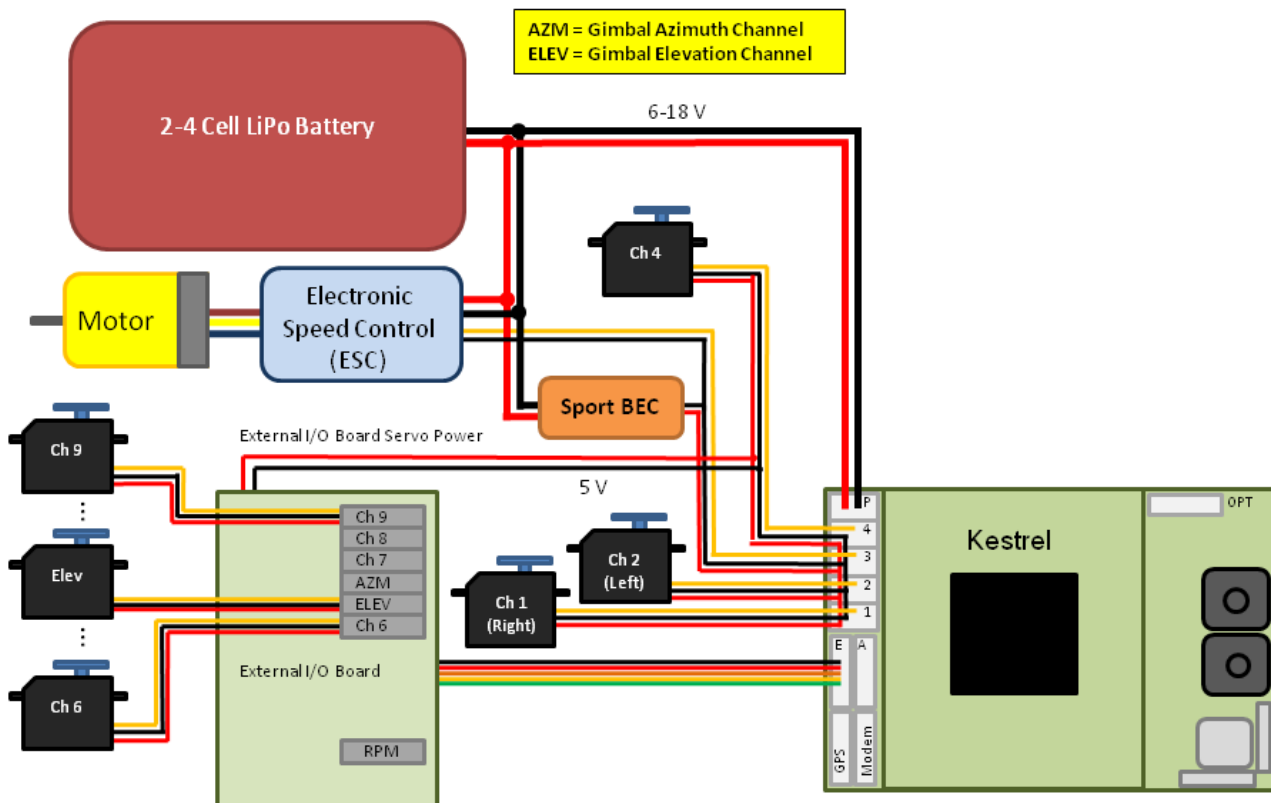


Figure 3 External I/O Board Power Diagram

The External I/O Board plugs into serial port E of the Kestrel Autopilot and can easily be enabled using the Virtual Cockpit. See the [Installation and Configuration User Guide](#) for details. Figure 3 shows the pin out the External I/O Board for all eight channels with the optional servo headers soldered on.