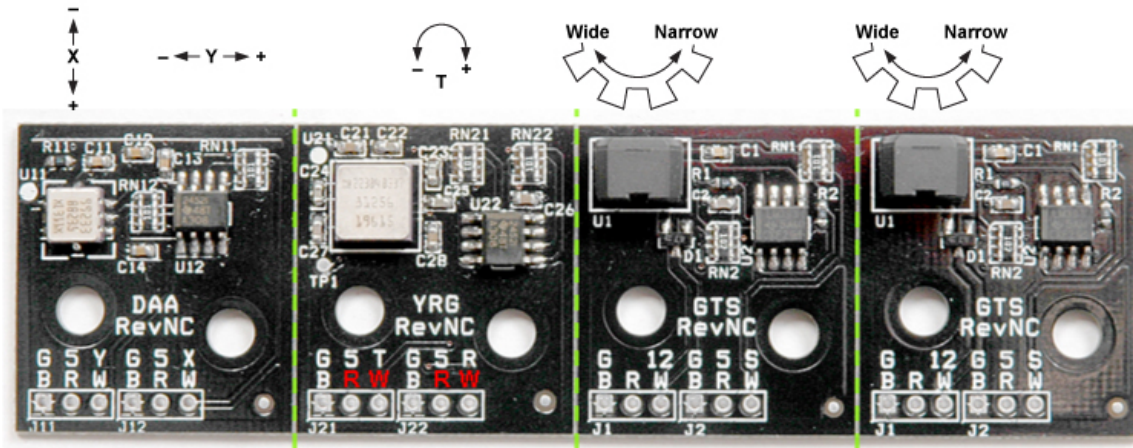


The 2006 FIRST Season sensors from Innovation First, Inc operate per the following information. This document is being provided as a courtesy, and is therefore not guaranteed to be supported by Innovation First, Inc.

1. General:

- a. All voltages and pulse widths are nominal. Refer to the component data sheets for exact part details.
- b. PC Board markings of "G" are ground connections, "5" are +5V connections and "12" is +12v or main battery connections. The row underneath the "G", "5",... is the wire color of our PWM cable that may be used to connect the sensors to the FRC. "B" is for the black wire, "R" is for the red wire and "W" is for the white wire.
- c. Generally, the "B", "R", and "W" connections connect to the black wire (ground), red wire (+5V) and white wire (signal) respectively of PWM cables.
  - i. **EXCEPTION:** The YRG (RevNC) sensor's "W" and "R" silkscreen has been marked incorrectly. The attached picture shows the CORRECT "R" and "W" in red. Connect +5V to the "R" and signal to the "W" per the picture.



- d. Analog values can be measured with the User Processor's A/D inputs. Use the Get\_Analog\_Value routine found in ifi\_utilities.c. The result will range from 0 (0.0 volts) to 1023 (5.0 volts).
- e. To break apart the four sensors of the sensor strip, gently grasp one sensor with one hand and the other sensor with the other hand. Gently flex the boards along the score line (green dashed line in above picture) until the two sensors separate.
- f. The two mounting holes for each sensor are 0.165" in diameter. The first hole is centered at 0.230" to the right and 0.440" up from the lower left hand corner. The second hole is centered at 0.770" to the right and 0.360" up from the lower left hand corner. It is recommended to use insulating washers on each side of the mounting holes.

2. Dual-Axis Accelerometer

- a. The Dual Axis Accelerometer (DAA) is intended to connect to two of the FRC Analog inputs to measure X axis (J12) and Y axis (J11) acceleration. They also detect the acceleration due to gravity, and can therefore be used as static orientation sensors.
- b. Connect J11-B to the an FRC analog input B pin with the black PWM cable wire, J11-R to an FRC analog input +5V pin with the red wire, and J11-W to an FRC

- analog input SIG pin with the white wire to monitor Y axis acceleration. Similarly connect J12 to a different analog port for monitoring X axis acceleration.
- c. For detailed operation of the Analog Devices ADXL311 DAA, refer to the [www.analog.com](http://www.analog.com) website. The output varies by 290 millivolts per g when given a voltage of 5.0 volts.
  - d. All of the voltages described below assume the board is stationary.

Board orientation	White dot by U11	X output (volts)	Y output (volts)
Horizontal	Don't care	2.5	2.5
Vertical	Upper Left	2.2	2.5
Vertical	Lower Left	2.5	2.8
Vertical	Lower Right	2.8	2.5
Vertical	Upper Right	2.5	2.2

### 3. Yaw Rate Gyro

- a. The Yaw Rate Gyro (YRG) is intended to connect to two of the FRC Analog inputs. The "T" output (J21) is "Twist" or rotational velocity. The "R" output (J22) is "Relative temperature". For detailed operation of the Analog Devices AD22304 YRG, refer to the [www.ifirobotics.com](http://www.ifirobotics.com) website.
  - i. A similar chip, the ADXRS150 is published on the [www.analog.com](http://www.analog.com) website. The actual Yaw Rate Gyro chip used on the 2006 YRG is the AD22304. It has a guaranteed dynamic range of +/- 80 degrees per second vs. +/- 150 degrees per second for the ADXRS150. Most other specifications are identical.
- b. The "T" output varies by 12.5 millivolts per degrees per second of rotation. No rotation will give a 2.5 volt output. Accelerating clockwise will provide a voltage above 2.5 volts. The 3 dB bandwidth of the Yaw Rate Gyro is set at 40 Hz.
- c. The "R" output varies by 8.4 millivolts per degree Kelvin. A temperature of 298 K (about 25 Celsius) will give an analog output of 2.5 volts. Higher temperatures will provide higher voltages. Cooler temperatures will provide lower voltages.
- d. Connect J21-B to the an FRC analog input B pin with the black PWM wire, the miss-marked J21-W to an FRC analog input +5V pin with a red wire, and the miss-marked J21-R to an FRC analog input SIG pin with a white wire for monitoring yaw. Similarly connect J22 to a different analog port for monitoring temperature if desired.

### 4. Speed and Direction Gear Tooth Sensor

- a. The Gear Tooth Sensors (GTS) are intended to connect to FRC digital interrupt inputs. Connect J1-B to ground with a black PWM wire and J1-W to +12vdc with a white PWM wire. Contact J1-R (red wire) is not connected internally on the sensor card. It may be left disconnected if desired. Connect J2-B to an FRC digital input B pin with a black PWM wire, J2-R to an FRC digital input +5V pin with a red wire, and J2-W to an FRC digital input SIG pin with a white wire.
- b. For detailed operation of the Allegro MicroSystems ATS651 Speed and Direction Sensor, refer to the [www.allegromicro.com](http://www.allegromicro.com) website.
- c. A ferrous metal clockwise rotating gear (when looking up from the bottom of the card) will provide a 39 microsecond wide rising pulse out of the "S" output when oriented per page 5 of the ATS651 datasheet. The circuit times are shorter than the data sheet due to the buffering circuitry.
- d. A counter-clockwise rotating gear will provide an 83 microsecond wide pulse to the FRC.
- e. If direction sensing is required, you will need to time events between rising and falling edges. The short pulses indicate clockwise rotation, the longer pulses indicate counter-clockwise rotation.
- f. To determine speed, measure the time between rising edges. Factor in your robot's gearing and wheel size to get speed.