REVIEW

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Graupner/SJ's FBL System

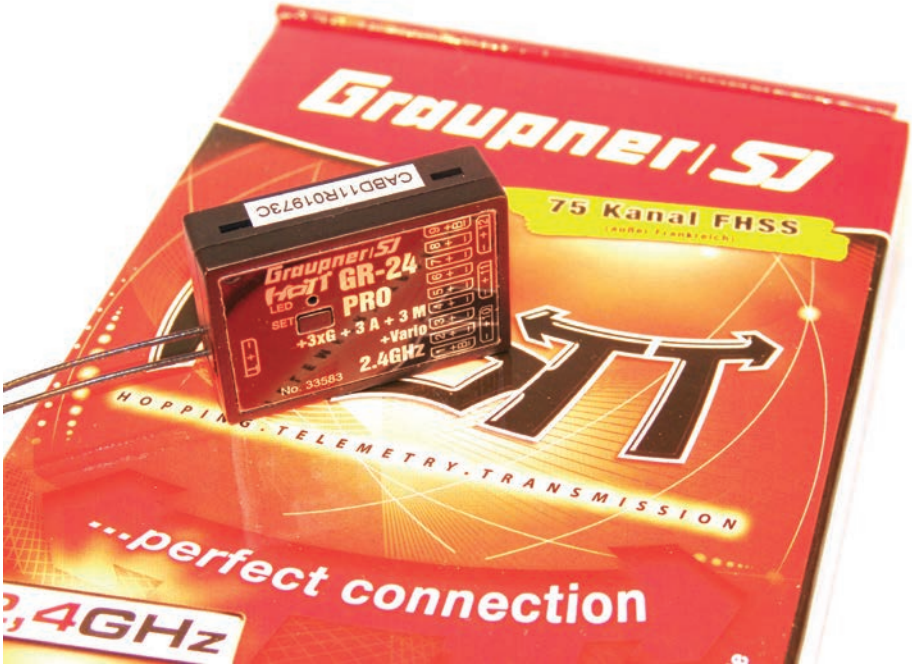
MORE TOTAL INTEGRATION: THE ALL-NEW GRAUPNER HOTT FLYBARLESS SYSTEM

At the ROTOR Live 2014 fair in Germany, Graupner launched their HoTT flybarless system for model helicopters by demonstrating it on the flight line and it created lots of interest. Of particular interest is its total integration into existing 2.4 GHz HoTT gyro receivers by simply doing a free of charge software update. It also offers the ability to perform model setup and parameter adjustments wirelessly and very comfortably via the radio, which has to be regarded as a groundbreaking feature in the industry. We checked out further details and want to show how the Graupner SAS works in practice.

First of all we should point out that the Graupner R&D team in Germany did all the programming of the FBL system. Experienced helicopter pilots from the European and Asian scene supported them by extensive flight tests and improving internal control algorithms. The hardware is manufactured, like most electronic devices coming from Graupner/SJ, at their headquarters located at South Korea.

The Graupner flybarless system is based on 2.4 GHz HoTT receivers (usable for pattern and helicopter applications), that are equipped with 3-axis gyro sensors right from the factory. These receivers are the GR-24 Pro 12-channel (3xG+3A+3M+Vario) and the new, 9-channel GR-18 (3xG+3A+3M+Vario). I will mainly focus on the GR-24 Pro receiver, because it is a perfect choice up to 700/800 size machines, but small enough to fit 450 size helicopters.

According to information from Graupner/SJ it is not finally decided whether to bring out the metal cased GR-18 '3D', shown at the Nürnberg Toy Fair. Nevertheless the plastic housing is totally up to the job and saves weight. The helicopter flybarless software can be downloaded very easily from their homepage and transferred to the gyro-equipped receiver via the update manager PC program (as used with other Graupner



The GR-24 Pro is a 2.4 GHz HoTT receiver and SAS in a single housing. It comes factory equipped with 3-axis gyro, 3-axis accelerometer and variometer, which opens the door for future interesting options

HoTT devices). When buying a new HoTT gyro receiver, pattern and helicopter applications are implemented and ready to run out of the box. Updating an existing device takes a few seconds and existing adjustments will not be overwritten.

A particular highlight is that the whole communication and adjustment of the SAS software is via the Tx telemetry menu, in my case a mx-20, or mz-24 HoTT. Thanks to bidirectional data transfer, there is no need for a separate user interface, smart phone or even push buttons on the unit itself. The transmitter is present anyway and acts as a wireless data terminal with an easily read display. All FBL related model data and adjustments are stored in the receiver itself.

One of the most important demands of the Graupner developers was making the initial setup of a new model as easy as possible without losing flight performance later on. For this the Graupner flybarless software is divided in two layers, the 'Base Setup' and 'Expert Mode'.

When doing the initial setup of a new model helicopter, the first step is to switch the bound HoTT receiver to 'Heli' mode. Having done this, the flybarless software is active and ready for adjustments. As with all other inputs, this is done by using the Tx telemetry, going through Base Setup menu first. The menu structure itself is built like a book, which can be thumbed through forwards or backwards from page 1 to 4, by pressing the transmitter buttons.

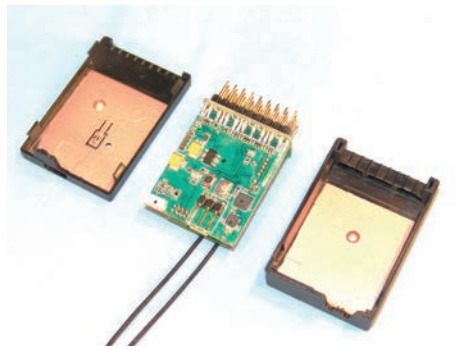
On each of these theme specific 'pages', related sub points are listed. Electronic swashplate mixing is performed inside the receiver/flybarless system itself, so the Tx has to be set to 1 servo swashplate (no mixing). All servos need to be plugged into the receiver in a given order, as shown in the manual.

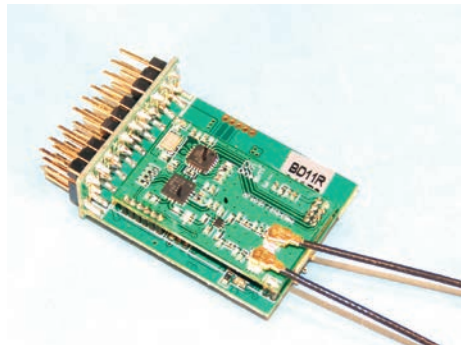
All basic steps that have to be done first are listed on the last two pages of the Base Setup menu! This makes some sense (?) because these points are only necessary once for a given model, so control loop related parameter settings can be reached very quickly on the first pages without going a long way round (*).

After selecting the swashplate type (90°, 120°, 135° or 140°) and rotational direction (initiates the correct pitch => rudder/cyclic => rudder feed forward direction and pirouette compensation), the next point is to set the servo travels. By collecting all three (or four) servos together in a group, you can go through all the possible norm/rev combinations by simply clicking one button – thus avoiding the irritating trial and error of setting the servo direction individually.

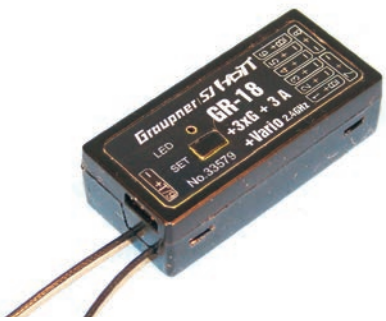
Having obtained the same directions for collective, you check the correct collective, cyclic and rudder effective stick directions by using the Tx servo reverse menu. Tx sub trims remain untouched as the flybarless system zeros all stick functions (=> yaw rate defaults) during every boot up sequence. Gyro 'Axis Assignment' is an easy job… Using the gimbal sticks, we select roll, elevator and rudder in sequence and when tilting the helicopter towards the correspondent

The GR-24 Pro serves 12 servos and external telemetry sensors can be plugged in

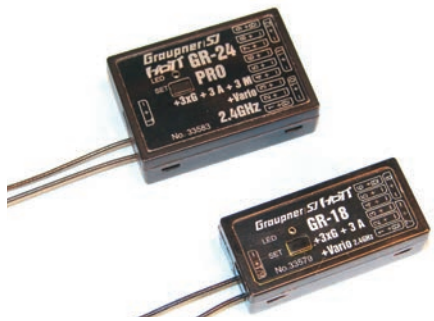




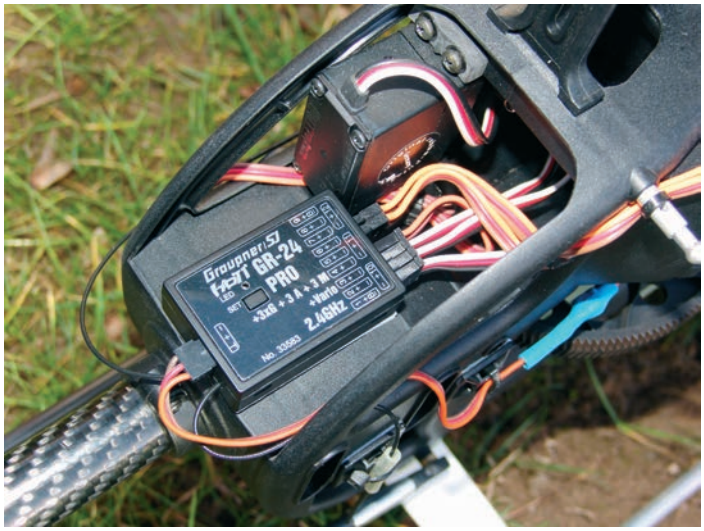
On top we have the UHF PCB (giving 2.4 GHz antenna diversity), lower PCB with servo signal processing and sensor arrangement. Plastic housing is internally 'metalized' for shielding reasons



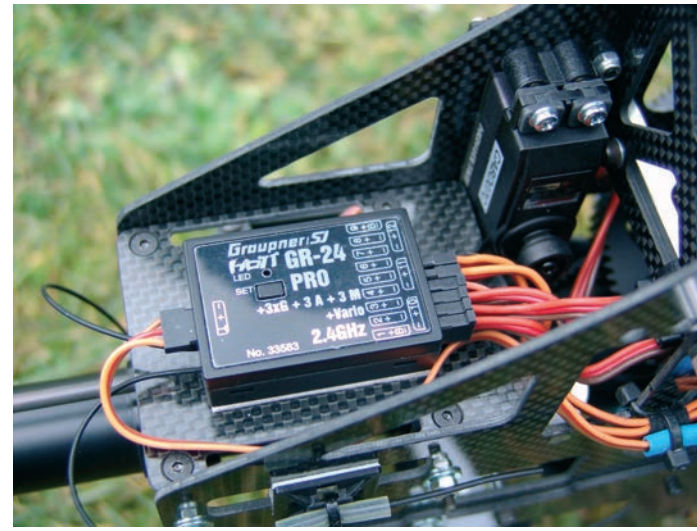
The brand new 9 servo GR-18 gyro receiver with integrated SAS serves 8 channels at the front and 1 at the rear, which can alternatively be used for external telemetry devices



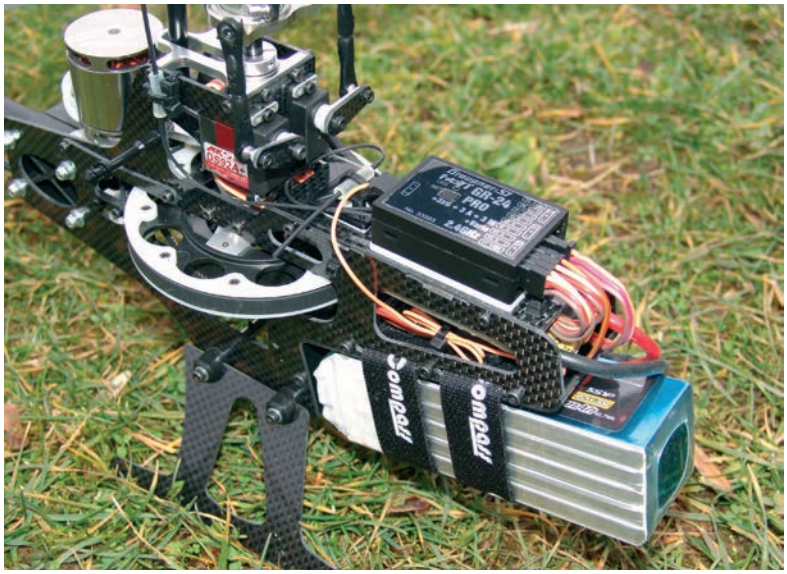
GR-24 Pro (12 channels) and GR-18 (9 channels) include SAS for model helicopters together with the proven 2.4 GHz HoTT protocol



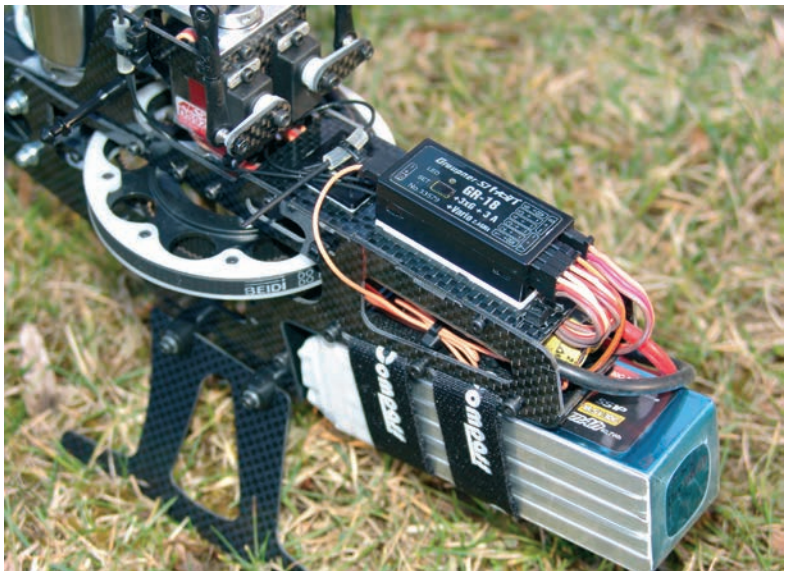
The Graupner receiver/SAS unit sitting in the back of my trusty Mikado LOGO 500SE



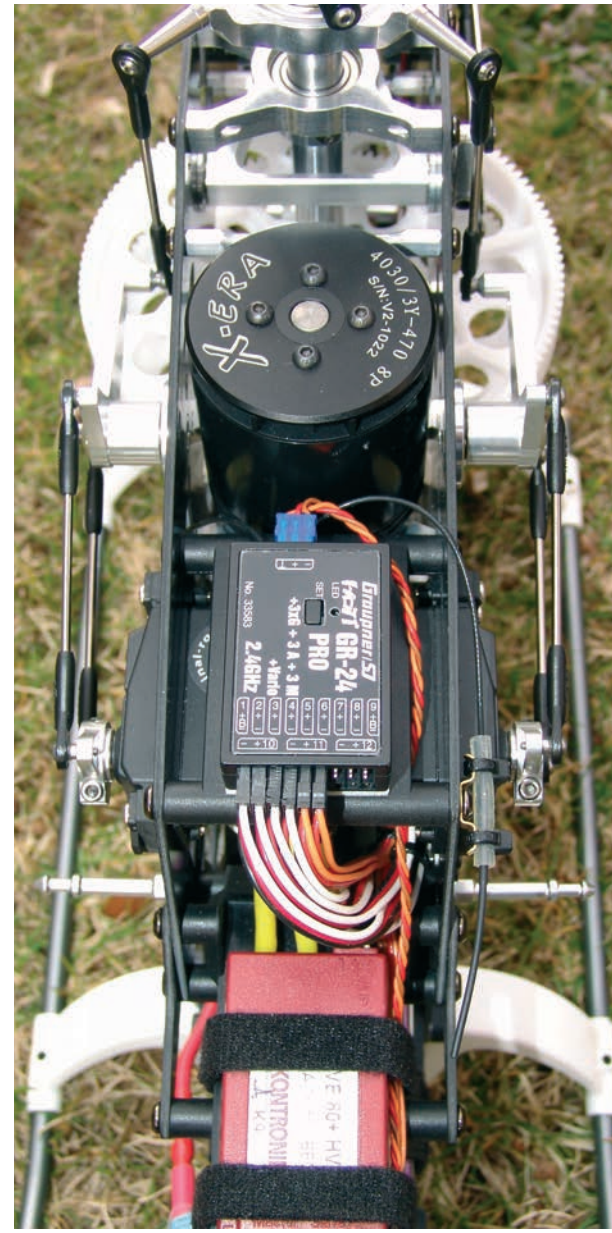
The GR-24 Pro unit performs excellently in a big 700 - my Compass 7HV Ultimate was one of the test bench during lots of flights



A GR-24 Pro is compact enough even in a small and light helicopter like the WARP 360 – it gave impressive flight performance using the factory settings!



The GR-18 is first choice for small helicopters like the WARP 360

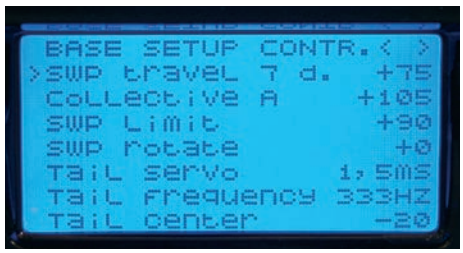


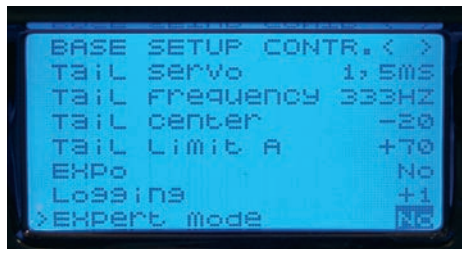
The Raptor E700's chassis provides too much space for the GR-24 Pro

When opening the telemetry menu of a Graupner transmitter you have access to the receiver/SAS units, after switching to 'Heli' you are in the 'Base Setup...'

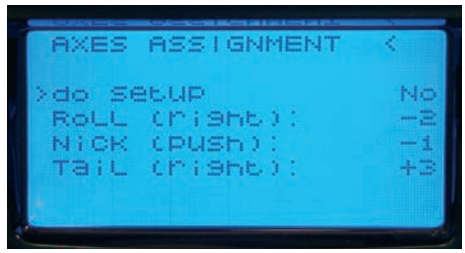
...with 'Swashplate Adjust' (SWP Gyro Sensitivity and Direct Stick)...

...and 'Tail Adjust' (Tail Gyro Sensitivity)





'Base Setup Control' scrolls through the initial model parameters



Gyro Axes Assignment is a single step – the last page

direction, the system stores the necessary gyro reaction, confirms it, and it's done.

The rest of initial setup is a familiar routine. For older analogue and modern digital servos, we are able to adjust the refresh rate for swashplate and tail rotor. It is possible to run standard rudder servos with 1.5 ms or special, narrow pulse gyro types of 960 and 750µs. In order to get a perfectly horizontal alignment of the swashplate and zero collective pitch of the main blades, the system switches off the control loops after selecting 'SWP S1/2/3 centre'.

Now we can perform the necessary fine adjustment very comfortably by using fingertips on the Tx touch pad. The same is true for the rudder servo centre offset. A pitch gauge is a big help while adjusting the necessary swashplate servo travel in the menu to achieve the required 7° cyclic pitch. After this we limit the maximum possible swashplate tilt angle without binding and fix max. and min. collective range. The same is done with the left/right throw limits and rudder servo/tail pitch slider.

'Swashplate Rotate' is only needed for multi blade rotors that need a virtual offset. System internal 'Expo' should be left 'YES' as per the factory default. This gives 25% on roll/ele, and 30% on tail in order to smooth the response around centre a little bit for the first flights. If you want to run your own Expo in the Tx, you simply select system internal Expo 'NO' and choose flight mode dependent values. Cyclic and rudder yaw rates are adjusted by using the transmitter servo travel volumes in general. As these values can be switched using the flight mode, it is not necessary to run bank switching in the SAS itself.

During dozens of test flights with different size and weight helicopters, 80% travel volume/0% Expo on swashplate and 70% travel volume/30% Expo on rudder, was found to be good overall values for response and smoothness. The only control loop parameter adjustments that are necessary in the Base Setup menu are optimising cyclic and rudder gyro sensitivities during flight.

If you want to run a crisper cyclic response, you increase 'Direct Stick' input – it could not be simpler. Running the factory default settings and only using the Base Setup menu, will give very good results for most helicopters. If you want to make the gyro sensitivity head speed dependent, you can set an aux Tx input function for this particular axis and change its value via the flight mode switch.

Expert Mode

As mentioned, 'Expert Mode' will probably be needed in a few cases. When switched to 'YES', the previously near empty Base Setup menu pages for swashplate and tail rotor will be filled with many more adjustment options. Now you have direct access to internal SAS control loop parameters (for example P: proportional, I: integral, D: differential), each of which can be adjusted and will change the flight characteristics – as described in the typically extensive Graupner user manual.

For us one interesting point might be the 'Speedflight' optimisation. By changing this value you damp the tendency of some helicopters (or better said: its particular rotor head/rubber damper/blade stiffness combination) to track any wavelike characteristics during high-speed runs. 'Hovering Stability' comes factory preset to 'Normal'. High or Low makes the helicopter more stable for beginners or more aggressive for 3D maniacs. In case you want to improve holding power of your tail during brutal collective inputs, you can adjust 'Torque' (collective and cyclic feed forward value) on this page.

A meaningful feature is the system implemented logging function. With this, internal parameters of the flybarless system are continuously written to the Tx SD card via the downlink. This data can be a helpful in the case of problems and can be analysed by the Graupner service team.

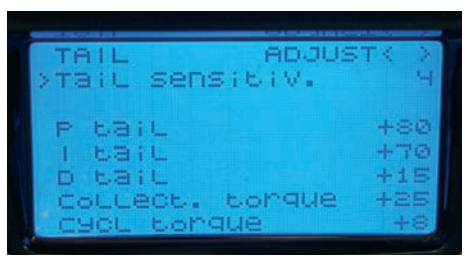
In Flight

Now the most important question is: how does the Graupner flybarless system perform during flight? To find this out, I converted several helicopters in my fleet to the new system and checked out their characteristics during lots of test flights. **Result**: all of them were very easy and exceptional quick to setup – thanks to the Tx based, wireless adjustment procedure.

In all cases after having done the compulsory gyro gain optimisation during the initial flight, the Base Setup menu was more than adequate to get a very well performing model. It seems that the factory default settings were very accurately matched.

When switching to 'Expert Mode...'

...swashplate and tail rotor menus become live with addition control loop parameter adjustments



Even hard, sudden bursts of full negative pitch during high-speed manoeuvres every time gave a neutral dive, without any tendency for undercuts. While mounted in my little Compass WARP 360, the internal Expo on swash and rudder gave an instant comfortable and relaxed flight feel without further adjustment of the parameters.

'Cooperation' with the ESC governor mode (often a problem with small models with a low rotor mass and short tail booms) worked well without tail wagging or slow periodic oscillation (a previous mounted SAS needed some control loop fine-tuning).

With the big Compass 7HV Ultimate running on 12S LiPo, after initial flights the internal Expo was switched to 'NO' and all expo settings were done in the Tx in order to get a very crisp and direct main rotor, but a smooth tail around centre. For the rudder I am using the very reasonably priced, but lightning quick Graupner/SJ HBS 770BB MG servo (high voltage, brushless motor) which does an excellent job.

We already discussed the values for servo travel volumes (=> yaw rate) and Expo in the transmitter, which were also confirmed in the Raptor E700. A total no-brainer was my GR-24 Pro equipped Mikado LOGO 500SE. Right from the very first lift off this model gave a feeling of stick confidence seldom felt before when flying it.

The GR-24 Pro pirouette compensation feature seems to be a system favourite. The ability to very quickly change parameters via telemetry, if wanted just for a short try, is a really great bonus – when/if anyone experiences this you will not want to do without it!

Conclusion

From my point of view, Graupner has done a very good job with their HoTT GR-24 Pro and GR-18 gyro receiver integrated flybarless system. The wireless easy initial set up via the transmitter together with excellent flight performance will ensure it becomes a serious market contender. When taking into account the other matching Graupner/SJ products such as the ESC (with integrated telemetry) and external HoTT sensors, we have to think about a cleverly thought out complete radio control system.

(*) Hint: when holding the ESC button on a mx-20 HoTT Tx for a longer time, you will directly enter the telemetry menu. With this little trick you get direct, lightning quick access to the SAS parameters. ***MHW***

Provides confidence in the 7HV

Works well in the Raptor E700

Good in the WARP 360 too!

Dislike

No FBL version GR-12 (3G+3A+Vario) receiver available

Likes

Totally integrated SAS/HoTT gyro receivers
Wireless adjustments via Tx
High performance flight characteristics
Low priced

Spec

PRODUCT	**GR-24 Pro (3xG+3A+3M+Vario)**
SERVO CHANNELS	12
TRANSMISSION	2.4 GHz HoTT (FHSS)
OPERATING VOLTAGE	3.6 – 8.4 V
DIMENSIONS	46 x 31 x 14 mm
Internal 3-axis gyro, 3-axis accelerometer, variometer	
Aux. External sensors possible	
UPDATE	via Internet
WEIGHT	18 g
ORDER NO.	33583
EURO RETAIL PRICE	€199.95

PRODUCT	**GR-18 (3xG+3A+Vario)**
SERVO CHANNELS	9
TRANSMISSION	2.4 GHz HoTT (FHSS)
OPERATING VOLTAGE	3.6 – 8.4 V
DIMENSIONS	46 x 21 x 14 mm
Internal 3-axis gyro, 3-axis accelerometer, variometer	
Aux. External sensors (instead of channel 9 servo outlet selectable)	
UPDATE	via Internet
WEIGHT	14 g
ORDER NO.	33579

Graupner/SJ products are distributed in the UK by Logic RC, Tel: 01992 558226, Email: mail@LogicRC.com
For further information, please visit their website at www.LogicRC.com
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P-33583 GR-24 PRO 3xG+3A+3M+Vario HoTT 12ch receiver £169.99