BL-3GRC Connections

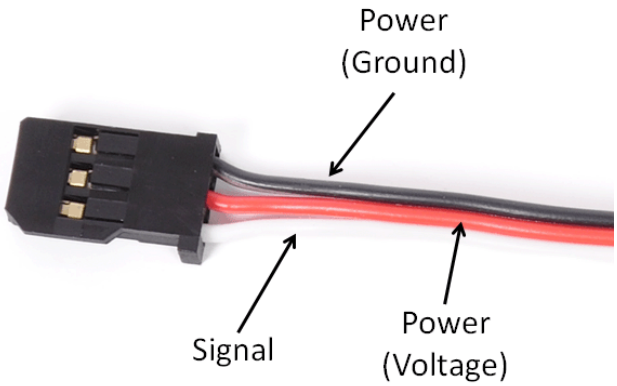
RC Electrical Interfaces Application Note

1.0 Introduction

The aim of this white paper is to highlight the main considerations when connecting up the unit to servos and power suppliers.

2.0 RC radio Output Signals

The RC radio receiver (RC Rx) has three pins for each control surface connection. A cable is connected onto these pins as shown here:



2.1 Voltages

Different receivers have slightly different requirements, but typically the voltage requirement is 5V, but can range from as low as around 3.7V up to 7.4V. When connecting a gyro or servo it is worth knowing what voltage you intend to use so you can check that the gyro or servo is going to be happy with the supplied voltage. Many servos operate over a wide range of voltages (giving higher torque at higher voltages). But, for example the Hi-Tech HS-50 only operates at 4.8V.

The ***BEC (Battery Eliminator Circuit)*** is a unit that supplies a regulated DC voltage to electronics such as RC Rx, gyro, and servos. If a LiPo battery is being used to drive an electric motor then it often also has a BEC output in order to take some of that LiPo power to drive the electronics too. Hence no need for an additional battery. Care must be taken in this respect if driving sensitive electronics since deriving a stable and clean voltage from a unit that is intended to drive high current into a modern brushless motor is certainly not easy to achieve. Also any noise induced into the BEC form external electronics can also feedback into the motor controller for the brushless motor. It is for this reason that manufacturers supply fast (400Hz, see below), optically coupled ESC for brushless motors. Such ESCs tend not to have a BEC output to keep the signals going to the motors as clean as possible. Such a system is recommended for any multi-copter system.

The BEC must be of correct voltage output to meet all the units it is powering. It must also offer a clean voltage to avoid any problems. Most importantly it must also provide enough power for all the systems it is intended to power. Calculating the power is not so easy, but certain assumptions can be made. As an example let's consider the case of a BEC for a six servo aircraft system.

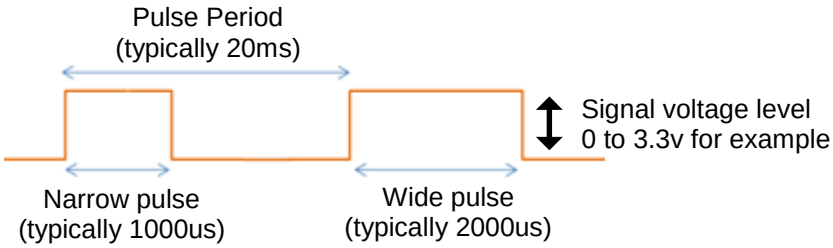
Power is actually measured in Watts. However for simplicity most RC people use current drawn as a good indication since most systems are operating at or around the 5V level. Current is also easy to measure with a multi meter and so a reasonable estimate can be made of the amount of current your particular servos will use. A typical value for a Futaba S3003 servo is around 650mA at full stall, to around 150 mA just end to end movement (measured at 5v).

For those interested the actual power is given by 650 mA x 5.0V = 3.25 Watts)

Hence worst case a system with six such servos will draw maximum 3.9 Amps. Hence a 5V BEC would need to be selected that could at least provide 3.9 A continuous current.
(or if, for example, 6V is needed, then 5V / 6V x 3.9A = 3.25 A).

2.2 Signals

The signal wire from the RC Rx will have a square wave signal to control a servo. The square wave carries the information as a PWM (Pulse Width Modulation) signal. What this means is that a narrow pulse will cause the servo to move in one direction, and a wide pulse in the other. The time between the pulses is also an important parameter and is known as the pulse period (or 1/period = frequency).



A typical period is 20ms (= 50 Hz frequency).

Futaba tend to use minimum pulse widths of 1100us and maximum 1940us, others 1000us and 2000us respectively (1us = 0.000001 second). This then defines the end points of the servo travel, or for gyro and other electronic systems it defines the maximum range at which they can operate.

The period of the pulses is important since it defines how fast the servo will respond. It is also important since if you drive a slower (analogue) servo too fast then it will not work correctly, will likely jitter around, get hot and damaged. Certain applications such as multi-copters also require very fast control changes from a gyro unit in order to maintain stability. If 20ms is fine for most aircraft it is much too slow for multi-copters.

A typical analogue servo requires 20ms pulses and a faster digital servo maybe 10ms or better.

For example the GoTeck HKS-9257 is a high speed digital servo and operates at 80Hz (1/80 = 12.5 ms period).

For a multi-copter the gyro output must drive a brushless motor. An Electronic Motor Controller (ESC) suitable for multi-copter use needs to operate at 400Hz (1/400 = 2.5ms).

2.2.1 Signal voltage level

Any signal square wave (PWM) going from one equipment to another. I.e. from RC Rx to servos, or from RC Rx to Gyro, or from Gyro to servos must have a signal that the receiving equipment can recognize. By that I mean the receiver must be able to detect when the pulse is supposed to be at a low voltage level and when it is supposed to be at a high voltage level. From a long way back this is normally assumed to be based on TTL (Transistor Transistor Logic) levels. In other words the receiver will identify a low level if the signal is below 0.8V and a high level if above 2.2V. However this should also be checked with different manufacturers' equipment to make sure this is adequate.

3.0 Connecting the BL-3GRC Gyro in low power configuration

The BL-3GRC Gyro requires an input voltage of between 4.8V and 20V, but 5V is recommended. 4.8V is not really recommended since any slight decrease in this voltage and the 3.3V that the BL-3GRC requires to operate correctly may be at risk. For example if powerful servos take sudden power the 4.8v may drop if the BEC is not so good.

In low power connection mode the BL-3GRC will take the input power supply and feed it through to the output to be used by the servos. This ability to pass through the current is limited by the size of the copper tracks on the BL-3GRC PCB. Hence this should be limited to around 3.0 to 3.5A maximum. Otherwise connect up in high power mode.

Check list

- Define the voltage all your components are happy with, and choose an appropriate power source to provide it.
    - For BL-3GRC it is best to use 5V DC power source

- Check that the signal square wave (PWM) is correct for the servos you intend to use. (Pulse voltage level, pulse period, and pulse min / max values).
    - BL-3GRC can set the PWM period and pulse min / max to suite just about all servos
    - BL-3GRC will output control signal pulses at maximum 3.3v output

- Check that your servos are getting enough power at the correct voltage.

- In low power connection mode the BL-3GRC will take the input power supply and feed it through to the output. So it should be checked that not too much current is passed through. (Limit to around 3.0 to 3.5A max). If in doubt connect in High power mode.
