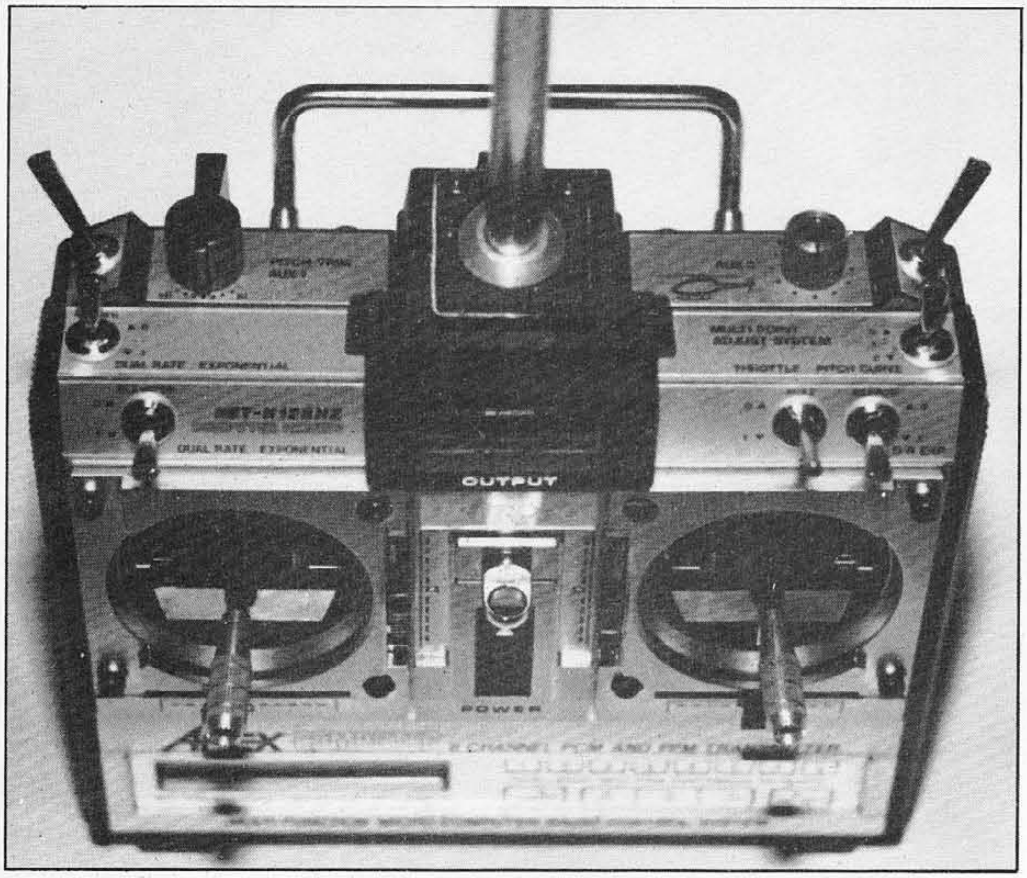


J.R. APEX COMPUTER INVESTIGATED

Dave Day digs into the inner secrets of JR's top range computer radio.

The JR 'Apex Computer' has now been available for some two years and has been seen in several different versions. This being a helicopter magazine, we will concern ourselves only with the helicopter versions. Originally, the main variations here were for the USA (with an invert switch) and the UK (with three pitch curves). A new version of the UK type has recently become available which is designed for those helicopters which utilise some form of swashplate mixing, known more fully as Cyclic/Collective Pitch Mixing, or CCPM.

Let's concentrate on this later version and detail the differences for other versions as we go along. Before you ask, it is not possible to have both CCPM and an invert switch in the same set due to the fact that there is simply not enough memory space available in the circuitry to accommodate them. For that you will have to wait for the PCM 10! Indeed the CCPM options take up so much memory that some minor functions of the original set have been lost in order to make room for them.

Until the Apex Computer appeared, the top-of-the-range JR set was the PCM 9 which was festooned with switches, knobs and numerous interior adjustments. While it was in many ways an excellent outfit, it could only perform a small fraction of the functions of the seemingly much simpler Apex. This difference is even more marked when you consider that the computer set can store all of the necessary settings for seven different models.

Top, overall view of Transmitter.

Right, auxiliary 0, 2 and 3.

Transmitter Controls

The transmitter is an eight channel unit so, in addition to the usual pair of dual axis sticks, we have two knobs and two switches which operate two proportional channels and two switched channels. Let's go through these in order:

Auxiliary 0 is a switched channel operated by a switch on the right of the top panel. It is intended for retracting undercarriage operation and the switch has a long toggle.

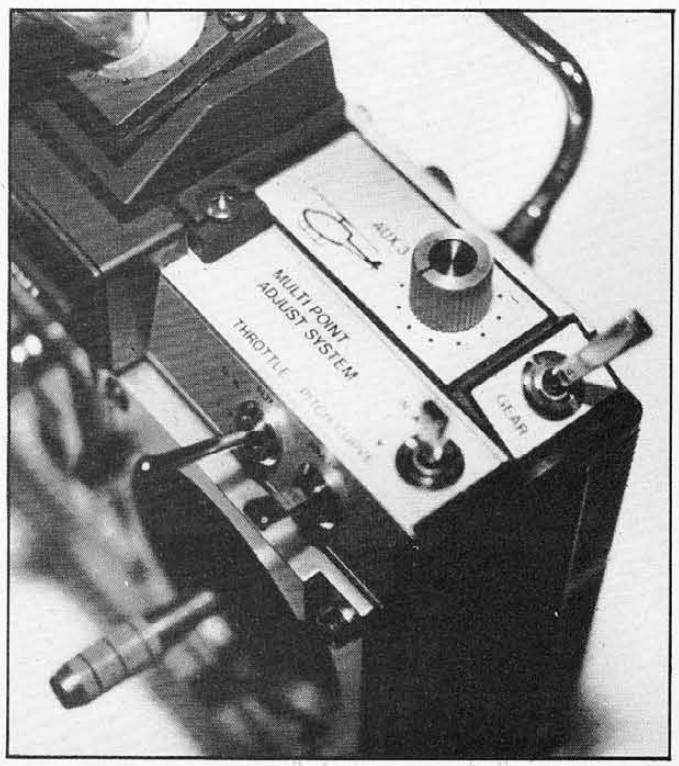
Auxiliary 1 is a proportional channel operated by a knob on the left of the top panel. When the set is in the 'Heli' mode this channel is the pitch channel and is operated primarily by the throttle stick. This knob is then the pitch trim control, of which more anon.

Auxiliary 2 is a switched channel operated by a long toggled switch on the top right of the front panel.

Auxiliary 3 is a proportional channel controlled by a knob on the right of the top panel.

The twin sticks are fitted with trim levers which incorporate a device which allows you to obtain additional trim movement if necessary.

There are five more switches. Three of these are rate switches for aileron, elevator and rudder controls, while the remaining two are a three position throttle/pitch curve selector and the throttle hold switch.



In terms of direct controls, that is the lot and represents far fewer than are to be found on the original 'Apex FM' transmitter. All the remaining features except that noted below will be familiar to anyone who has used the old FM set. Case, on/off switch, pilot LED, universal jointed aerial, aerial stowage, RF meter, RF module, charge and DSC sockets, etc. are all identical. However the cover over the original servo reversing switches is no longer removable and serves no purpose.

The difference on the computer set is to be found at the bottom of the front panel in the form of a 16 character LCD and 13 touch sensitive keys. This allows all of the additional functions to be programmed into the memory.

The Keyboard And Display

When you switch on, the pilot LED will light to indicate that you have power and the display will say something like '10.3 V MODEL 1'. This indicates that the battery voltage is 10.3 volts and the transmitter is set to control model number one. Very logical really.

There are now two ways to access the various functions:

If you press the 'ENTER' key, the display will change to 'FUNCTION 06'. You can then enter the number of the function you require and press 'ENTER' agian, which will then give you the required function.

Alternatively, you can press the 'CLR' key and the display will say 'DIRECT MODE'. You can then use the 'INC' and 'DEC' keys to step through each of the functions in turn. For safety reasons, however, this does not give access to the reset mode.

This gives you the following functions:

No	Function	Default Pos
11	Reverse Switchs	Normal
12	Travel adjust	42 to 213
13	Dual rate	100%
14	Exponential	Linear
15	Sub trim	0
16	Hold switch pos	42 & inhibit
18	Throttle curve	Linear
21	Swashplate/ Throttle mix	0%
23	Input reverse switch	Normal
28	Reset all values to default setting	
31	Elevator D/R switch	Separate
32	elevator/Aileron mix	0%
41	Rudder/Throttle mix	0%
47	Revo gain	0%
48	Acc gain	0%
55	Mode select	Heli
56	Model select	As prev set
58	Swashplate type	1 servo
68	Pitch curve	Linear
75	Servo test 1	
76	Servo test 2	
77	Fail safe memory	Hold
85	PCM/PPM	PCM
86	Stopwatch	0.00
87	Alarm timer	0.00
88	Integrating timer	As prev set

Function 15 allows the centre of each channel to be offset by up to 50% of the maximum throw.

Function 21 allows an adjustable increase in power to compensate for loss of lift due to cyclic input.

Function 23 is used when the CCP, options is in use and reverses all of the servos associated with a particular cyclic input.

Function 28 resets all values to the default setting. This is not available from the direct mode and must be accessed by entering 'FUNCTION 28'.

Function 31 sets the elevator D/R rate switch to separate operation or commons it with the aileron D/R switch.

Function 32 allows an adjustable amount of aileron input (in either direction) when an elevator input is applied. This can be used to offset any undesirable effects caused by phaselag in the swashplate system.

Function 41 allows for the throttle setting to be adjusted for changes in the tail rotor load. The direction for this is set by the ATS setting. If the ATS is not in use it must still be set for the correct direction.

Function 58 decides which of the five different swashplate systems is to be used, as follows:

1 servo. No mixing. One servo for each terminal.

2 servos. 2 servos mixed for aileron/collective. No elevator mixing. Standard *Heim* system.

3 servos (2 roll). 3 servos spaced at 120°. All 3 moving for collective pitch. 2 servos for roll and one for elevator.

3 servos (2 Nick). 3 servos spaced at 120°. All 3 moving for collective pitch. 2 servos for elevator and one for roll. 'Nick' is German for elevator.

4 servos. 4 servos spaced at 90°. All 4 moving for collective pitch. 2 lateral servos move in opposition for roll and 2 fore/aft servos move in opposition for elevator.

Note that the 3 servo systems are designed for use with inputs spaced at 120° and that the descriptions above are simplified for convenience. In fact all three servos will move for any cyclic input.

Function 75 moves all servos slowly from end to end over their full throw.

Function 76 moves each servo in turn from centre to full throw, then to full opposite throw and then back to the centre.

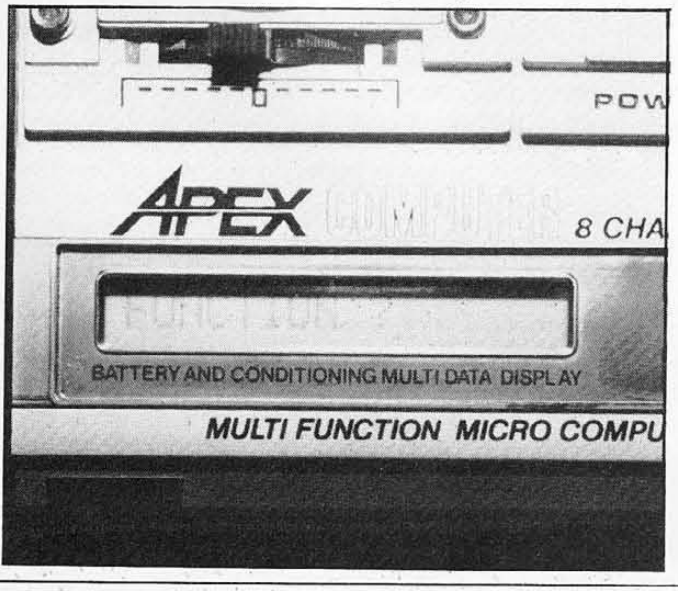
All of these functions must be individually set *for each model* or they will assumed the default setting.

Throttle/Pitch Options

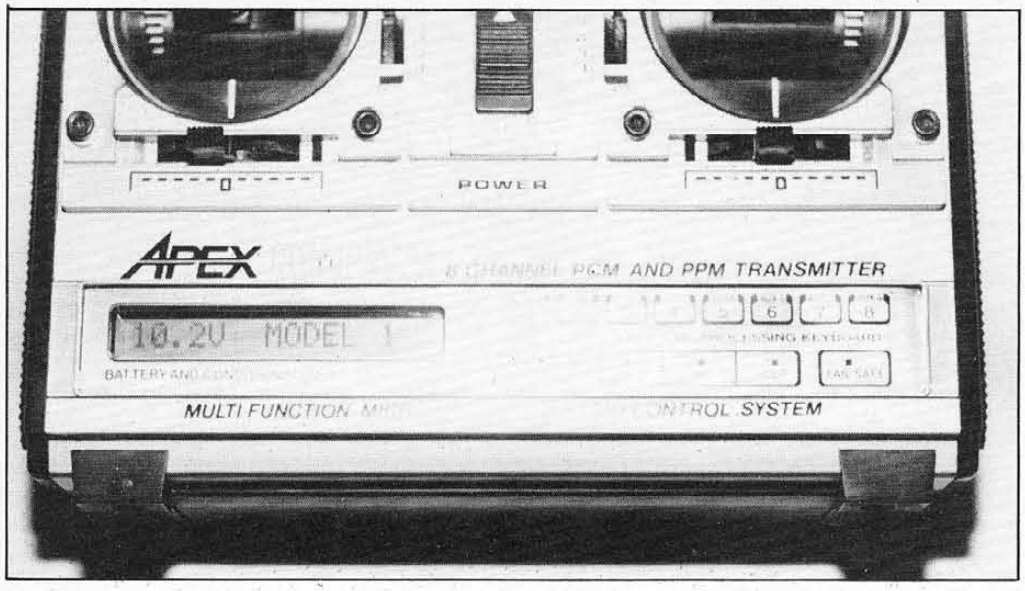
As with any specialised helicopter radio, the heart of the system lies in the various configurations of throttle and collective pitch which can be selected. In this case there are four different throttle/pitch combinations available via the throttle hold switch (H) and the three position throttle/curve selector switch (N, 1 or 2).

On both the throttle and the pitch channel, both end points can be set and also four intermediate positions. These do not necessarily have to be in a progressive order — in other words you can have an 'S' shaped curve if you need it. It also means that you can stop moving the throttle while there is more pitch travel left, or vice versa. The throttle hold 'freezes' the throttle at a present point and still allows full

The 16 character LCD Display.



There are 13 touch sensitive keys.



Neat and easy to use keyboard and display.

pitch control. The virtues of this arrangement take some time to sink in — but they are considerable.

It is not necessary, as with so many other sets, to make compromises to one pitch range to suit the requirements of another — each is *totally* separate. Each time you hit the throttle hold switch you will get the right pitch curve for autorotation, regardless of any other adjustments you may have made. Until you have tried it you have no idea just how reassuring that can be!

You can play around with all of this while the model is on the ground with the engine running too. When you enter the pitch curve or throttle adjustment functions you will find the display reading 'THRO DATA HOLD?'. If you then press 'ENTER' you will get normal throttle operation. If, however, you press either the 'INC' or 'DEC' buttons, the throttle is frozen in the last position while adjustments are made. Pressing the 'ENTER' you will get normal throttle operation. If, however, you press either the 'INC' or 'DEC' buttons, the throttle is frozen in the last position while adjustments are made. Pressing the 'ENTER' button restores normal operation. If this is done with the throttle stick in the high position, you will be invited to close the throttle before normal operation can be resumed. A nice touch that.

By means of the above it is possible to set up the '1' and '2' positions of the throttle/pitch curve selector switch to give two different idle up settings with appropriate pitch curves. This can be used to suit the differing requirements of hovering and aerobatic manoeuvres. If more drastic changes are required, it is possible to use more than one model number for a given model, so the possibilities are endless.

All three positions of the pitch curve selector switch give separate setting for the ATS system which allows this to be automatically switched out in some positions if required. An interesting novelty here is that the '2' position gives an ATS setting which moves the same way for both 'up' and 'down' compensation. This just might be a legacy of the fact that this position is used as an inverted switch on the American version, or did someone request it for aerobatics? Incidentally, pre-CCPM models have only *one* ATS setting for all three pitch curves, which is nowhere near as useful.

The 'Pitch trim' lever is an oddity that appears to be left over from the original 'Apex FM'. It moves the whole pitch range up and down, including the end points. With the adjustment potential of this set, this is definitely bad news — particularly since it is easily disturbed. Here the pre-CCMP sets are at an advantage since they can set the range of this control by setting the throw for Auxiliary 1 to 0%. This is a casualty of the restricted memory available when CCPM is added.

All channels have a trim facility via FUNCTION 15 — Sub Trim. This allows you to offset the throw in exactly the same way that the stick trims do. In fact they duplicate the effect of the stick trims which may seem at first to be rather pointless, but it is very useful when changing from one model to another. It also duplicates that pitch trim — which makes *that* even more pointless!

Setting Up A Model

It is possible to go on for ever about the features of this system so let's see just how you would go about setting up a given model, which should make things a little clearer.

Switch on and use FUNCTION 56 to select a model number, say Model 1.

Use FUNCTION 11 to set each servo to operate in the correct direction. Select each channel in turn and use the 'INC' or 'DEC' button to set 'NORM' or 'REV'.

If any of the servos is driving a linkage too far, use FUNCTION 12 to tailor the end point to suit. This will not work with the throttle.

Use FUNCTION 18 to set up the throttle end point *in all three pitch curve positions* so that the servo is not stalling at the top end. Set the bottom end by guess for the moment.

Use FUNCTION 13 to adjust the dual rates so that the normal (100%) setting is at the end of the switch which you prefer (can be either end) and set the low rate to, say 60%, for the moment.

If you like exponential travel and have an idea just how you like it to be set, use FUNCTION 14 to set this.

Use FUNCTION 47 to set the 'REVO GAIN' to, say 50% up and down. Remembering to set it on all three pitch curves or as you like it. Note that when you operate the 'Throttle hold' switch, the ATS setting will stay at the value demanded by the position of the pitch curve switch. This can be useful if you can program your brain accordingly! Remember to set the direction to suit your main rotor direction.

FUNCTION 55 should be set to 'heli' anyway, but check it.

Use FUNCTION 58 to set your swashplate type. We will assume '1 Servo' (no mixing) for the moment.

With the aid of a pitch gauge, use FUNCTION 68 to set up your pitch curve to the manufacturers recommended values. It would be a miracle if these were right, but they make a good starting point. Remember that you have four curves to set. If in doubt, make them all the same for now. American versions exchange the pitch curve '2' position for an invert switch, which would appear to be a far from convenient way of doing things and liable to error.

The system of using numbers to indicate the pitch and throttle travel takes a little getting used to, but remember that the normal travel is from 42 to 213, with 127 as the centre point.

Use FUNCTION 85 to set PPM or PCM to suit your receiver. Your old *JR* FM receiver can be used without any problems — provided you use *geniune* JR crystals — but I don't recommend trying it with other types.

Now, before we go any further let's point out that the *absolute maximum* throw is 150% or normal. You can set the travel (ATV) to 150% and the rates to 125%. BUT, you cannot have both *at the same time*. If you set the rate to 125% then you can only set the ATV to 120% (1.25 x 1.2 = 1.5 — OK?).

Unfortunately, it's not that simple (?) since, if you do set both to a maximum, you will get the increased rate over the first part of the stick throw. However, the servo will run out of throw before the stick does and the last part of the stick movement *will not move the servo*. Yes, it's confusing, but there is nothing wrong. You are just asking for more than it can give.

It should also be remembered that, if you have used up all of the 150% throw on any function and *then* attempt to add the sub trim facility, you

will run out of throw and introduce an asymmetrical response. throws within throws!

Having got that out of the way, we are ready to set up a CCPM system. First of all, do remember that we are going to mix two, or more, inputs into one servo. This means that the servo will be driven beyond its normal movement. In any set-up this will give rise to non-linearity. Where two servos are sharing a given duty it can produce very strange effects.

Most mixing systems take care of the problem by halving the servo movement. The 'Apex Computer' goes one better — it lets you decide just how much reduction you can take.

So, let's assume that we are going to fit the system into a *Heim* type model, where two servos are used to provide both collective and lateral cyclic control by mixing these two channels.

Use FUNCTION 58 to set to 'SWASH 2 Servo' and plug one servo into the aileron plug on the receiver and the other into pitch (Aux 1). If you now try to operate the system you will find that the servos travel through almost 180° and that this gives lots of interaction. Now use FUNCTION 12 to set both the Aileron and Aux 1 channels to give 50% throw *in each direction*. You should now be able to obtain satisfactory operation.

If you are now unable to obtain sufficient throw on either channel, you can experiment to see if you can obtain satisfactory operation with more than 50% throw. Remember that any increase must be the same for both directions of each channel to avoid non-linearity. If this does not work then you must use longer servo arms. The same basic principal applies to three and four servo systems.

You can now go out and fly the model and make any necessary adjustments by trial and error. If you want to try drastic changes, try allocating another model number to those settings so that you can return to the original for comparison.

As the heart of this system lies in the transmitter, we have concentrated entirely on that. Airborne systems are, in any case, common with other *JR* systems.

Oh yes, the system also has a failsafe (PCM only), a stopwatch, a countdown alarm and a time-since-charged indicator (provided you remember to reset it!). It probably has several other features which we have forgotten or not discovered yet.

Conclusions

Well, I like it and am rapidly reaching a point where I don't think I could do without it (no, we are still talking about radio control gear). If you only have one or two models or are not seriously interested in competition flying then you probably don't need it. Come to think of it, you probably can't justify the effort involved in learning to drive it either.

However, if you are seriously into rotary flight and have more than two models, it's probably the best value around. The only real snag here is a disappointing battery life — only about one and a half hours per charge. Still, you can't have everything and there is some evidence that the battery alarm (did I mention that?) is pessimistic. Roll on the PCM 10, it will have to be good!