Gas Flow

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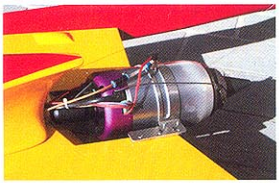
JetCat Kerosene start, Weatronic Receiver and new electronics from RBA

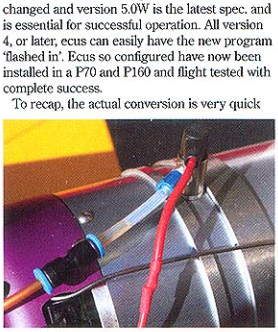


Installing the hardware to covert a JetCat gas turbine to kerosene start operation takes just a few minutes

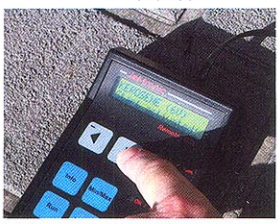
JetCat Kerosene Start

In the last edition Gas Flow we described the conversion of the JetCat engines to start on kerosene rather than the propane system as hitherto used. My own P70 ecu had been upgraded to Kero Start format by Peter Agnew at Intairco some months ago in preparation for receipt of the hardware from JetCat in Germany. Unfortunately, by the time the components were received the software requirements had changed and version 5.0W is the latest spec. and is essential for successful operation. All version 4, or later, ecus can easily have the new program 'flashed in'. Ecus so configured have now been installed in a P70 and P160 and flight tested with complete success.

To recap, the actual conversion is very quick



For the first start to be successful it is essential that both fuel lines are properly primed



The ECU can be toggled between kero and propane start simply by switching on the ECU and holding down the + or - key

and easy to configure. The gas line to the engine is removed and the part is plugged. A 'T' piece is inserted in the fuel line, after the pump but before the main fuel valve. This fuel tapping is routed to the gas valve and the line continued from the valve to the new fuel injector/ignition plug of the engine. The new igniter unit simply screws into the engine after removal of the previous glowplug. The new unit contains a fuel inlet and a ceramic heating plug. The final few centimetres of fuel line is made of Teflon to resist the heat of the plug. The total conversion takes no more than ten minutes. Should the mounting clamp have to be relieved slightly to accommodate the new plug, the hole of which is slightly larger than the glowplug. Once this has been done the engine is ready to start.

To achieve a successful first ignition it is essential that the instructions are carefully followed in order to ensure that both fuel lines are properly primed. This is achieved by use of the GSU. With fuel lines primed, engine start is initiated in the normal way by moving trim up and moving the throttle lever forward. The engine is given a short duration rotation with the starter motor to indicate start activated and power is applied to the ceramic glow plug for the preheat phase. As soon as significant rpm and EGT rise is detected the fuel pump starts, line empties and the start fuel valve (the valve previously used as the gas valve) is opened. Fuel is then drizzled into the plug and the started climbs unassisted to complete the start. The main fuel valve then opens and the pump delivers fuel to the main engine manifold for normal running (as for a propane start).

The most noticeable difference from propane starting is the almost undetectable initial light up, almost silent, reason the 'thump' sometimes experienced with propane. In addition EGT rise is very smooth indeed and hardly overshoots the idle value. Typical start times on the P70 were around 45 seconds and the maximum start EGT was 565 degrees.

Start sequences on both the P70 and P160 were equally smooth and of similar duration and temperature.

The P70 is installed in a BVM BobCat VI, which has Durable Plus batteries for both the radio and ECU. I have been able to get the starts and flights with the ECU battery using jumper ignition, because the Durable charger does not indicate the charge put into the battery it was not possible to measure current consumption at the same start mode. However I measured the unloaded voltage between flights and it did show a slightly greater voltage decline, no doubt due to the power consumption of the ceramic heater. Nonetheless my guess is that the Durable batteries should still be good for about eight flights as after five on the BobCat the battery was still showing a healthy voltage.

Apart from a slightly hesitant first start whilst air cleared from the fuel lines, all of the kerosene starts were completely successful. Plug life of the ceramic heater unit is expected to be comparable – perhaps equal to the twenty-hour maintenance period of the engine. Of course, the engine can be converted back to propane start as the kerosene start ECU upgrade retains the propane start program, and switching is easily achieved by use of the plus or minus keys on the GSU.

The cost of conversion kits and ECU flash updates will vary from country to country.

Weatronic Dual Receiver Description

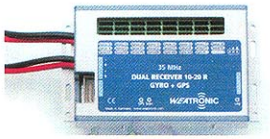
In the last twenty years or so there have been enormous advances in the technology used in radio-controlled systems. We now have computerised transmitters, digital and programmable servos, synthesised transmitters and receivers and, above all, huge improvements in reliability. Something which has changed little is the relatively dated radio frequency, RF, link operating on the HF band at 72, 36 and 35 MHz. Although spread spectrum radios are in use for park flyers, with relatively low range, such radios for general use – particularly for jets – still seem to be some way in the future.

With the aim of greatly enhancing the RF link by using modern technology and components a new German team of electronic communications and information processing specialists, Weatronic Gmbh have announced production of a new Dual Receiver unit. This is, in fact, far more than just a receiver, combining many useful functions into one unit.

The Weatronic Dual Receiver (DR) is produced in four versions. The 8-12 is an 8-channel unit with 12 servo outputs. The 10-20 unit offers 10 channels and 20 servo outputs. It is also available with an integrated gyro system including a GPS receiver.

The heart of all DRs is the dual receiver system common to all units.

Each unit incorporates a state of the art digital



The Weatronic Dual Receiver is probably the most advanced receiver unit ever offered for radio control use. All units feature twin receiver circuitry and voltage stabilization. Other versions include gyro and GPS functions. Size is 110 x 77 x 25 mm, weight is not more than 182 g

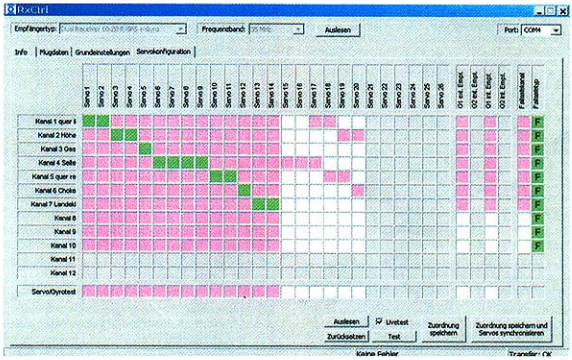
diversity receiver with two entirely separate input circuits each comprising of identically structured superhet receivers each with its own antenna. Obviously, each antenna should have a different orientation as this will have a significant effect on field strength detected by the receiver units. The receiver is capable of tuning, very precisely, to any transmitter in its allocated band. This is tuned either fully automatically (the preferred way) or by selection of the frequency by use of the software. Both receivers operate on the same frequency. A 16-bit CMOS microcontroller selects the best signal, within 1/10,000th of a second and controls the main functions of the receiver unit. Weatronic state that the DR features extreme tuning precision and immunity to interference and a large useable range which is beyond the capability of traditional receiver systems.

The built-in power unit supplies the electrical requirements of the receiver and servos. It has been designed to meet the current peaks of modern digital servos. The power unit regulates the control signals and screens the servo leads thus avoiding the need for ferrite cores allowing the safe use of long servo leads. Integrated in the power unit is a voltage regulator which delivers a stable output of 6 volts for the servos and an optimum voltage for the receiver unit, with a peak current capability of 20 amps. The power unit is fed by two batteries, a main pack and a secondary battery which acts as a standby (unlike the popular Powerbox unit where both batteries work in unison). The unit can use NiCd, or NiMh, 6 cell, 7.2 volt packs or 2 cell Li-Po batteries which deliver 7.4 volts and a low-loss P channel MOSFETs handles switching between packs. The two battery connectors on the unit are high quality Multiplex units well proven to be able to handle high currents and the unit is reverse-polarity protected both for battery and servo leads.

A flash memory is built into the receiver unit and this can use either the internal memory for low rate recording or a plug-in SD/MMC card for longer duration data recording at a higher sample rate. Recorded data includes battery voltage, current consumption, field strengths of radio signals received and antenna selection, the number of valid and failsafe frames as well as service temperature and the positions of all servos. The internal memory can record data for one hour 8 Mb of data is recorded per hour therefore when using a memory card eight hours can be recorded on a 64 Mb card, although use of such a card is not essential to normal operation of the DR. All of this stored data can be viewed on the PC using the Weatronic software which is supplied with the Dual Receiver unit.

On the GPS version the card also records GPS data such as speed, height (or should that be altitude, there is a very important difference), position and distance from start point are all recorded. All flight and operational data can be downloaded to the PC by connecting the unit via a USB cable, but data on the SD/MMC card can be read by means of a card reader in conjunction with the supplied software. Firmware updates can be downloaded from the Weatronic website onto the card and when the card is installed into the DR the receiver firmware is automatically updated.

In addition to GPS two DR versions include a built-in gyro function, and two external gyroscopes can also be used in conjunction with the unit. There are three LEDs on the face of the unit, red, yellow and green. The yellow LED indicates autotune status, the red indicates various memory functions and the green indicates a valid GPS fix. An external control board, connected to the DR by a ribbon cable, doubles as switch unit and USB connector socket. The DR is switched on by the removal of a bridge which activates the internal electronic switch. The board incorporates a high intensity LED that indicates which battery is in use, one flash for the main battery, and a double flash for the standby battery. Should the external control board fail, the DR continues to operate normally, as the power supply is electronically latched on.



In this shot the first 7 channels have had servos allocated and the channel numbers have had plain text added to indicate their function. Further servo allocations are possible to any channel so long as no more than 8 servos are assigned to any one channel

Tuning to Tx

The Weatronic DR can be tuned in two ways. One way is to simply set the frequency in the supplied PC software for download from the PC. The preferred way is to select autotune and this is achieved by placing the radiating transmitter close to the receiver. The DR yellow LED flashes when the unit has located the frequency and it then enters a fine tuning phase when the LED flashes rapidly. When tuning is complete the LED extinguishes. The receiver can be set to decode either Graupner/JR S type 1024 PCM, Futaba 1024 PCM and several forms of PPM, again selectable via PC software. The unit can be supplied configured for use in the 35, 36 or 72 MHz. band.

That really concludes a broad brush description of the RF and power supply aspects of this remarkable instrument but the unit has a lot more capabilities than hitherto seen on any receiver seen to date, particularly in the field of servo configuration so let us take a look at some of what it can do.

Software Set Up Procedure

The DR unit has ten channels on the 10-20 R unit with a capability to drive from between one and twenty servos, and any one channel can handle up to eight servos (so twenty servos would require three channels). Channel/servo allocation is handled via the operating software after connecting the DR to the PC via the USB cord.

The computer requirements are an Intel Pentium running at 200 MHz minimum and at least 32 Mb of free RAM with 5 Mb of free disc space. On the appropriate screen there is a channel servo matrix and by clicking on the field where the channel and servo lines intersect you indicate that servo will be activated by that channel. When that is done, the intersecting box changes to a light green colour. In the channel column each channel is numbered but to this can be added, in plain text, the channel function, e.g Kanal 1 (it is all in German!) can be added, say, 'aileron left'.

Again using appropriate screens of the software the response of an individual servo can be modified to provide a neutral change (same as the JR subtrim), exponential in any form simply by clicking on the screen to alter the response curve, servo reverse, called 'Invertieren servo'. These settings are similar to changes hitherto possible on high end transmitters, but the curves are more variable. Each servo assigned to each channel can be configured individually. One channel can, for example, be set to drive two ailerons where obviously servo movement will need to be reversed assuming similar link-

The adjustment curve of any servo is achieved by clicking on the appropriate point of the submenu screen and almost any shape of response curve can be formed. The transmitter expo/dual rate function should be left as a straight line to prevent illogical results

ages and aileron differential adjusted.

Another major benefit of the DR servo allocation is to form servo groups, particularly useful where several servos are used to drive ONE control surface as on a large model rudder on an IMAC machine. One or two groups can be allocated to any one channel and each group can use up to four servos, the Hauptservo and its secondary servo(s) known as Nebenservo(s). When formed as groups the secondary servos follow exactly the main servo, including response curves, reversing, neutral layer shift and any gyro inputs, and can be automatically synchronised over 16 points. When a servo is designated the master servo its matrix colour remains light green and slave servo boxes become dark green with black lettering. Secondary servos can be inverted or reversed, to cater for servos acting on opposite sides of the control surface – in this case the box video reverses, becoming black with dark green lettering.

Another program in the software allows all servos in one group to be synchronized automatically so that all servos are acting exactly in harmony and this is achieved by clicking on 'Synchronisieren' in the submenu.

The failsafe system is also highly configurable in that it has three settings, F failsafe, H hold and L learn. Each channel can be allocated a failsafe setting by clicking on the appropriate screen. Failsafe activates in Hold for .25 seconds after which servos will drive to their failsafe position. When using a Weatronics receiver the normal transmitter failsafe should be deactivated. Using a spare channel with a three position switch it is possible to set and test the failsafe settings in the air, the L position and after the appropriate control settings have been determined by flight test that spare channel can be deactivated and assigned to other uses.

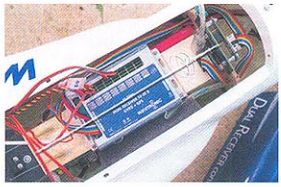
Gyro Function

The 10-20 R +Gyro incorporates a built in gyro which can act on aileron, rudder or elevator depending on the orientation of the DR unit itself. The gyro signal can be assigned to any channel and a separate channel used to control sensitivity. Once this sensitivity has been established the DR can be set to input a constant value for the sensitivity and the gain channel released for other use. Software use also allows correct sense of gyro operation by allowing the user to add or subtract gyro on a sub-menu. In addition the unit has provision to accept a second and third, external, gyro which can be assigned to any function and, again, the unit can supply a value to the gyro gain channels without the need to allocate a channel permanently to that function. For jets that might mean, for example, the internal gyro being assigned to ailerons whilst an external gyro is connected to the rudder and/or nosewheel steering and that is the application intended when the review unit is installed in the Airworld Hawk after a flight test in a Skymaster Hawk.

It would take most of this magazine to fully describe exactly how all of this unit's functions work. The instruction manual is almost 40 pages long but by now the reader should have a fair idea of its capabilities. Let's take a look at the flight data recording function.

Memory Storage

As mentioned before the DR can record operational data on its internal memory or on inserted SD or MMC cards. When recording on internal memory the sample rate of the various parameters is less than when recording to the card. For example GPS frame and battery data is recorded on the SD card at 60 records per minute but at only half that rate on internal memory. Receiving RSSI (relative signal strength indication) and antennae data is recorded internally at 60 times per minute and 600 on the card, overall current being sampled 6000 times per minute but at only 600 internally. Nonetheless, this is more than sufficient for model applications! The supplied software package of RxCtrl1.0, NavView 1.0 and Nav2CSV uses two formats for storing and processing the flight data. Nav files contain the complete and compressed flight data and CSV files are text files which complete flight data in the form of a table which can be read by software such as Microsoft Excel.



Two versions of the DR feature an internal gyro system and up to two external gyros and gain controls, can be connected if desired. The orientation of the DR will decide in which axis the gyro function will operate but it can be assigned to elevator, aileron or rudder. In this picture the gyro will act in the roll axis and is therefore being used on the roll channels

The stored data can be viewed and evaluated on the PC screen in two formats, 2-D or 3-D. The 2-D format shows the data in both lines of data and in graphical form as one might expect when merely showing a value against time. When using the GPS system the flight can be displayed in 3-D form with 10 format options. These include GPS position to show the actual flight path, as a straight line and in a spiral representation where the straight line is 'wound up' to form a circle, each circle forming 5 minutes of flight time. One function even allows the view of the flight path to be rotated around the 'X', ground level axis, and 'zoom' allows the distance between the camera and the selected point to be adjusted.

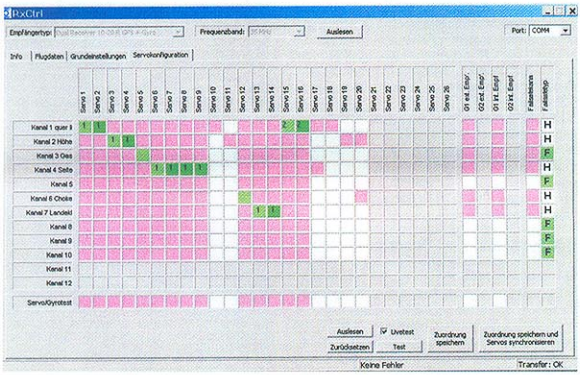
This is an incredibly sophisticated and complex unit. In my view, it offers a huge step forward in safety and control integrity. This is not least due to the ability to analyse exactly how a model's radio system is performing in the air, thus allowing adjustments to internal electronics such as ECUs and the meaningful evaluation of the effect of those changes. The cost of these units is quite reasonable too as, for the price, one gets two receivers, a power supply unit, and on some models a gyro and GPS system.

I would personally like to see a DSC (direct servo control) facility and the eventual development of the unit into a dual frequency unit (although that, of course, would need a major change to the transmitter). Thomas Gleissner, the World Jet Champion, has been demonstrating the Dual Receiver to great success in an Airworld L39. The review unit will be flight tested in a Skymaster Hawk and when that is done this magazine will bring you more details of what looks to be a superb unit, which may well, in the near future, become standard fit in large jets. Certainly if the unit delivers what it promises, this type of receiver unit will be fitted into all of my large jets including the two Airworld Hawks now under construction and my twin JetCat 160-powered Mig 29.

In the meantime further details can be found on the Weatronic website

Technical Data, Weatronic Dual Receiver:

DDS dual superhet synthesizer with automatic frequency finding
Operating voltage: 6-9 volts
Current consumption 250 mAh
Channel grid 10 KHz, finding grid 500 Hz
Sensitivity 1.9mV/-104dBm
Programmable failsafe
USB connection
Data memory, internal flash + SD/MMC card
Dimensions: 110 x 77 x 25 mm
Weight 170-182 g dependent on version
Temperature range 0 to 60°C



Each channel can be assigned a failsafe function either to Hold (H) or a dedicated failsafe position (F) as indicated in the last box on this screen shot