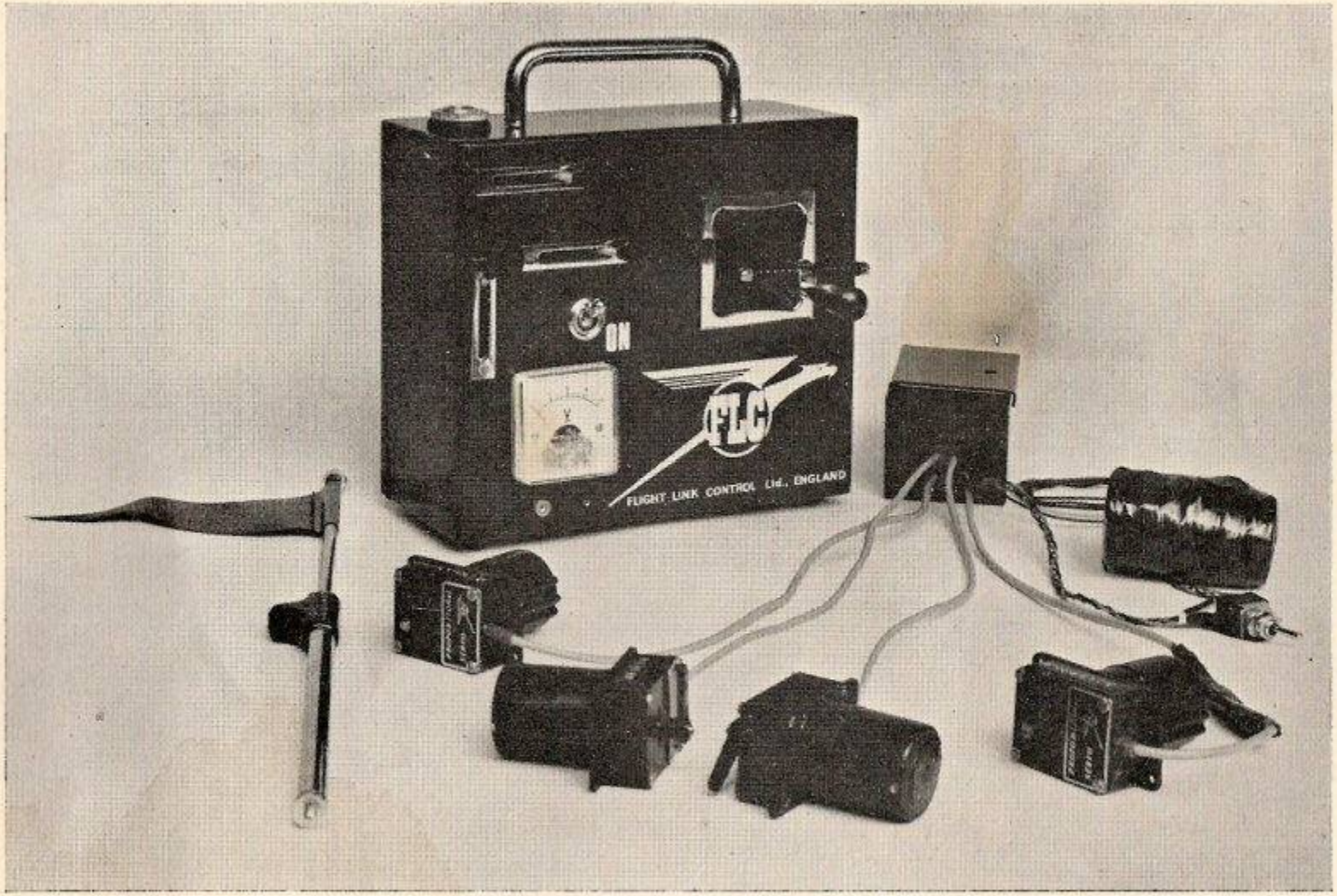
THE FLIGHT LINK

FIVE CHANNEL PROPORTIONAL

RADIO CONTROL SYSTEM



FLIGHT LINK "FIVE"

THE FLIGHT LINK "FIVE"

FIVE FUNCTION PROPORTIONAL RADIO CONTROL SYSTEM

For many years it has been the ambition of radio control modellers to achieve the same degree of control of their models as that possessed by their counterparts in full-sized machines. To achieve this precise control it is necessary that the modeller should operate fully variable controls which are followed exactly by the control surfaces of the model, so that the response of the model is in proportion to the control applied. This "proportional" control allows a greater affinity between operator and model than is possible with obsolescent "button pushing" control systems.

It was in 1964 that practical, reliable and realistically-priced proportional systems were first marketed in significant quantities, outstanding among these being the Flight Link "Series One" equipment. Since that time, proportional equipment has become the standard, taking over the major part of the market from the previously dominant tuned reed systems. Since this time many new developments and improvements have been introduced to proportional equipment, and the emphasis has swung, even for sports fliers, from the cheaper intermediate systems to the "full house" 4, 5 or 6 channel equipment.

While producing, and extending the original "Series One" equipment from the original 3 servo Super-regen to the 3 + 1 Superhet, we at Flight Link have developed a new, more sophisticated system — the "Five". This new system incorporates all the practical experience gained from 3 years production of the "Series One" gear, and all the improvements in semiconductor circuitry and electronic techniques made possible by the new devices now available.

Primary considerations in the design of this new system were:—

Up to 5 simultaneous and independent proportional channels,

Extremely high rejection of noise and interference,

Fast servo response, with no dead zone,

Out of sight range,

Negligible drift of control settings,

Extremely high crash and vibration resistance,

An automatic, simple "fail safe" system to give neutral control surfaces and slow throttle upon loss of transmitter signal,

A natural control stick arrangement not requiring operation of two short control sticks by two thumbs.

Outstanding appearance,

Realistic price.

We feel that in the system described here we have achieved all that we have set out to do, and more. This system, with its many unique features, will be a worthy successor to the "Series One" equipment which gained such an excellent reputation for performance, reliability and value for money.

The system is neither a conventional analogue nor a so-called "digital" one. Instead, it uses predominantly digital circuitry to achieve the same accurate response as conventional digital systems, but, (by virtue of the unique "active filter" decoder) with the high noise and interference rejection of the best analogue systems. Don't be brow-beaten by the people who insist that only this system or that is any good—judge for yourself, by performance, appearance and reputation.

The equipment described here is obtainable in 3, 4 or 5 servo versions (with or without batteries) from most good model shops, or in case of difficulty, direct from the manufacturers. The manufacturers are always willing to discuss special applications or requirements.

THE TRANSMITTER

THE CASE

The transmitter is housed in an elegant black stove-enamelled aluminium case with chrome trim. Case size is 6" x 7" x 3⅛" excluding handle and controls, and the 60" telescopic aerial is removable. The case lid is retained by a single Dzus fastener which is released by a slight anticlockwise twist. The weight of the complete transmitter is 3½ lbs.

THE CONTROLS

The distinctive feature of the transmitter is the single-stick arrangement of the flying-surface control.

As experienced pilots know, rudder control is used in only a relatively small part of a flight—ground manoeuvres, take off and spin. In normal flying, therefore, the joystick is held at the knob, and the rudder bar ignored. There is, therefore, no possibility of inadvertent operation of rudder. When rudder command **is** required, the rudder-bar is immediately accessible, and operates in a very natural manner.

Trim of the three flying surfaces is given by the three levers on the face of the transmitter. Full range of servo travel is maintained either side of the trim position — unlike some mechanical trim arrangements, which simply vary the trim point within a fixed total travel. Trim movement is approximately 20% of the main movement.

The transmitter case is cradled in the left arm so that the fingers of the left hand curl around the side of the case to operate the two sliding knobs which control throttle and the auxiliary (5th) function.

We at Flight Link feel that this control arrangement is a significant advance over the conventional "two-stick" arrangements which require operation of two short sticks by the two thumbs, and which frequently necessitates the use of neck straps to support the transmitter. However, a two stick version of this equipment is also available. In addition, a dual control unit is available to make flying tuition easier and safer.

POWER SUPPLY

The transmitter is powered by two 7.2 volt 500DKZ D.E.A.C. accumulators wired in series to give 14.4 volts. The current drain of approximately 120mA allows 4 hours continuous operation, the battery voltage being indicated by the meter fitted to the transmitter. When the voltage reading drops to 12 volts, stop flying and recharge the accumulator.

TRANSMITTER OUTPUT

The peak radio frequency power given by the transmitter is approximately .8 watts. This output is modulated at a frequency always between 1,500 and 3,500 cycles per second, the modulation being of a 100% square wave type, but with rise and fall times controlled at approximately 100 microseconds to minimise cross-talk with adjacent channels.

Frequencies available are:—

26.995 Mc/s	(Brown channel)	27.145 Mc/s	(Yellow channel)
27.045 Mc/s	(Red channel)	27.195 Mc/s	(Green channel)
27.095 Mc/s	(Orange channel)	27.255 Mc/s	(Blue channel)

Up to 6 Super-het systems each, one on each of the above channels, may be operated simultaneously without mutual interference. Super-regen versions are not available.

TUNING AND ADJUSTING

All tuning and adjusting is carried out at manufacture, and no adjustment of the RF or encoder settings should be necessary.

However, as compensation for long term drift of the encoder or decoder settings would be so easily incorporated, this has been done. A single preset potentiometer fitted to the transmitter printed circuit board will shift the neutrals of all servos in sympathy. Thus if all servos appear to be slightly offset relative to the perpendicular axes of the servo cases, the preset control may be adjusted to correct this. This preset control is situated near the top left hand corner of the Tx panel, viewed from the copper side of the board. The design of the circuitry is such that any long term drift which might occur must be common to all servos.

TRANSMITTER MAINTENANCE

Apart from charging of the internal battery, the only maintenance required by the transmitter is an occasional drop of oil on the joystick mechanism, but this only if any stiffness is felt in moving the joystick. Use of a wax polish on the transmitter itself will help to preserve the high gloss finish.

THE RECEIVER

CONSTRUCTION

A great deal of thought and practical experience has been put into making the airborne system extremely resistant to vibration and crash damage. All the airborne electronics, including servo amplifiers, is contained within the rugged black stove-enamelled aluminium case. This has many advantages, including ease of building and servicing, greater reliability, and smaller servos which are relatively inexpensive, as they contain only mechanical parts. (It is thus an economic proposition for a flier to fit a spare set of servos to a reserve model, and change over only the receiver).

The receiver is built on three fibreglass printed circuit panels, bolted together to form an extremely rugged unit. Component layout is designed for resistance to crash damage, and all leads in the airborne system are properly supported to prevent fracture due to vibration.

The battery, and all servos, (except the aileron and auxiliary servos) are normally supplied wired direct to the receiver without plugs and sockets, in the interest of utmost reliability. This absence of connectors does not make installation at all difficult, but additional plugs and sockets may be inserted if required.

The receiver does not contain space for the auxiliary servo amplifier, as only a relatively small number of sets are likely to use this optional function. Thus the auxiliary servo is of a slightly larger type containing its own amplifier, and connects the receiver via a plug and socket.

The receiver aerial consists of a 24" length of flex, colour coded to correspond with the receiver channel. This aerial should preferably be taken back to the fin of the aircraft. If necessary the receiver aerial may be shortened, but the receiver tuning should then be checked.

RECEIVER SPECIFICATION

The receiver is an all-transistor unit employing a conventional superhet circuit operating at an intermediate frequency of 456 kc/s, and giving a ground range of at least 800 yards when used with the matching transmitter.

Dimensions:	$2\frac{7}{8}$" x $1\frac{7}{8}$" x $1\frac{3}{4}$"
Case Material:	18 s.w.g. aluminium
Finish:	Glossy Black Stove Enamel.
Weight:	7 ozs.
Current Drain:	Approximately 50 mA.
Supply Voltage:	6.5 to 8 volts (i.e. 7.2 v D.E.A.C.)
Tuning:	Single aerial tuning control accessible through hole in case.

THE SERVOS

Flight Link servos have been in continuous production since July 1964, and in that time have acquired an enviable reputation. They combine in a compact unit the essential qualities of reliability, ruggedness and low current drain, yet with a pull of over 20 ozs., which wind tunnel testss and actual experience have shown to be more than

adequate for all model aircraft. The low current drain properties are all the more important in systems where up to 5 servos are operating simultaneously, if reasonable durations are to be achieved. A 4 servo system should fly for at least 4 hours on a 500DKZ D.E.A.C. Thus no flier should normally find his flying limited by battery capacity.

These servos operate on the familiar "closed loop" or "feedback" principle by which the full servo torque is available to correct any discrepancy between the actual and desired servo positions. Sensitivity is such that there is no perceptible "dead zone" — that is, it is impossible to move the control stick without the servo following.

PROPORTIONAL SERVO SPECIFICATION

Weight:	$2\frac{1}{4}$ ozs.
Dimensions:	1 " x $1\frac{3}{4}$" x 2" deep (excluding output shaft and flanges.
Output Torque:	Greater than 10 oz. ins. Typical at $\frac{1}{2}$" radius. Pull = 20 ozs. Main movement = .7" Trim movement = .15"
Output:	Rotary via either Arm or Disc (both supplied).
Recommended Voltage:	$\pm$ 3.6 volts.
Response Speed:	.7 seconds limit to limit. Maximum delay between operation of a control and power being applied to the servo — 1/20 seconds.
Current Drain:	Idling on no load — less than 20 mA Stalled — 140 mA.

PSW SERVO

This servo, containing its own amplifier, is supplied for the 5th auxiliary function. Its specification is as above, but the servo case is a little larger, and the weight is $3\frac{1}{2}$ ozs.

SERVO MAINTENANCE

Very little maintenance is required by the servos — many examples have operated regularly for 3 years with no maintenance whatsoever. The servomotors have sealed-in silver brushes with a life of 5,000 hours, and so need no attention. The gears run in nylon bearings, so no oil is necessary. The only attention needed by the servo is that of cleaning of the internal potentiometer track, but even this should only be done if the following symptom occurs:

If the movement of the servo is smooth and accurate in the anticlockwise direction, but hesitant and jerky in the clockwise direction, then either the potentiometer track is dirty, or the wiping contacts have insufficient pressure.

To dismantle the servo—

(1) Remove the output arm.

(2) Remove the 8 B.A. nuts and screw down the 8 B.A. bolts far enough to clear the servo top plate.

(3) Carefully prise off the nylon top plate, while pressing on the end of the output shaft to prevent the shaft lifting with the top plate.

(4) Once the top plate has been removed, operate the servos and observe the points at which the wiper dithers when the servo is moved clockwise.

(5) Clean these points by scraping very lightly with a tool such as a small screwdriver. Once the servo is operating smoothly, redistribute some of the track lubricant on to the cleaned sections of track.

(6) If cleaning of the track does not completely cure the hesitation of the servo, it may be that the wiper pressure should be increased. To do this, remove the forked wiper and the output gear, and bend down both wipers to increase the contact pressure. Replace the gear and wipers carefully to avoid damaging the track.

It should be mentioned that this cleaning operation is very rarely necessary, and is by no means a regular servicing requirement.

INSTALLATION

The receiver and servo are supplied as separate but wired units, only the aileron and auxiliary servos being connected by plugs and sockets. When the 3 function version is supplied, the rudder servo is not supplied. Thus the aileron servo on its plug and socket connection may be used either as an aileron servo or as a rudder servo, as required. Extra plugs and sockets can be fitted to any servo.

The receiver contains no moving parts and is an extremely strong crash-proof unit. It may thus be installed very simply in any convenient position between pads of foam plastic or similar material.

While the servos are very rugged and vibration proof, most modellers would prefer to mount them resiliently, to prolong the life of gears and bearings. By far the most effective way of mounting these (or any other) servos is to mount all of them (except the aileron servo) on a plywood or tufnol panel which is resiliently mounted on the airframe. Four special mounting grommets are supplied for this purpose. It should, of course, be ensured that the panel is not free to move in such a way as to affect control surface positions. Generally, less vibration is present in a wing than in a fuselage, and it is not so desirable to mount the single aileron servo resiliently.

Correct direction of movement of the control surfaces is obtained by selecting the appropriate positions of the servo output arms on their shafts. The arms and discs will fit in any of four positions.

Care should be taken to match the movement of the throttle servo to that of the throttle barrel. Particularly, it should be noted that if the servo is stalled against the stops of the carburettor, current will be drawn continuously by the servo. This current is in no ways harmful to the servo, but it will decrease the duration given by the servo battery.

As with any proportional system, all linkages should be made as free as possible, so as to maintain the high resolution of the servo. Generally, the best linkages are the push rod type with screw adjustors at either end. Avoid using Bowden cable linkages (except possibly on the throttle connection), as these invariably introduce friction and backlash.

This equipment has been designed from the outset to be insensitive to the "metal-to-metal" noise which is such a problem with many other systems. Test flights of the prototype sets showed that aircraft containing many metal parts rubbing and vibrating together (e.g. metal linkages on metal aileron horns, all-metal throttle linkages, etc.) can fly perfectly. However, as a general rule it is safer to avoid the use of two metal parts that can rub together under the influence of engine vibration. The easiest solution is to make one of the parts a nylon one, or if this is not possible, the two metal parts should be linked by a short flexible conduction, which will eliminate any electrical "noise".

Lastly — the most common mistake made by fliers installing their first proportional equipment is to give too much control surface movement. If in doubt, get a second opinion before flying. Excessive movement can easily lead to overcontrol, with the inevitable result.

BATTERY CONNECTIONS

The 7.2 volt 500DKZ centre tapped D.E.A.C. for Rx and servos is normally supplied ready wired to the Rx, via the switch, as follows:—

— 3.6 volts	to	Black lead.
0 volts (Centre tap)	to	White lead.
+ 3.6 volts	to	Red lead.

In addition Red and Black leads are wired to the battery for charging purposes.

INITIAL CHECKING

First fit the Transmitter aerial and switch on, checking that the meter needle is in the green section of its scale. Straighten the receiver aerial and switch it on. After a moment's delay the servos should take up the positions dictated by the transmitter controls. Carry out a full check of the controls, and trims to familiarise yourself with the equipment. Before the first flight, carry out one long range check as follows:—

With the gear installed in the model, switch on and check operation of all controls. Ask a helper to hold the transmitter and set the throttle control to "fast".

NOTE THAT THE AERIAL SECTION IMMEDIATELY ABOVE THE CENTRE LOADING COIL MUST CLICK OUT THE LAST HALF INCH, OTHERWISE THE TRANSMITTER WILL GIVE ONLY 10% OF ITS POWER.

Now carry the model away, at shoulder height, until the throttle servo starts to go "slow" through loss of range. To get the absolute maximum range, tune the Receiver via the hole in the receiver case to return the throttle to "fast". Range under these conditions should be at least 800 yards. The receiver tuning is not particularly critical, and need not be checked again.

Check also that when the transmitetr is switched off the servos move gradually to their "fail safe" positions, neutral for flying surfaces and "slow" for throttle.

BATTERY CHARGING

The transmitter is powered by two 7.2 volt 500DKZ D.E.A.C. accumulators and the receiver (and servos) by one. The correct charging rate for these accumulators is 50mA, a full charge period being 14 hours.

A mains-operated charger is required to charge these batteries — either a constant output 50mA type, or a type having a meter and a control to set the charging current to 50mA. Suitable chargers are available from Flight Link or form most good model shops. Charging leads, plugs and sockets are supplied, which allow the transmitter and receiver batteries to be charged individually or in series.

To charge the transmitter alone connect:—

Positive charger output to RED transmitter socket.
Negative charger output to BLACK transmitter socket.

Set the charging current to 50mA. The battery is fully charged after 14 hours, from the discharged state, or when the voltage across the sockets reaches 18 volts (with the transmitter switched off, but on charge).

To charge the receiver alone connect:—

Positive charger output to RED receiver socket.
Negative charger output to BLACK receiver socket.

Set the charger current to 50mA. The battery is fully charged after 14 hours from the discharged state, or when the voltage across the socketss reaches 9 volts with the receiver switched off but on charge.

To charge the transmitter and receiver in series connect:—

Positive charger outputs to RED transmitter socket.
BLACK transmitter socket to RED receiver socket.
Negative charger output to BLACK receiver socket.

Set the current to 50mA. Charging periods and voltages are as above. If one battery becomes fully charged before, the other, disconnect it and continue to charge the other as long as necessary.

Most fliers tend to overcharge their accumulators to be "on the safe side". Constant overcharging will reduce the capacity of a battery but not to a dangerous extent. We do recommend, however, that every few months the receiver should be switched on and allowed to run down until the servo movement becomes slow. Then switch off and leave the transmitter switched on until the battery voltage falls to 12 volts. Then recharge both batteries for 14 hours at 50mA. When "topping up" after a day's flying, charge at 50mA for approximately 3 times the previous period of use.

The first sign that the receiver batteries are nearly exhausted is that the servos will start to chatter slightly, and then servo movement will become progressively slower. If in doubt about battery state, check for these symptoms, or check the voltage across the charging terminals. If this is less than 7.2 volts — do not fly.

SERVICING OF EQUIPMENT

Equipment returned to Flight Link for servicing is normally returned within 48 hours of receipt — unless flight testing is required, or any parts are out of stock. When returning equipment for servicing, please —

(1) Pack the equipment well — do not squeeze it into a small box. Remember — postmen play football with parcels!

(2) Label the parcel clearly, and write "Fragile" all over it.

(3) **ALWAYS** register the parcel for the full vaiue.

(4) If in doubt about whether to return equipment, telephone Flight Link to discuss the symptoms.

(5) Include clearly your name, address and full details of faults or cause of damage.

(6) If you want your equipment flight tested, this can be done for a fixed charge of £2, which will, of course, be waived if the servicing is carried out under guarantee.

PROPORTIONAL MODEL FLYING

The particular advantages of proportional control systems in model aircraft are that really smooth flight patterns are easily achieved, and that under difficult gusty conditions it is very much easier to fly because of the continuously applied control.

It should not be thought, however, that proportional control eliminates the necessity of learning to fly! It is not generally realised that a model aircraft can be more difficult to control than a full sized aircraft. This is because the pilot actually seated in an aircraft "flying by the seat of his pants", can immediately sense any small change in attitude of his craft, whereas the model pilot cannot correct until the change has become large enough to be observed

at some distance. Furthermore, the relative positions of the full sized pilot and his aircraft are constant, but as many modellers have found, a model flying towards the pilot can be quite difficult to control.

Both beginners and experienced pilots would be well advised in the early stages to choose a stable model and become accustomed to the 'feel' of proportional control before attempting complicated manoeuvres. The elevators particularly should be left well alone until the rudder control has become competely instinctive.

After initial training has been completed the very real advantages of this proportional control system will become more and more apparent.

THE FOLLOWING ARE THE GOLDEN RULES FOR SUCCESSFUL TROUBLE FREE FLYING:

(1) Range check and tune your equipment before the first flight.

(2) Then carry out some short range checks with the transmitter aerial removed or retracted, to use as your standard, quick check before the first flight of each day.

(3) Pilots new to proportional flying should use small moving surfaces and small movements. More models "die" of over-control than of anything else.

(4) The output of the transmitter is a minimum along the axis of the aerial. Therefore do not point the transmitter at the model.

(5) Always ensure that the transmitter aerial is fully extended.

(6) Metal to metal linkages should be avoided or linked wherever possible.

(7) When flying simultaneously with other equipment on adjacent channels, bear in mind that a very strong signal from the wrong transmitter can induce spurious signals in the receiver, especially if the correct signal is very weak. In practice this means that pilots should stand reasonably close together (say 20 to 30 yards) and that models should not be flown very close to other pilots, for electrical as well as humanitarian reasons!

GUARANTEE

ALL FLIGHT LINK products are covered by a full guarntee and prompt after sales service.

We wish you successful flying with your equipment. Your experience with this equipment is of vital concern to us, and we would much appreciate a report on its performance, as soon as you have had a few days' flying.

FLIGHT LINK CONTROL LTD.

MANUFACTURERS

FLIGHT LINK CONTROL LTD.

BRISTOW WORKS,

BRISTOW ROAD,

HOUNSLOW, MIDDLESEX

01-570 4065