MODERN RC RECEIVERS

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I've been surprised at just how fast new receivers are being developed to a high specification and low cost; yet still maintaining high quality!

The Rx is one of the most critical components in an RC system – it is the only part in the airframe that determines whether you have control or not. As such it deserves a little consideration of how it works and how recent advances can be used to give more reliable (and safer) flights.

Below you will find some of the more recent modern ***full-range*** Rx's suitable for glow or electric, and an explanation of the features and their importance. I hope that this document is thought provoking and helps others to think about this critical system component before their next purchase.

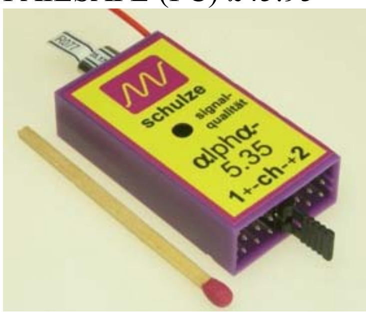
Failsafe RX's

PPM DSP Failsafe

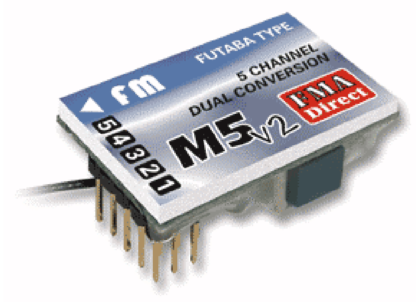
Hyperion HP-DSP8-FS
(www.robotbirds.com)
8 Channel Single Conversion PPM DSP FAILSAFE £49.95

Hyperion HP-DSP6-FS
(www.robotbirds.com)
6 Channel Single Conversion PPM DSP FAILSAFE £44.95

Schulze Alpha 8.35w
(www.westlondonmodels.com)
8 Channel Single Conversion PPM DSP FAILSAFE (PC) £45.95



Schulze Alpha 5.35w
(www.westlondonmodels.com)
4 + 1 Channel Single Conversion PPM DSP FAILSAFE (PC) £33.95



FMA M5 V2
(www.aurorra.co.uk)
5 Channel Dual Conversion PPM DSP
£38.00

FMA FS8
(www.aurorra.co.uk)
8 Channel Dual Conversion PPM DSP
FAILSAFE £84.00

PCM DSP Failsafe

Futaba R146IP Receiver
(www.srcm.co.uk)
6 Channel Dual Conversion PCM
FAILSAFE £46.99

Futaba R138DP Dual Conversion PCM
Rx
(www.srcm.co.uk)
8 Channel Dual Conversion PCM
FAILSAFE £79.99

PPM non-Failsafe

Futaba R148DF Dual Conversion Rx
(www.srcm.co.uk)
8 Channel Dual Conversion £71.99

Hyperion HP-DSP4-TSR
(www.robotbirds.com)
4 Channel Single Conversion PPM DSP
£37.95

Futaba R118F Receiver
(www.srcm.co.uk)
8 Channel Single Conversion £49.99

Crystals

A note about crystals, this component has to be bought and used for you to tune your transmitter and receiver to each other. Most people buy these devices fit them and forget them. One could argue their reliability and performance actually determines whether you fly or crash! If these devices are slightly off frequency then with the case of your transmitter you will be transmitting off frequency and could be causing splatter with the adjacent channel. Like wise if your receiver is slightly off frequency you will be susceptible to your adjacent channel transmitter.

Crystals in many respects are treated badly considering their importance in tuning the system.

I would advise very much the following:

- Never keep crystals in a storage environment whereby they are rattling around
- Never drop a crystal on a hard floor they are susceptible to shock vibration
- Replace the crystal after a crash
- Crystals age, they go off frequency slowly day by day
- Never mix crystals from different manufacturers with different Rx manufacturers (i.e. only use a Futaba crystal in a Futaba Rx, Sanwa Crystal in a Sanwa Rx e.t.c.)
- More expensive crystals are likely to be better specified crystals on ageing

It is important to have crystals checked regularly.

Failsafe operation

Some receivers are able to be programmed for 'failsafe' operation in the event of signal loss. The use of failsafe receivers is strongly recommended in sensitive flying sites, such as Slough, where the flying site might be bordered by residential properties or other equally sensitive areas. The BMFA recommend that all operational fail-safes in use on powered models (including "add on" devices used with PPM) must set the throttle to tick-over (stopped in the case of electric power) regardless of the other control operations governed by the failsafe and regardless of the size of the model.

The throttle failsafe is a minimum. There is however debate over what is best to set for the other control surfaces; some prefer to set rudder for left circuits and others prefer to set ailerons and elevator. This is your choice as long as throttle is set to idle according to the BMFA guidance.

With the low price of modern failsafe receivers it can be argued that every pilot should consider fitting a failsafe receiver in their model; either PCM or PPM – ***however if you do the failsafe action on throttle must always be set.***

What is meant by PPM modulation?

A PPM (PULSE POSITION MODULATION) modulation scheme is whereby the servo position information for each channel of the receiver is transmitted using

Frequency modulation. The modulation is quasi digital in the sense that the servo information is in pulse form but the actual servo position information is a measure of the pulse position.

What is meant by PCM modulation?

A PCM (PULSE CODED MODULATION) modulation scheme is whereby the servo position information for each channel of the receiver is encoded and then transmitted again using Frequency modulation. This is true digital modulation in the sense that the servo position information is sent in the form of a value encoded to 10bit resolution. Error bits are added so that any corruption of data can be recognised by the decode section of the receiver and if necessary rejected and not sent to the servo. The servo on that channel will hold the last valid frame position until a good frame is received.

A PPM receiver cannot decode the servo position information from a PCM transmitter and likewise for a PCM receiver from a PPM transmitter.

In general a PCM receiver is less susceptible to noise and inherently very sensitive. However because it is more complex and transmits more information per channel it is much slower than a PPM system.

A PPM receiver has a frame rate of about 25 msecs, (frame rate is the amount of time that the receiver updates all the servo channels), A PCM receiver has a much slower rate of nearly 48 msecs.

To summarise therefore a PCM receiver incorporates true digital modulation which allows the receiver to stop the servos receiving corrupt data for whatever reason. Users do not see servo jitter. If there is a complete loss of radio link for a set time then PCM receivers can automatically go into a preset failsafe mode until the radio link returns. This facility is very much a bonus for users in terms of coping with possible interference or radio failure. The model can be preset into a safer mode such as throttle low to stop fly away.

Recent PPM receivers with DSP decoding

Recent advances by Companies such as Schultz, Berg, FMA have produced receiver designs which although using PPM modulation, have by the addition of a small computer in the decode section of the receiver and using suitable algorithms the ability to clean a noisy PPM signal and again only pass to the servos on any channel the data that it recognises to be valid. This technique is known as a DSP technique (digital signal processing) and provides for PPM the preset failsafe facility.

This new generation of receivers are much less expensive to produce than a PCM receiver because they have less complexity in decoding the modulation and in my opinion a major advantage at being much faster. They are quick to go into failsafe when loss of valid data occurs but they are twice as fast at coming out of failsafe when a good signal returns because of the frame rates discussed earlier.

A further advantage with a number of the receivers using this technique is that they incorporate an Led indicator in their design to acknowledge any received glitches during a flight. This can be very useful to help the user determine the possible sources of glitching.

This may seem a mute point but remember by the very nature of the processing any likely glitching is masked by the last valid frame function of the PCM receiver. You may be happily flying and receiving interference which is not enough to trigger a failsafe condition. Many people say “I have not had any glitches since I used PCM” believing that the receiver is impervious to noise: in fact the last valid frame function is stopping you from experiencing the glitching. I like the LED indication because although the receiver coped with the noise I still know if it received any interference.

<u>Single and Dual Conversion Receivers</u>

Any form of RF receiver whether it be a broadcast radio or otherwise receives the modulated RF, to which it is tuned, at a high frequency and then converts it down to a lower frequency to demodulate and process the signal. There are many technical reasons for doing it this way, which for the purposes of this exercise we need not go into.

This frequency conversion process works fundamentally on the fact that if you mix two frequencies together in a suitable RF mixer circuit then the output of the mixer will consist of many components, which include the sum and difference of the two frequencies. This concept is the process of super heterodyne mixing and all modern receivers are generally superhet types. Usually the difference of the two frequencies is selected by suitable filtering to be processed and demodulated at the much lower frequency known as the IF frequency, which for most R/C radios is at 455Khz.

The first stage of the input to a R/C receiver sees all of the RF picked up by your aerial. The receiver crystal, which you purchase for the channel you want to operate on, sets very accurately the frequency of the mixer to only down convert the signal from your transmitter. The crystal in essence is the device that tunes the receiver to your transmitter.

The above basic process describes a single conversion receiver as there is only 1 mixer being used. This method however can suffer one drawback. We mention that the mixing process produces a number of frequency components which we filter out to pick out the one at 455 kHz the IF frequency.

Since this process produces the sum or difference of two signals it is a fact that you can have two R/C transmitters that are at different frequencies such that they can combine to produce a component at 455 KHz (the difference). This process is likely to happen if the two transmitters are very close to each other and is one of the reasons that the BMFA recommend that pilots flying at the same time on a flight line distance themselves from each other.

Dual conversion receivers are a more sophisticated superhet receiver that employs two mixing processes which again without delving into very technical explanations removes the possibility of the above effect occurring. Because there are two mixing processes there are two IF frequencies, the first mixer is chosen to be at a frequency usually to give a first IF of 10.7Mhz the signal from this stage is then further mixed down to the 2nd IF of 455khz.

Most people flying at a busy indoor event have experienced glitching, try a dual conversion type and this will disappear.

Yes you do need a dual conversion crystal in a dual conversion receiver… why?

The crystal tunes the receiver and sets the frequency of the mixer, since a dual conversion receiver has two stages and the first IF stage is now 10.7 MHz not 455 KHz. Our trusty single conversion crystal will not tune the dual conversion receiver for this reason.