The BalloonSat Extreme is one of the largest BalloonSat flight computers. When assembled, students have a programmable flight computer for BalloonSats that’s capable of collecting data from up to eight analog sensors, operating five digital sensors, controlling three servos, operating three cameras, and reading GPS data. Data is stored onboard the BalloonSat Extreme’s BASIC Stamp 2pe (this must be purchased separately from Parallax Inc) and downloaded after recovery.

**Overview of the BalloonSat Extreme Project**

There are 47 parts in this kit that when soldered together, create a programmable BalloonSat flight computer. The heart of the BalloonSat Extreme is a BASIC Stamp 2pe - an easy to program microcontroller. The BS-2pe’s internal memory consists of 16 banks of 2k byte each. At least one bank is required for the mission program, leaving up to 30 k bytes of data storage per mission. After recovery of the BalloonSat, its data is downloaded to a laptop or PC for processing in a spreadsheet.

A four cell “AAA” battery pack provides power for the flight computer and attached experiments. Up to three attached servos get power through a separate three cell “AAA” battery pack. There are three pairs of camera ports on the BalloonSat Extreme that can support both modified camera shutters (that shorts out the shutter button) and Canon cameras with CHDK installed and running the USB remote. The BalloonSat Extreme’s I/O port provides power to any attached experiment. Two ports are included. The first is eight channels for analog sensor voltages and digitized to 12-bit of resolution with a MAX186 ADC. The second port has five channels that connect directly to the BASIC Stamp. This port is ideal for digital devices like Geiger counters. The BalloonSat Extreme is wired to a control panel measuring 2.5 by 2.5 inches. The panel mounts to the wall of the BalloonSat airframe and contains the switches, indicators, and commit pin to
control the operation of the flight computer without having to open up the BalloonSat. The weight of the BalloonSat Extreme and its alkaline batteries is only 177 grams and leaves plenty of weight free for the BalloonSat airframe and sensors (lithium batteries are a better choice in most cases and lighter). Because of its large amount of I/O, the BalloonSat Extreme is ideal for larger BalloonSats and groups projects.

To program the BalloonSat Extreme, students will need access to a PC with the BASIC Stamp program editor installed. The kit does not come with camera cables since there are too many choices available. The kit builder must provide the proper camera cable. Suggestions are located at the end of these directions.

**Parts List**

Look at the top of the printed circuit board (PCB) and you’ll see white lettering indicating the placement and orientation of individual electronic components. Below is a list of the components in the BalloonSat Extreme kit and their references you’ll find on the BalloonSat Extreme PCB.

<table>
<thead>
<tr>
<th>Component</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>47uF tantalum capacitor</td>
</tr>
<tr>
<td>C2</td>
<td>4.7uF tantalum capacitor</td>
</tr>
<tr>
<td>C3</td>
<td>0.1 uF capacitor</td>
</tr>
<tr>
<td>C4</td>
<td>0.1uF capacitor</td>
</tr>
<tr>
<td>C5</td>
<td>4.7uF tantalum capacitor</td>
</tr>
<tr>
<td>C6</td>
<td>0.01 uF capacitor</td>
</tr>
<tr>
<td>D1</td>
<td>1N4001 diode</td>
</tr>
<tr>
<td>D2</td>
<td>1N4001 diode</td>
</tr>
<tr>
<td>D3</td>
<td>1N4001 diode</td>
</tr>
<tr>
<td>DB-9 Female</td>
<td></td>
</tr>
<tr>
<td>RL1</td>
<td>5V reed relay</td>
</tr>
<tr>
<td>RL2</td>
<td>5V reed relay</td>
</tr>
<tr>
<td>RL3</td>
<td>5V reed relay</td>
</tr>
<tr>
<td>R1</td>
<td>(R5 in some older kits) 680 ohm resistor (blue, gray, red, gold)</td>
</tr>
<tr>
<td>R2</td>
<td>4.7k ohm resistor (yellow, violet, red, gold)</td>
</tr>
<tr>
<td>R3</td>
<td>680 ohm resistor (blue, gray, red, gold)</td>
</tr>
<tr>
<td>R4</td>
<td>1k ohm resistor (brown, black, orange, gold)</td>
</tr>
<tr>
<td>U1</td>
<td>24-pin socket, 600 mils wide</td>
</tr>
<tr>
<td>U2</td>
<td>20-pin socket</td>
</tr>
<tr>
<td>U3</td>
<td>LM2950 +5 volt regulator (TO-92)</td>
</tr>
</tbody>
</table>

The remaining items are required to complete the BalloonSat Extreme, but they do not have a reference on the PCB.

<table>
<thead>
<tr>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 by 3 pin straight header</td>
</tr>
<tr>
<td>3 by 5 female receptacle</td>
</tr>
<tr>
<td>3 by 8 female receptacle</td>
</tr>
<tr>
<td>Wire (#24 AWG)</td>
</tr>
</tbody>
</table>
4 “AAA” cell holder
3 “AAA” cell holder
Four 4-40 ¾ inch bolts
Four 4-40 nylocks
Plastic tube ¼ inch diameter

The Control Panel is the second PCB and has markings (but not designation) for the following components
Two toggle switches
Two LEDs
2-pin right angle header
2-pin shorting block

**Theory of Operation**

![Figure 2. BalloonSat Extreme Schematic](image)

The arrangement of components in the BalloonSat Extreme are designed to support the BASIC Stamp (BS2pe recommended) in the process of collecting and storing data.
Below is a brief description of each component and how it supports the mission of the BalloonSat Extreme.
The voltage regulator (LM2950) converts the slowly declining voltage of the four “AAA” battery pack into a constant five volts that the BASIC Stamp prefers. The 47 uF capacitor next to the voltage regulator acts as a temporary battery to maintain a more constant five volt output. If the voltage surges slightly higher, the capacitor absorbs the excess current; changing it into charge stored on its plates and bringing the voltage back down. If the voltage drops slightly lower, the capacitor dumps its stored charge; changing it into needed current and pushing the voltage higher. There are three pads for the capacitor, just in case a larger capacitor is included in the kit.

The Main Power and Servo Power toggle switches are soldered to the Control Panel and connect the two battery packs to the BalloonSat Extreme PCB. Also attached to the Control Panel are two LEDs that light up when main power or servo power switches on. Therefore the LEDs are solely power indicators (without them, there is no other way to see that the BalloonSat Extreme is operating). The 680 ohm resistors connected to the LEDs limit current flowing through them so they and the voltage regulator are protected from excessive current.

The program header is a female DB-9. Since it is soldered to the BalloonSat Extreme PCB, the flight computer can only be programmed while the BalloonSat is opened. A GPS can be a part of the BalloonSat payload and it attaches to the GPS port, a male DB-9. The fourth pin of the port provides +5 volts to power the GPS in flight. If the GPS will fly on its own batteries, then verify its fourth pin is not being used (in many commercial GPS receivers, like the Etrex, this pin is left unconnected to the receiver.

The Commit Pin is a 2-pin right angle header on the center of the Control Panel PCB. When a shorting block is not placed over the header, a +5V signal (a logic high) is sent to P12 of the BASIC Stamp. The shorting block is designed to short this signal so that zero volts (ground or logic low) is applied to P12 of the BASIC Stamp when it is in place. Program the BASIC Stamp to monitor this pin before it begins recording data. That prevents the BASIC Stamp from recording data while the BalloonSat is on the ground. Doing so lets the internal GPS achieve a satellite lock before launching the BalloonSat.

The MAX186 is an eight channel SPI analog to digital converter (ADC). Up to eight sensors can be plugged into the Analog Port and their voltages digitized and recorded in memory (along with the GPS altitude and/or time). The eight analog ports onboard the PCB provides each experiment with +5 volts, ground, and a unique connection to the MAX186. Data from sensors is typically a voltage that varies by magnitude in response to a particular environmental condition. **The MAX186 is not included in the kit because it can be sampled for free from the MAXIM website, www.maxim-ic.com.**

The 3 by 5 Digital Port is for monitoring a voltage that either is on or off based on conditions or is data consisting of meaningful pulses. A typical experiment for the digital port is a geiger counter. The program downloaded into the BASIC Stamp analyzes the output from sensors and records the results for downloading after recovery.
The Servo Port is a 3 by 3 male header. The pin arrangement of the port matches typical model airplane servos. A separate power supply is provided for the servos (4.5 volts) in case one seizes up and drains the battery. It is better to have a failed servo than a failed BalloonSat mission. Typically, this is not a risk and servos will function normally in near space. However, at 100,000 feet, it’s difficult for you to fix a servo problem.

The three reed relays on the BalloonSat Extreme can be closed to provide a signal to cameras. Many electronic cameras have been modified to where an external relay will trigger their shutter switches. A recent move is to using Canon cameras in near space. Software onboard their SD card can control the camera. One popular program is using the camera’s USB port to trigger the shutter. The BalloonSat Extreme’s three camera ports have both options available.

**Assembling the BalloonSat Extreme V2.1**

The diagram below illustrates the placement of the components you will solder to the BalloonSat Extreme PCB. Now you’re ready to make a flight computer. Check off each step as you complete it.

![Figure 3. Parts Layout for the BalloonSat Extreme V2.1](image)
1. Resistors
Form (bend) the resistor leads before inserting them into the PCB. Each resistor’s position is indicated by its R-number.
- □ R1 (RS) 680 ohm (blue, gray, brown, gold)
- □ R2 22 k-ohms (red, red, orange, gold)
- □ R2 4.7 k-ohms (yellow, violet, red, gold)
- □ R3 680 ohm (blue, gray, brown, gold)
- □ R4 1 k-ohm (brown, black, red, gold)

2. Diodes
The diode has its name, 1N4001, printed on it and a white stripe painted around one end. Orient the diode’s stripe to match the top silk diagram on the PCB. If the diode is soldered backwards, the BASIC Stamp will not be able to operate the relay and trigger the camera.
- □ D1 1N4001
- □ D2 1N4001
- □ D3 1N4001

3. IC Sockets
To protect the BASIC Stamp and the MAX186 from heat damage by the soldering iron, solder their IC sockets to the PCB and not the ICs themselves. Electrically speaking, the orientation of the IC sockets doesn’t matter. However, still solder the sockets with their notches aligned with the notches on the top silk graphic. The notch in the IC sockets will then specify the proper orientation of the BASIC Stamp and MAX186 when you install them. If the BASIC Stamp or MAX186 are installed backwards, the BalloonSat Extreme will not function. Do not install the BASIC Stamp or MAX186 into their respective sockets before soldering the sockets to the PCB – this defeats the purpose of using the socket.

Insert the first IC Socket and only solder two diagonal corner pins. Flip the PCB over and verify that the socket is sitting flush on the PCB. If not, press on the high corner and reheat the pin until the receptacle snaps down. Now solder the remaining pins. Repeat for the second IC socket.

After soldering, do not insert the BASIC Stamp or MAX186 yet, as the BalloonSat Extreme must be tested first.
- □ U1 24-pin IC socket
- □ U2 20-pin IC socket

4. Capacitor
The capacitor is polarized, so look for a plus (+) mark stamped on its body. The plus marks the positive lead. Orient the capacitor according to the diagram above and solder. The capacitor will probably resist being set flush to the PCB, so don’t force it.
- □ C1 47 microfarads
- □ C2 4.7uF tantalum capacitor
- □ C3 0.1 uF capacitor
- □ C4 0.1uF capacitor
C5 4.7uF tantalum capacitor
C6 0.01 uF capacitor

5. Relays
The pads on the PCB allow the relays to be oriented two different ways. One of orientations is wrong. If soldered backwards, the relay will not function. The white strip on the relays in figure 3 represents the lettering on the side of the relay. The relays sit flush to the PCB surface.

RL1 Reed relay
RL2 Reed relay
RL3 Reed relay

6. Analog, Digital, and Servo Port Receptacles
The I/O receptacles were cut from a longer block of receptacles, so their edges are raw. Use a utility knife or sand paper to smooth its edges. Insert the first receptacle and only solder two diagonal corner pins. Flip the PCB over and verify that the receptacle is sitting flush on the PCB. If not, press on the high corner and reheat the pin until the receptacle snaps down. Now solder the remaining pins. Repeat for the second receptacle.

Figure 4. The proper fitting of the servo header and analog/digital port.

3 by 5 Receptacle
3 by 8 Receptacle

Unlike the Analog and Digital Ports, the Servo Port is a header (3 by 3 pin). Its orientation does not matter. Insert the short pins into the PCB and solder two diagonal pins. After verifying the header is flush, solder the remaining pins.

Figure 5. The short pins of the header are soldered to the PCB. This leaves the longer pins free for the servos.
7. Voltage Regulator
The voltage regulator is a polarized device, so install it with the flat face of the regulator aligned with its top silk illustration. This is another component that will not sit flush on the PCB, so don’t force it.

U3 LM2950

8. DB-9 Connectors
The DB-9 connectors may come with solder cups or pins on the back. If they have pins, they are ready to solder to the PCB. On the other hand, if it has solder cups, the DB-9 needs some prep first.

Figure 6. The back of a DB-9 connector with solder cups.

It’s easiest to prep the DB-9 with a set of helping hands, as it is a three-handed job. Heat the first cup with a soldering iron and dab a bit of solder inside. Use just enough solder to fill the cup. Cut and strip a thin piece of wire. A cut resistor lead is perfect for this wire. Use pliers or tweezers to hold one end of the wire and press it against the cup of solder. Reheat the cut until the solder melts and the wire is soldered to the cup. Repeat this for the remaining eight solder cups.

Figure 7. A DB-9 with two wires soldered to the solder cups. The length of the wires are important, as they will be cut after the DB-9 is soldered to the PCB.
After prepping the DB-9 (or using a DB-9 with pins on the back), insert the DB-9 into the PCB. The male DB-9 is soldered to the GPS Port and the female DB-9 is soldered to the PGM Port. You may have to twist the DB-9 slightly and cajole the wires to get them all into the PCB. Press the DB-9 down firmly and solder two opposite pins. Verify the DB-9 is still sitting as low the PCB as possible and solder the remaining pins. Cut the excess leads. Then solder the second DB-9.

There are two wings on the DB-9 where it can be bolted into a plastic housing. Instead of a housing, you will mount the DB-9s to stand-offs. Inside the kit are a ¼ inch diameter plastic tube and four sets of 4-40 bolts and nylocks. Measure the gap between the one wing of the first DB-9 and the PCB below it. Cut a piece of plastic tube to that length and wedge it between the DB-9 wing and the PCB. Run a 4-40 bolt through the PCB, the plastic tube, and the DB-9 wing. Use a nylock to tighten the DB-9 in place. Repeat for the other side and ten repeat for the second DB-9 connector.

![Figure 8. A DB-9 mounted to the PCB with two 4-40 bolts and spacers.](image)

9. Battery Holders
Solder the 4 “AAA” and 3 “AAA” cell holders to the PCB. The 4 “AAA” cell holder is the BalloonSat Extreme’s main power and the three “AAA” battery holder provides power for the servo (servos can draw a lot of current, hence a separate battery). Note that there are large diameter holes near the edge of the PCB and smaller holes inside of them. The large holes are the strain relief that will prevent normal usage from breaking the wires off the PCB. The wires of the battery holders are red and black. The red wire is positive voltage and the black is ground. These must be soldered to the proper pads in the PCB or either the flight computer will not power up or the servo won’t rotate. Push each wire up through the strain relief hole from the underside of the PCB and then bend each wire down and into its pad. Push the wires through the pads until their insulation is flush with the PCB and no bare wire is exposed above (or nearly no wire is exposed above).
Figure 9. Strain relief for wires soldered to a PCB.

☐ 4 “AAA” Battery Holder
☐ 3 “AAA” Battery Holder

Assembling the BalloonSat Control Panel
The diagram below illustrates the placement of the components you will solder into the Control Panel PCB. Continue checking off components as you solder them.

Figure 10. Parts layout for the Control Panel.
1. Right Angle 2-pin Header
Solder the short pins of the header to the PCB. To protect the header and toggle switches so they won’t break off the Control Panel, they lay flat to the surface of the PCB.

- Right Angle Header

2. Toggle Switches
Orient the switches and plug them into the PCB. Verify they are laying flat before soldering. Both switches are identical, so it doesn’t matter which switch is in either position.

- Logic Toggle Switch
- Servo Toggle Switch

3. LEDs
First, look on the side of each LED and find the flat edge. See figure 11 for an illustration. The flat side (which is usually also the short lead) is not soldered to the pad closest to the top silk A. The rounded side (and usually longest lead) of the LED is soldered to the pad closest to the A. If an LED is soldered backwards, the BalloonSat Extreme will continue to function, however, the LEDs will not illuminate to indicate power is applied.

![Figure 11. The anode and cathode of a light-emitting diode (LED).](image)

The color of the LEDs is not important, solder which ever color you desire into the pads.

- Main Power LED Indicator
- Servo Power LED Indicator

**Connecting the BalloonSat Extreme to the Control Panel**
A cable of ten wires unites the Control Panel to the BalloonSat Extreme. The color of each wire between the two PCBs is not important for electrons, but using a smart arrangement will reduce the chances of miswiring the two boards. Each wire in the cable is about one foot long. Look at the wires in the kit and begin cutting some of them in half or fourths until they are roughly the same length.
Blue wires are for the switch pads
Yellow wires are for the commit pads
White wires are for the LED anode pads
Black wires are for the LED cathode pads

Use the strain relief holes for these wires just like you did for the battery holders.

**Note**
In the early PCBs, the Servo LED anode is mislabeled. The leftmost pad is the cathode of the Servo LED and should be a black wire.

**Note**
The function of each pad in the Control Panel is listed on the back of the PCB.

![Figure 12. The back of the Control Panel and its cable.](image)

**Checking Your Work**
That completes the assembly of the BalloonSat Extreme. However, don’t plug in the BASIC Stamp, MAX186, or batteries just yet. That’s because if there is an error in the assembly, the flight computer could be damaged when powered up.

- Check soldering (missing or overflows)
- Check there are no shorts between battery power and ground

Set the toggle switches to power off the flight computer. Insert batteries and then flip on Logic Power. The Logic LED should light up. Now check voltages on the BalloonSat Extreme. Note that where the voltage should be +5V, it can actually be a value between 4.75V and 5.25V (five volt plus or minus 0.25 volts).
Ground on U1 pin 4 and +5V on U1 pin 21
Ground on U2 pins 9, 13, and 14 and +5V on U2 pin 20
Ground on male DB-9 pin 5 and +5V on male DB-9 pin 5

It’s easier to check the Analog and Digital Ports if you stick cut resistor leads into the openings. That is unless your DMM has fine tip test leads. A port’s GND row should be ground and the +5V row should be +5V.

![Diagram of GND and +5V connections]

**Figure 13.** The green squares are the grounds in the I/O port. The red squares are the +5 volts in the I/O port. The white squares are digital and analog connections to the BASIC Stamp and MAX186.

Ground and +5V on the Analog and Digital Ports

The Servo Port is designed the same way as the Analog and Digital Ports, but it will measure around +4.5V instead.

Ground and +4.5V on the Analog and Digital Ports

Now the BalloonSat Extreme is ready for the BASIC Stamp and MAX186. Shut off power to the BalloonSat Extreme. Verify the BASIC Stamp and the MAX186 chips are oriented properly and their pins are lined up on their sockets. Then push the center of the ICs firmly to seat them in their respective sockets.

Install the BASIC Stamp and MAX186

Boot up a PC and start the BASIC Stamp Editor. Type the following program to verify the BASIC Stamp, BalloonSat Extreme, and program editor are working properly.
DEBUG “Test”

If the BASIC Stamp has not been damaged and the programming header is properly soldered, the debug window will open and display the message “Test”.

- BASIC Stamp programs

Camera Cables
The BalloonSat Extreme V2.1 has three pairs of camera ports. The first ports are named Cam-8, Cam-9, and Cam-10 and are connected to the three relays. These camera ports are for cameras with modified shutter buttons. The termination for these cables depends on the method used to terminate the camera’s shutter cable. A Dean’s Micro Plug works well for a standard terminator. Dean’s connectors are available at many hobby stores that carry RC cars.

![Figure 14. A Dean’s Connector attached to a camera cable.](image)

The second pair of camera ports are labeled USB 8, USB9, and USB 10. These ports are for Canon cameras running CHDK and the USB remote script. Solder to these ports a stripped down version of the mini USB adapter for the camera. The cable has a mini USB on one end and a regular USB on the other.

![Figure 15. A mini USB for a Canon camera.](image)

The USB remote only uses two wires in the USB cable, +5 volts and ground. The extra wires, shield, and insulation makes the mini USB heavier than necessary. Therefore, cut off the regular USB plug (leave the mini attached) and carefully strip off the outer plastic.
jacket and inner braid. Be careful not to cut or nick the four thin insulated wires inside the cable. After removing the insulation and shielding, you need to identify the power and ground wires in the USB cable. Several I have used were red for +5 volts and black for ground. However, even if your USB cable has these color wires, it’s still a good idea to verify the cable’s wires. Use a multimeter to measure continuity and identify the power and ground wires using the small contacts inside the mini USB.

Figure 16. Placement of the +5 volt and ground tabs inside a mini USB.

Once the +5V and ground wires of the cable have been identified, cut off the remaining two wires. Strip ¼ inch of insulation from the thin wires and solder them to the USB ports like the other wires (i.e. using the strain relief holes). Whereas polarity isn’t an issue with the Camera 5 and 6 ports, it is for the USB 5 and 6 ports. Solder the ground wire to the pad marked with a letter G. All the camera and USB ports can have cables soldered to them. Probably, cameras can be connected to all four cables and operated.

Figure 17. The stripped down mini USB cable soldered to a BalloonSat Extreme.

Commit Pin
The Commit Pin prevents the BalloonSat Extreme from recording data before the beginning of the mission. There can be times when the BalloonSat is powered up well before the near spacecraft is launched (for instance, to let the GPS Receiver get a satellite lock). As long as the Commit Pin is inserted, the BalloonSat Extreme will not begin running experiments and collecting data. This means that someone must pull the Commit
Pin shortly before the BalloonSat lifts off. To ensure someone at the launch site will see the Commit Pin, tie a brightly colored ribbon to the pin as shown in figure 18. Use a strong woven cord, like good quality Dacron kite line, to tie a loop through the hole in the tab of the shorting block and the red ribbon.

![Figure 18. A brightly colored orange ribbon tied to the Commit Pin. This ribbon ensures that no one forgets to pull the Commit Pin at launch. A short length of heat shrink tubing is covering the knot in the shorting block.](image)

**Connecting Sensors**

Near space experiments for the BalloonSat Extreme flight computer must terminate in a three pin header. Each pin has one of the following functions, ground (zero volts or the negative terminal of a battery), +5 volts, and input/output to the BASIC Stamp or MAX186. The pins of the header have a spacing of 0.1 inch between pins and the pins are 0.025 inches across. A sensor can use a second three pin header and it doesn’t have to use all three pins of either header. Typically, a second header is needed when the sensor produces two outputs or it requires a command from the BASIC Stamp to produce an output.

![Figure 19. The pin outs of a three pin sensor cable header.](image)

The benefit of using three pin headers is that sensors can be plugged into any I/O channel. As soon as its cable is plugged into a channel, the sensor receives power and communications with the BASIC Stamp and MAX186. The sensor cable can be moved to a different I/O channel with only a minor change to the flight program. The output from sensors plugged into the BalloonSat Extreme can be either an analog voltage to the MAX186 or a series of voltage pulses (on and off) or an on-off states to the BASIC Stamp.
Making Sensor Cable Terminators
A sensor cable should always be terminated in a three pin header (even if the sensor only needs one or two connections). Headers normally come in a long row designed to be snapped to the proper length. These are referred to as snappable headers. To use them, cut a three pin section off the end of a row of snappable headers. Select one of the end pins to be pin number one. Pin 1 is the signal pin and can be either the output from or input to the sensor. The second pin is the power pin, five volts to operate the sensor comes from this pin. Pin number three is the ground or zero volt pin and completes the circuit for the sensor. Follow these steps to terminate the sensor cable.

1. Tin the short sides of the pins in the header
2. Strip ¼ inch of insulation from the wires of the sensor
3. Twist the wires tightly and tin them
4. Cut ½ inch of heat shrink for each wire and slide them over the ends of the tinned wires

Note: Slide the heat shrink away from the tinned ends of the wire or else they may shrink in place when you solder the wires to the header.

5. Place the sensor’s signal pin against pin #1 of the header and touch a hot soldering iron to the pin and wire (the solder in the tinned wire and header pin will fuse the two together)
6. Hold the wire against the header pin until the solder cools
7. Repeat for the remaining two pins (+5 volts and ground)
8. Side the heat shrink over the soldered connections and shrink

Use double row snappable headers to terminate sensor cables requiring a second row of three pin header.

Figure 20. A completed three pin sensor cable. In this example, the black wire is ground, the red wire is +5 volts, and the white wire is the sensor signal. Using color coding like this is the smartest way to make cables.

Examples of Code
You’ll find example flight programs for the BalloonSat Extreme on the NearSys website (nearsys.com) under the NearSys Catalog.

You’ll find BASIC Stamp resources like the program editor and datasheets at the Parallax website: http://www.parallax.com

1 September 2010