

Read through the instructions, then look at TABLE 1 and decide what range for averaged voltage you would like to use. Make a note of which LED(s) must be lit in configuration to choose that range. Decide whether to use Glitch or Failsafe mode, which determines whether you want LED 8 on or off in configuration. Initially use Normal PLV Range – You can change to Low Range later if desired. The 18 configuration choices are in a loop; after 18, it starts back at 1. You can only select one choice at a time, then save it by turning the power off. So if you wanted to change everything (averaged voltage range, PLV range, and glitch/failsafe) it would take three times through, turning power off after each time, to save the selection. It's a good idea to know what LEDs you want lit in advance because after 20 seconds without any activity, the previous configuration is restored and configuration ends. The complete configuration is briefly displayed on power up, at the end of the LED test pattern.

**CAUTION:** Do not connect to over 8.7 volts—damage may result.

1. **Connect the attached lead**, just like a servo, to the receiver. (Wire colors: brown is equivalent to black, and orange is equivalent to white.) A "Y" harness may be used if there is not a spare channel on the receiver. If a "Y" harness is used, connect it to a channel with low current draw. When configuring VoltMagic for failsafe detection on receivers with a failsafe setting (e.g. PCM), using a separate channel is advised since its failsafe position will be adjusted for VoltMagic. VoltMagic can also be plugged into a socket that does not have a channel signal (such as one for a DSC) or connected directly to a battery (such as a 7.4v LiPoly). Naturally, if VoltMagic is connected without a channel signal, glitch/failsafe detection is disabled and you will have to connect it somewhere with a channel signal temporarily to change the configuration (in step 3).
2. **Set Glitch or Failsafe detection:** Glitch detection checks if signals from the receiver fall outside the normal range of pulse widths. Failsafe detection (for receivers with a failsafe setting) checks if the signals from the receiver are at maximum high or low, which is the failsafe position to set for the channel connected to VoltMagic. The receiver must apply this failsafe position signal when the radio signal is lost. If a failsafe position isn't possible, use glitch mode. As a side note, we recommend that you check that the throttle channel failsafe is set to idle. See your transmitter manual for specific procedures for setting failsafe positions.
  - Proceed to the **CONFIGURATION GUIDE** and begin at the top of the configuration flow chart.
3. **Set the Averaged Voltage range (AV):** See Table 1 and choose a voltage range. Note the LEDs that are lit during configuration when that particular range is selected. To enter configuration, your transmitter ATVs for the channel connected to VoltMagic should be about 85% (or more if not using PCM failsafe detection).
  - Proceed to the **CONFIGURATION GUIDE** and start at the SET VOLTAGE RANGES block.
4. **Test Glitch or Failsafe detection:** Turn on the transmitter and receiver for **longer than one minute** to enable glitch (or failsafe) counting, then turn the transmitter off and back on. Green LED 1 should blink (see the Operation Guide). If failsafe detection doesn't work at first, try setting the failsafe again to the opposite extreme.
5. **Mount VoltMagic** by applying double-stick tape to the back. Mount away from engine exhaust, preferably where it can be seen in a hover or slow fly-by. For mounting inside the fuselage, cut a slot for viewing the LEDs.
6. See the **OPERATION GUIDE** for specifics on reading the LEDs.

**TABLE 1: Voltage Ranges + Glitch or Failsafe Mode** -- In order of appearance during configuration.

Range	Averaged Voltage (AV) for LED's 1-8 *	PLV or OV Range **			Configuration LED Display	Applications ***
		Normal	Low	OV		
1	5.3 – 4.6 volts	4.6 – 3.8	4.2 – 3.4		Green LED 5	4 cell Ni
2	5.4 – 4.7 volts	4.6 – 3.8	4.2 – 3.4		Green LED 4	4 cell Ni
3	5.5 – 4.8 volts	4.6 – 3.8	4.2 – 3.4		Green LED 3	4 cell Ni
4	5.6 – 4.9 volts	4.6 – 3.8	4.2 – 3.4		Green LED 2	4 cell Ni
5	5.5 – 4.8 volts	4.4 – 3.8	4.0 – 3.4	5.8	Green LED 4 + Green LED 5	5.4 to 5.1 Regulators
6	5.7 – 5.0 volts	4.4 – 3.8	4.0 – 3.4	6.0	Green LED 3 + Green LED 4	5.6 to 5.3 Regulators
7	5.9 – 5.2 volts	4.4 – 3.8	4.0 – 3.4	6.2	Green LED 2 + Green LED 3	5.8 to 5.5 Regulators
8	6.1 – 5.4 volts	4.6 – 4.0	4.2 – 3.6	6.4	Green LED 2 + Green LED 5	6.0 to 5.7 Regulators
9	6.5 – 5.8 volts	5.6 – 4.8	5.2 – 4.4		Green LED 5 + Yellow LED 6	5 cell Ni
10	6.6 – 5.9 volts	5.6 – 4.8	5.2 – 4.4		Green LED 4 + Yellow LED 6	5 cell Ni
11	6.7 – 6.0 volts	5.6 – 4.8	5.2 – 4.4		Green LED 3 + Yellow LED 6	5 cell Ni
12	6.8 – 6.1 volts	5.6 – 4.8	5.2 – 4.4		Green LED 2 + Yellow LED 6	5 cell Ni and 6.6 LiFe
13	7.7 – 7.0 volts	6.6 – 5.8	6.2 – 5.4		Green LED 5 + Yellow LED 7	7.4 Li
14	7.8 – 7.1 volts	6.6 – 5.8	6.2 – 5.4		Green LED 4 + Yellow LED 7	7.4 Li
15	7.9 – 7.2 volts	6.6 – 5.8	6.2 – 5.4		Green LED 3 + Yellow LED 7	7.4 Li
16	8.0 – 7.3 volts	6.6 – 5.8	6.2 – 5.4		Green LED 2 + Yellow LED 7	7.4 Li
17	PLV Normal or Low Range				Green LED 1 <b>Slow blink</b> = Normal / <b>Fast blink</b> = Low Range	
18	Glitch (PPM) or Failsafe detection				Red LED 8 <b>OFF</b> = Glitch / <b>ON</b> = Failsafe	

\* The 8 LEDs each represent a nominal 0.1 volt step. For example, in the first range, Red LED 8 on indicates 4.6 volts or less, Red LED 7 is 4.7 volts, Yellow LED 6 is 4.8 volts, Green LED 5 is 4.9 volts, and so on. A deadband dampens changes between LEDs.

\*\* Including the on-demand Extended PLV (see Table 2). \*\*\* Ni = Nickel (NiCd or NiMh) Li = Lithium (LiPo, Li-ion, LiMn)

## VOLTMAGIC 2R R/C SYSTEM MONITOR – WHAT IT DOES:

**Averaged Voltage (AV)** — Shows a steady display of the current voltage. Each LED represents a 0.1 volt step. 4-cell, regulator, 5-cell, and 7.4 Li each have four ranges, for a total of 16 ranges. This allows one monitor for all applications, plus you can fine-tune the colored LEDs to match your system, and your personal preference. [Table 1]

**Peak Low Voltage (PLV)** — Below a certain threshold, shows the lowest voltage at the receiver (or wherever it's connected). The range of PLV is based on the selected AV range, but you can also select Normal or Low Range PLV. **Extended PLV** shows an extra 0.2 volts of PLV on the high end for an early look. It's displayed on LED 5 if the switch (or other control VoltMagic is connected to) is toggled quickly 5 times AFTER 1 minute of run time. [Table 2]

**Overvoltage (OV)** — For regulated systems, shows if the voltage went above a certain threshold. [Table 2]

**Glitch and Failsafe Counting** — Selectable for Glitch (PPM) or Failsafe (PCM or any receiver with an adjustable failsafe). The counting is smart, so several within a short time period are counted as the same glitch. [Table 3]

**Data Logger** — This feature plays back any PLV / OV and Glitches from the previous flight when the power is turned on.

At least one LED will always be lit showing AV. You could have up to three LEDs lit at one time: one showing the AV (any of the LEDs), one blinking to show the PLV or OV (LEDs 5-8), and one blinking the Glitch/Failsafe count (always LED 1). If the AV is lighting up the same LED that the PLV / OV or Glitch counter is blinking, it will blink off instead of on. This is the key to understanding the display.

## GENERAL INFORMATION – (also see the FAQ page at VoltMagic.com)

**AV Ranges:** [See Table 1] For batteries, select a range that shows yellow when the battery is starting to get low. Battery voltage and idle current will vary, so adjust for your setup. When to charge a battery depends on battery characteristics, amperage, flight duration, etc. Using battery load, discharge, or capacity test instruments in addition to VoltMagic is always good practice. You can compare with a loaded meter test, or set for 1 green LED above yellow with about 50% discharge. For voltage regulators, ranges 5 through 9 are ideal -- select a range that displays the regulator output in the green band, but below the highest green LED.

**PLV Ranges:** [See Table 2] For each AV range there are two PLV ranges, Normal (default) and Low. Some power hungry servos make it harder (but not impossible) to keep the peak low voltage out of the yellow/red using Normal Range PLV. Although less voltage drop is always better, you can select Low Range PLV if Normal Range PLV gives a warning sooner than desired.

**NOTE:** For Low Range PLV with the 4-cell or regulator ranges, the first yellow PLV alert is 3.8 volts. This is the same voltage at which some manufacturers initiate their battery failsafe IF a time delay period elapses. Typically the voltage will spike below 3.8 momentarily BEFORE it stays low long enough to initiate the battery failsafe. Absolute minimum voltage requirements vary, and manufacturer's ratings may not include this information. Some airborne equipment may require 3.5 volts (or more), some may tolerate 3.0 volts. The failure mode from momentary undervoltage also varies widely. Notable is the reconnect time for some types of receivers.

**Troubleshooting Low PLV:** For non-regulated systems, plug the battery directly into the receiver and then stir the sticks quickly. Servos draw in-flight load current with a sudden reversal, but only for a short duration. Slower devices will miss these quick voltage dips, VoltMagic will record them. If the PLV is now significantly better, the resistance of switch harness and its connectors caused the difference in PLV, and the harness probably isn't suitable for the peak amperage of the servos. If there is still low PLV, the battery and/or its connector are probably not suited for the peak amperage of the servos (even though the battery may check out fine by itself). Note that it is often normal to have yellow or red PLV when a battery is getting low. Cold temperatures can also degrade battery performance, resulting in lower PLV.

For regulators and all battery setups, you can unplug individual servos and stir the sticks to see the effect of lowering servo load on PLV. Batteries or switch harnesses that are barely capable of handling multiple digital servos are common. R/C connectors from a battery are marginal when they have to feed the current for several digital servos.

With a regulator, low PLV can be caused by the regulator itself, poor connections, excess servo load, or the supply battery (possibly from internal voltage drop, cold temperatures or low charge). The averaged voltage output of a regulator shouldn't change as the battery discharges. However, the voltage at the receiver will still vary, especially with sudden load changes. OV is caused by the regulator itself.

**Example:** Generic 4-cell 2700 MAH battery and generic HD switch with one 9251 & four 9252 digital servos, the PLV was **3.4 volts**. Substituting a 4-cell Sanyo 1950 HR-4/5FAUP pack, and a Futaba HD switch modified with a powerpole connector to the battery plus twin leads feeding the RX, the PLV is now **4.6 volts**. Both tests were after a full charge followed by a 1200 MAH discharge.

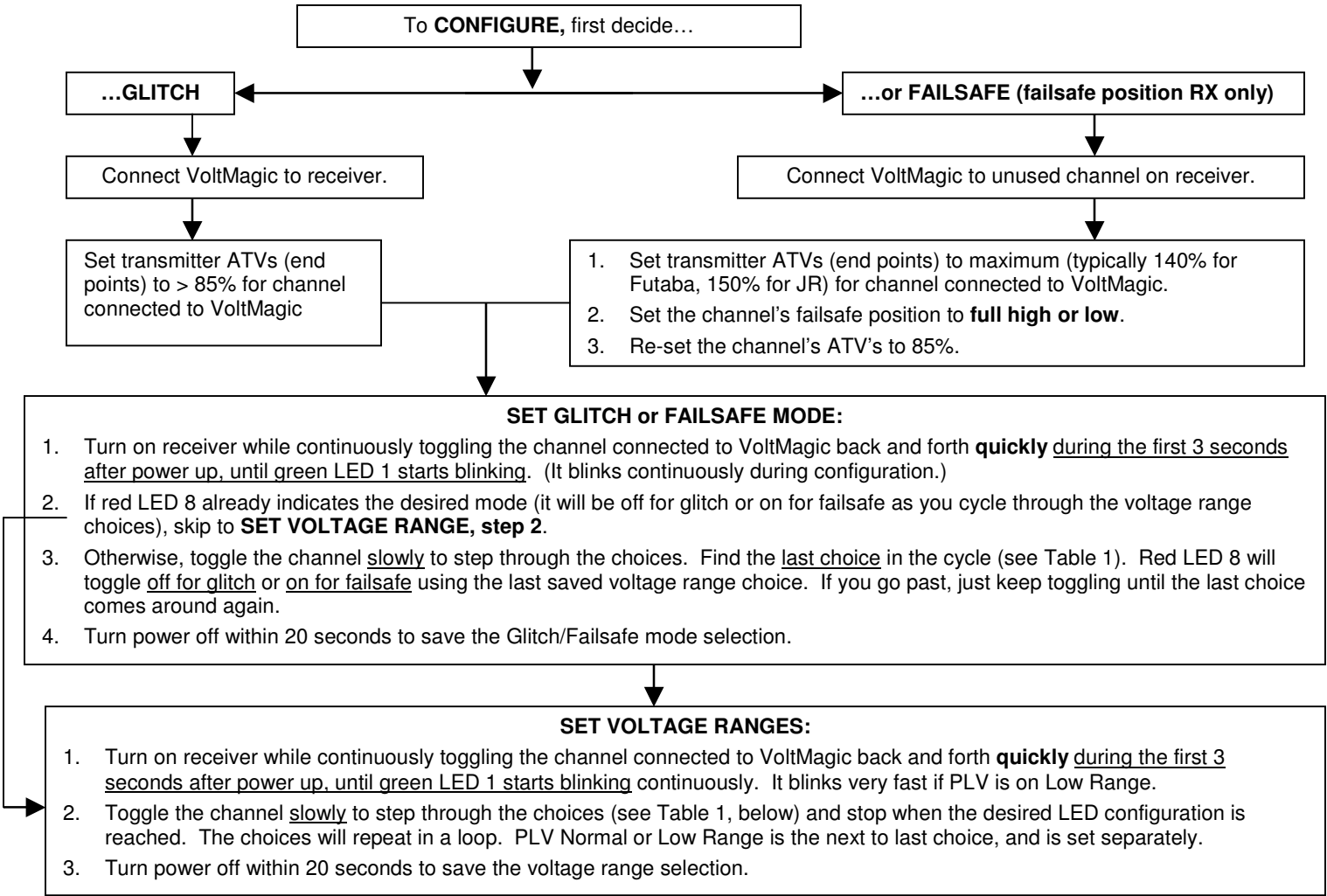
Generally, use whatever keeps the voltage normal, but here are some specific suggestions with digital servos and Ni batteries: Use low impedance batteries (5 mOhms or less). For example, the Sanyo discharge graph for 1950 HR-4/5FAUP cells shows ~1.1 volt per cell at 10 amps, and the weight is only 39 grams. Use a high current switch with two poles (e.g. Futaba's heavy duty switch). Either use a battery with twin leads (or dual batteries) and install two switches both feeding the receiver, **or** replace the connector between the battery and switch with a Power Pole or Deans type. To further lower voltage drop with a single switch setup, replace the single output lead of the switch harness with two leads to feed the receiver.

## Specifications

Weight: 7.3 grams    Input voltage: 2.7 to 8.5 vdc    Calibration: within 0.15 vdc    Sample rate: 1000/second    Frame Rate: 12-23ms

## LIABILITY EXCLUSION AND SAFETY

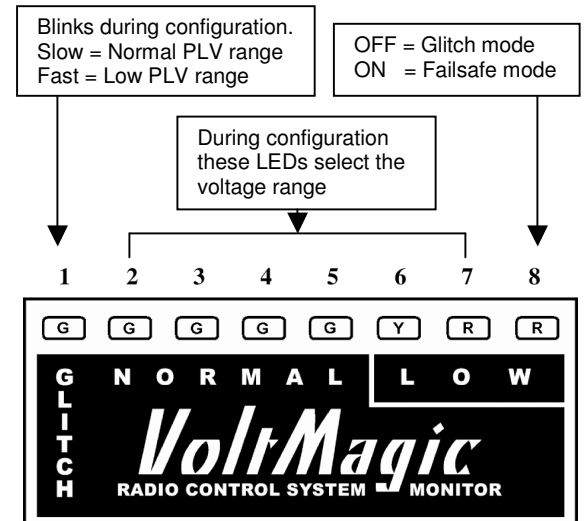
Never turn off your brain and rely solely on this device. Observe safe practices concerning your particular model. Always perform an appropriate pre-flight check. As manufacturers, we are not in a position to ensure the proper methods of operation when installing, testing, or using this product, nor can we assure the fitness of this product for your particular application. For these reasons, we do not accept any liability for loss, damage, or injury connected with this product. By using VoltMagic, you agree to this.



**TABLE 1: Configuration of Voltage Ranges + Glitch or Failsafe Mode** -- In order of appearance during configuration.

✓ Note: The default (range 3) is a conservative four-cell Ni battery choice. Battery voltage and idle current will vary, so adjust for your setup. There are ranges for many different batteries and regulators, please see the Introduction page for more details.

Voltage Ranges				Configuration LED Display	
	Averaged Voltage	PLV range *			
		Normal	Low		
1	5.3 – 4.6	4.6 – 3.8	4.2 – 3.4	Green LED 5	4 cell Ni
2	5.4 – 4.7	4.6 – 3.8	4.2 – 3.4	Green LED 4	4 cell Ni
3	5.5 – 4.8	4.6 – 3.8	4.2 – 3.4	Green LED 3 (default)	4 cell Ni
4	5.6 – 4.9	4.6 – 3.8	4.2 – 3.4	Green LED 2	4 cell Ni
5	5.5 – 4.8	4.4 – 3.8	4.0 – 3.4	Green LED 4 + Green LED 5	V reg
6	5.7 – 5.0	4.4 – 3.8	4.0 – 3.4	Green LED 3 + Green LED 4	V reg
7	5.9 – 5.2	4.4 – 3.8	4.0 – 3.4	Green LED 2 + Green LED 3	V reg
8	6.1 – 5.4	4.6 – 4.0	4.2 – 3.6	Green LED 2 + Green LED 5	V reg
9	6.5 – 5.8	5.6 – 4.8	5.2 – 4.4	Green LED 5 + Yellow LED 6	5 cell Ni
10	6.6 – 5.9	5.6 – 4.8	5.2 – 4.4	Green LED 4 + Yellow LED 6	5 cell Ni
11	6.7 – 6.0	5.6 – 4.8	5.2 – 4.4	Green LED 3 + Yellow LED 6	5 cell Ni
12	6.8 – 6.1	5.6 – 4.8	5.2 – 4.4	Green LED 2 + Yellow LED 6	5 cell Ni
13	7.7 – 7.0	6.6 – 5.8	6.2 – 5.4	Green LED 5 + Yellow LED 7	7.4 Li
14	7.8 – 7.1	6.6 – 5.8	6.2 – 5.4	Green LED 4 + Yellow LED 7	7.4 Li
15	7.9 – 7.2	6.6 – 5.8	6.2 – 5.4	Green LED 3 + Yellow LED 7	7.4 Li
16	8.0 – 7.3	6.6 – 5.8	6.2 – 5.4	Green LED 2 + Yellow LED 7	7.4 Li
17	PLV Normal or Low Range			LED 1 <b>Slow blink</b> = Normal / <b>Fast</b> = Low	
18	Glitch (PPM) or Failsafe detection			Red LED 8 <b>OFF</b> = Glitch / <b>ON</b> = Failsafe	



\* PLV = Peak Low Voltage (including extended PLV). Overvoltage (OV) is included for the regulator ranges. See Table 2 for the specific trigger points.

One of the 8 LEDs is always lit to show Averaged Voltage (AV) for the battery or voltage regulator output; see Table 1. One of LEDs 5-8 may blink to record Peak Low Voltage (PLV) or OverVoltage (OV); see Table 2. LED 1 may blink to count radio glitches; see Table 3. If the same LED blinks that is also lit for AV, it will blink off instead of on. Properly configured, the LEDs show the following:

<b>RED</b>	AV very Low (LED 8)	<b>1 or 2 blinks</b> = PLV very Low
<b>YELLOW</b>	AV moderate Low (LED 6) or Low (LED 7)	<b>1 or 2 blinks</b> = PLV moderate Low / Low
<b>GREEN LED 5</b>	AV normal	<b>1 or 2 blinks</b> = PLV approaching Yellow, or OV (ranges 5-8)
<b>GREEN LED 2 - 4</b>	AV normal	
<b>GREEN LED 1</b>	AV normal (full)	<b>Blink(s)</b> = Glitch (or Failsafe) count

On power up, VoltMagic displays an LED test pattern that ends with a display of the current configuration (see Table 1). Then, if peak low voltage (PLV), overvoltage (OV) or glitches were logged from the previous flight, they will display for 10 seconds, after which VoltMagic displays the current averaged voltage (AV) and the PLV or OV. **Glitch (or failsafe) counting is enabled after one minute.**

- ✓ Note that if you cycle power within a minute of turning on, you can view the previous flight data again. After one minute of operation, the previous data is erased and current data is recorded.

Batteries need some time and load for the voltage to stabilize. Exercise the servos rapidly and check VoltMagic before flying.

**TABLE 2: Peak Low Voltage (PLV) and Overvoltage (OV)** -- The specified LED blinks once or twice followed by a pause when voltage falls below the PLV setting; only the lowest voltage is displayed. If averaged voltage (AV) is also being displayed with the same LED, it will blink off instead of on. Either Normal or Low range can be selected in configuration. OV is for regulators only.

LED	Blink	Ranges 1-4 4-cell Ni		Range 5 5.1 - 5.4 reg		Range 6 5.3 - 5.6 reg		Range 7 5.5 - 5.8 reg		Range 8 5.7 - 6.0 reg		Ranges 9-12 5-cell Ni		Ranges 13-16 7.4 Li	
		Norm	Low	Norm	Low	Norm	Low	Norm	Low	Norm	Low	Norm	Low	Norm	Low
Red LED 8	2	3.8	3.4	3.8	3.4	3.8	3.4	3.8	3.4	4.0	3.6	4.8	4.4	5.8	5.4
Red LED 8	1	3.9	3.5	3.9	3.5	3.9	3.5	3.9	3.5	4.1	3.7	4.9	4.5	5.9	5.5
Yellow LED 7	2	4.0	3.6	4.0	3.6	4.0	3.6	4.0	3.6	4.2	3.8	5.0	4.6	6.0	5.6
Yellow LED 6	2	4.1	3.7	4.1	3.7	4.1	3.7	4.1	3.7	4.3	3.9	5.1	4.7	6.1	5.7
Yellow LED 6	1	4.2	3.8	4.2	3.8	4.2	3.8	4.2	3.8	4.4	4.0	5.2	4.8	6.2	5.8
Green LED 5	2	4.3	3.9	5.8 OV		6.0 OV		6.2 OV		6.4 OV		5.3	4.9	6.3	5.9
Green LED 5	1	4.4	4.0	—		—		—		—		5.4	5.0	6.4	6.0
↓ <b>Extended PLV</b> is displayed for 5 seconds IF the channel connected to VoltMagic is toggled quickly 5 times AFTER 1 minute of run time															
Green LED 5	2	4.5	4.1	4.3	3.9	4.3	3.9	4.3	3.9	4.5	4.1	5.5	5.1	6.5	6.1
Green LED 5	1	4.6	4.2	4.4	4.0	4.4	4.0	4.4	4.0	4.6	4.2	5.6	5.2	6.6	6.2

**TABLE 3: Glitch (or Failsafe) Event Counter** – Glitch (or failsafe) counting is enabled after one minute, unless connected without servo pulses. After a bad or missing pulse, any more within 2/3 second are counted as the same glitch. If LED 1 is displaying averaged voltage (AV), it will blink off instead of on.

Number of LED 1 Blinks	Glitch or Failsafe Count
1	1
2	2 to 3
3	4 to 7
4	8 to 15
5	16 to 31
6	32 or more

**Averaged Voltage (AV)** is shown by which one of the 8 LEDs is on. The LEDs are in 0.1 volt increments per the range configured (see Table 1).

Sudden changes in voltage from servo movement are filtered out for a steady reading. **Note:** If connected downstream of a voltage regulator, the voltage output of the regulator will be monitored, not the battery voltage.

**PLV** is shown by **blinking** LEDs 5 - 8 (see Table 2).

**Note:** If the same LED indicates **AV**, it will blink off instead of on for **PLV**.

Examples with default configuration

LED 3 on	Voltage = 5.3
LED 3 on LED 5 blinks once	Voltage = 5.3 PLV = 4.4
LED 5 on LED 5 blinks (off) twice	Voltage = 5.1 PLV = 4.3
LED 8 on LED 6 blinks twice LED 1 blinks twice	Voltage = 4.8 PLV = 4.1 2 to 3 glitches counted

