23 Hazledene Road, Aberdeen, AB15 8LB, Tel 01224 208617

Newsletter Feb 99.

Well men! do we have any lady members? here we are in the depths of another building season, we are building aren't we?. All last seasons' disappointments and frustrations have been tempered into a firm resolution to do better this coming season. One thing about doing demos is that you have to build something to demo with. Those of you who came to the wing cutting demo know how quick it is to cut a set of wings once the cutter is set up, and that it is almost as quick to cut two or three sets, hence I have cut 3 sets of open wings and two sets of 100S wings for the coming season. If anybody wants a wing section printed out give us a call, I can knock them out very quickly.

Recent correspondence to GRC has been positive, on the issue of future development of Calder Park the party line is that while there are a number of initiatives to do with further development nothing has been decided. As and when the site is developed GRC will find us an alternative site.

GRC have also approved our competition dates for the 5th and 6th of June at Hazlehead – best efforts everybody to make it a good turn out.

The club is now in possession of a new Graupner winch so hopefully we will not experience the frustration of last season. Thanks to Neil for expediting this purchase.

These months' technical issues are lifted from the Internet and all credit must be given to the authors. The crystal write up throws some light on how crystals are made, how transmitter and receiver frequencies are matched, and due to the fragility of the crystals, some food for thought on doing range checks after a hard arrival. The second write up is on the properties of different foams that we may come across in the course of our modelling activities.

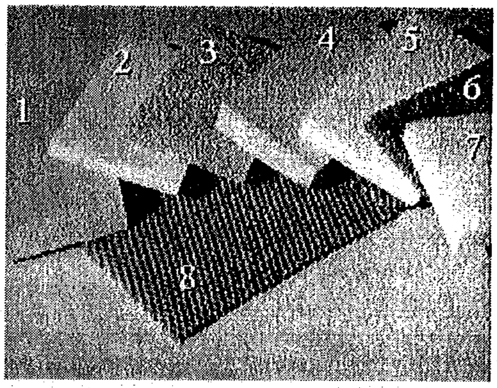
The drawing I have reproduced is for John Stevens Eliminator 100S – this is currently the benchmark model for 100S aircraft. John produces this model from a plan only upto a semi-kit requiring only the purchase of sheet material; he also produces a fibreglass Fuz. The kit is of traditional built up construction, suitably reinforced, this makes it quite robust and goes up the line like a rocket, it looks nice, and is fairly easy to fly. This is an excellent first serious model.

Coming Events

16th Feb.	Vacuum bagging demo. 23 Hazledene Road
16th March	Video evening – British Legion.

t' Committee

FOAM MATERIALS



Following on from my short description of the fabrics available to modellers we now switch our attention to foam. Foam is used in two ways; either for the cores material in wood veneered or glass vacuum bagged wings or as the sandwich material for the skins of hollow moulded wings. We've all come across white and blue foam but there are some other foams we could look at...

1) Styrofoam SP, 2) Rohacell 51, 3) Conticell, 4) Styrofoam IB,

5) De-Q-cell, 6) Termanto, 7) Polyfoam Plus and 8) Nomex Aramid Honeycomb.

POLYSTYRENE FOAMS

Polystyrene foams come in two types: expanded foam and extruded foam. Common *bead-type* white polystyrene is expanded foam (in a mould) and it's the cheapest available. It comes in a variety of densities from about 17 kg per cu. m. upwards for the large bead foam. Expanded foams are only really suitable for covering with wood veneer since the fine trailing edge needed for vacuum bagged wings is hardly obtainable with this foam. There are, however, better white foams other than the standard builder's yard material in DIY stores. Left to right the samples here are:

One such PS foam is De-Q-cell found in Germany which has a sort of crystalline appearance when you look at it. I haven't seen it for sale here in the UK but it maybe available from Windsurf board manufacturers, I don't know. It comes in 3 weights: 17, 30 and 40 kg/cu.m.

Extruded polystyrene (forced through a die) foams are eminently more suitable for wing cores - their closed cell structure (hit the DOW logo to see it) giving a much finer trailing edge. In the UK we call it Blue foam, in France they call it *Roofmate*. It doesn't have to be blue, of course for I have seen *Gray board* from the States, an orange one from Germany and I'm told you can even buy a green variety from the *Bricolage* at the Calais Hypermarket. An old DOW catalogue I have actually lists 17 types of Roofmate, Wallmate, Floormate boards with densities from 28 to 45 kg/cu.m. The one I generally use is called Styrofoam IB with a density of 28 kg/cu.m. but I have also used Styrofoam SP (34kg/cu.m.) which I found less easy to use.

Polyfoam Plus, the pink extruded variant, available in the UK from LinPac, is once again an insulation

material for building which boasts the use of steam instead of CFC's (Freon?) as the *blowing agent*. Its cavity wall board has a density of 20 kg/cu.m. while the floorboard comes in at 27 kg/cu.m. Lighter but a little more care needs to be taken because it's easier to damage its surface through heavy handedness and workshop dings. Cuts OK though with a standard hot wire set up.

POLYMETHACRYLIMIDE FOAM

rohacell® Otherwise known as Rohacell (PMI) foam this is very expensive white coloured foam and does not cut with a hot wire like polystyrene foam; it is cut with a knife or saw. It is available in ready cut sheets at 1 mm, 2, 3, 4.... up to 65 mm thick. Modelling applications require 1 or 2 mm. Its superior compressive strength over PS foams means that it's ideally suited for sandwich construction. Modern moulded models (especially tailplanes) may use Rohacell as the sandwich between lightweight (40 -70gsm glass or 100gsm carbon) plies of reinforcement cloth. It can be cut and sanded easily and is not subject to attack by most solvents (styrene, acetone, MEK, etc). Rohacell is made by Röhm of Germany as is classified as Rohacell 31, 51, 71, 110, 170, 190, the numbers denoting it's density in kg/cu.m. We would use the 51 type for modelling.

POLYVINYLCHLORIDE FOAM

PVC rigid foams are rarely used in modelling but full size gliders sometimes use it. Trade names are Termanto, Conticell, Divinycell. These cannot be hot wire cut either but must be sawn to size, they are also used as sandwich materials. They are yellowish brown in colour. Densities range from 30 to 400 kg/cu.m.

POLYURETHANE FOAM

We're more likely to see polyurethane foam from an aerosol can but it's also available in sheets as a sandwich material. It has few uses in modelling but I have heard of the aerosol foam used for repairing broken fuselage booms.

POLYPROPYLENE FOAM (EPP)

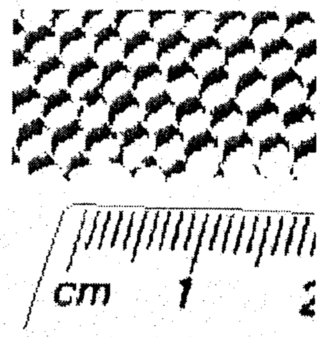
This is the latest foam on the modelling scene. In the US it comes under the brand name of Eperan 2, the bead precursor for the foam (Neopolen P) is made by BASF and is expanded in a low pressure steam chamber without using blowing agents. In the jargon it's called a *closed-cell thermoplastic olefinic foam* material. Nowadays it's used for wings and fuselages for Combat flying although was originally developed for use by the car (automotive) industry for impact absorption (i.e. bumpers, dashes, etc). EPP is a beaded foam which has a memory; that is to say that it returns to its shape after being distorted. It is a white coloured foam with a waxy feel and appearance and really needs to be sprayed with 3M adhesive before applying fibreglass reinforced tape and/or plastic film. It can be cut with a hot wire, though not as well as PS foams. I hear tell some cut it with a flexible wire saw too. As far as I know it comes in two standard grades, 1.3 lb and 1.9 lb per cubic foot. The lighter version is generally used for models.

Link:RPV Industries http://members.aol.com/Rpvi/F-21.html

POLYETHYLENE FOAM (Ethafoam)

Polyethylene foam is similar to polypropylene foam and is made by the DOW Chemical company. As far as I know two grades are available: Ethafoam Nova and Ethafoam Select. They are low-density polyethylene foam products. For more info: http://www.dow.com/ethafoam

NOMEX HONEYCOMB



Nomex is not a foam but since it is used as a sandwich material in full size (and can be used for models) I include it here. It's made by DuPont and is really a sort of expanded Kevlar paper. Layers of this paper material are laid one on top of the other with lines of adhesive. Each layer has the adhesive lines in a different place. When the adhesive has set and the layers are expanded the honeycomb is formed. It is then sawn into sheets. Available in 2 mm sheets upwards for modelling. Once again a very expensive material and, although difficult to use, my brother did make a set of moulded wings using it as the sandwich material. I sometimes use it between two plies of carbon cloth as a lightweight wood substitute for ply servo trays and the like. Even though Nomex is mostly air, it still comes in at 29 kg/cu.m.

A source list is something modellers often ask for but something I'm not prepared to do here. If you're looking for foam suppliers a good place to start is the Yellow Pages under Insulation. In the UK, Pink Foam came to me via LinPac and Blue Foam through Sheffield Insulations. Rohacell made by Röhm in Germany used to be available here but the company stocking it in the UK ceased trading. De-Q-cell comes from Bacuplast in Germany and Nomex is available form R and G Flüssigkunststoff also in Germany.

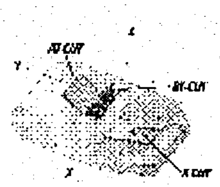
SUMMARY OF FOAM PROPERTIES

PROPERTY	WHITE	PINK	BLUE	ROHACELL	CONTICELL	NOMEX
Type of Foam	(PS)	(PS)	(PS)	(PMI)	(PVC)	(ARAMID)
Tensile Strength (N/mm^2)	0.4	-	0.6	1.9	1.5	-
Compressive Strength (N/mm^2)	0.2	0.12	0.25	0.9	0.8	0.5-0.6
Density (kg/m^3)	~17	~20	~30	~50	~60	~29

THE PIEZOELECTRIC EFFECT

Ubiquitous quartz surrounds us - it's everywhere, it's in the soil and in the houses we live and beats at the heart of almost every piece of consumer electronics - we're talking crystals here...

Piezoelectricity is the property of quartz that we utilise in our receiver and transmitter crystals. So what is it? Put simply: it is an electric voltage produced by certain crystals and by a number of ceramic materials when they are subjected to pressure. What's more, the piezoelectric effect works both ways: stress a piece of quartz and you get an electrical output from it that is proportional to the stress it undergoes. That is to say, when the quartz has an electric field applied to it, the crystal becomes deformed or strained by an amount proportional to the applied field; the sense of the strain depends on the direction of the field. Incorporate a crystal in an oscillator circuit (in our Tx and Rx) and it will run very accurately at the required frequency.



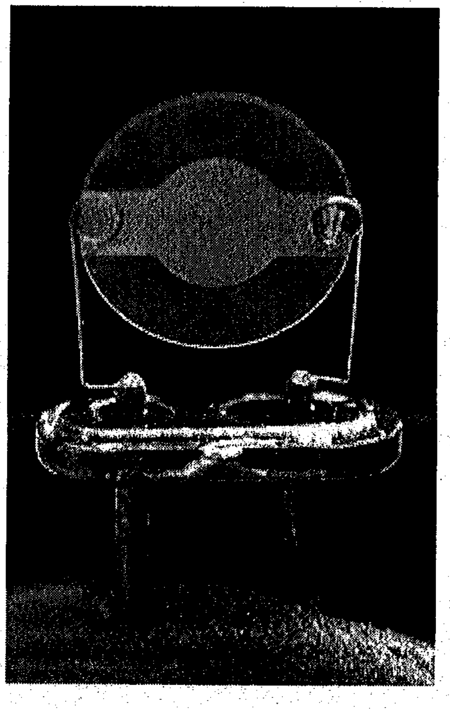
Each slice of crystal has a natural resonant frequency it likes to oscillate at depending on the 'cut' of the crystal. The frequency of the crystal is controlled by the thickness of the quartz slice plus the added metal electrodes. Most crystals are made from one of three different cuts (right) of quartz according the frequency required *(Click it for larger image)*. AT-cut (1MHz to 300MHz), BT-cut (2MHz to 38MHz fundamental) and the X-cut (24kHz to 50kHZ).

Of course, there's much more to it than that because fundamental frequencies or overtones are selected for circuits and some oscillators need to be very temperature stable and so on. In 35MHz equipment 3rd overtone receiver crystals are generally used but some Tx's like Graupner MC-20 use an 8 point something MHz fundamental and multiply it up by four. Designers' circuitry requirements (single and double superhet receivers, capacitance, etc) require different values for receiver crystals too; DS Rx's have two crystals 10.7 + 24...MHz - this is why crystals are not interchangeable.

Nowadays, the designers of electronic equipment don't go traipsing round the Brazilian jungle looking for the large natural quartz specimens we see in museum gemstone collections to cut up; there is a large business concerned with the growing of manmade crystals of all sorts. The process is hardly different from that of your school days when you dangled a seed crystal of copper sulphate on a cotton thread in a saturated aqueous solution of copper sulphate to grow a larger specimen. With quartz the process is essentially the same but uses steel wire suspended in molten quartz under extremes of pressure and temperature with the crystal literally pulled slowly from the solution. Control of the speed of pull, pressure and temperature and doping agents enables crystal bars of all sorts of materials from humble quartz to the complex compounds (for transistors, IC's, l.e.d.'s, etc.) to be created with precisely aligned crystallographic orientations and electronic/quantum physical properties.

These bars are then sliced into thin wafers for etching and cutting for the manufacture of electronic components.

In my photograph of a damaged 35MHz AT-cut 3rd overtone receiver crystal (shown here with the dented can removed) notice how thin the slice of quartz is; notice too the shaved edge where quartz slice was aligned with the actual crystal structure of the crystal when the quartz plates were cut from the original bar. Now look at the those hair-thick wires with loops on... your prized or expensive model is hanging on just such a pair of delicate wires inside the receiver! Remember this the next time you crash a model. Also note that pulling crystals in and out of equipment doesn't do the crystal pins and sockets any good at all - these delicate, sensitive wafers of quartz are hermetically sealed in a dry nitrogen atmosphere in their cans with their pins in 'glass' seals and should be handled with care so as not to damage the seal. If the seal fails then moisture can penetrate the can and degrade the electrodes. It goes without saying you should take special care of your crystals.



Once a wafer has been cut, the next stage of the production process involves the reduction in thickness of the quartz to get it to the correct size - this skilled process is called 'lapping'. During this stage the sliver of quartz is 'lapped' to the correct size so it will resonate at the correct frequency. Some say this process is somewhat of a 'black art'. Electrodes of silver or gold are added by vacuum deposition - this is where the wires are connected. The final frequency of the crystal is adjusted by adding an extra layer of silver to one side of the quartz sliver. Tolerances are extremely fine (measured in parts per million) and define how close the resonant frequency is to the required frequency - the smaller the tolerance the more expensive it will be. Crystal frequency is usually specified at 25ºC since crystal accuracy is very temperature dependent - some crystals are made to operate in temperature controlled ovens.

The Piezoelectric Effect was discovered by Pierre and Marie Curie in the 1880's and is used widely in a number of transducers and electronic gear. Your old record player had a cartridge that used the piezoelectric effect, the ultrasonic transducers in your old car alarm used it, that hospital ultrasound scanner uses it, some gas and cigarette lighters use it. Then there are strain gauges and accelerometers, flow meters and pressure transducers of all sorts including altimeters, variometers and airspeed indicators not forgetting modern barometers, model gyros, radios, TV's, microphones and computers, your Swatch watch and even artificial limbs. You name it, there's a tiny piece of quartz or piezo-ceramic in there somewhere.

As an aside: on a global scale, large earthquake movements are also *said to produce* massive releases of piezoelectricity in the form of sparks and ball lightning as rock formations are put under extremes of pressure. GW

THE UK 35 MHz BAND

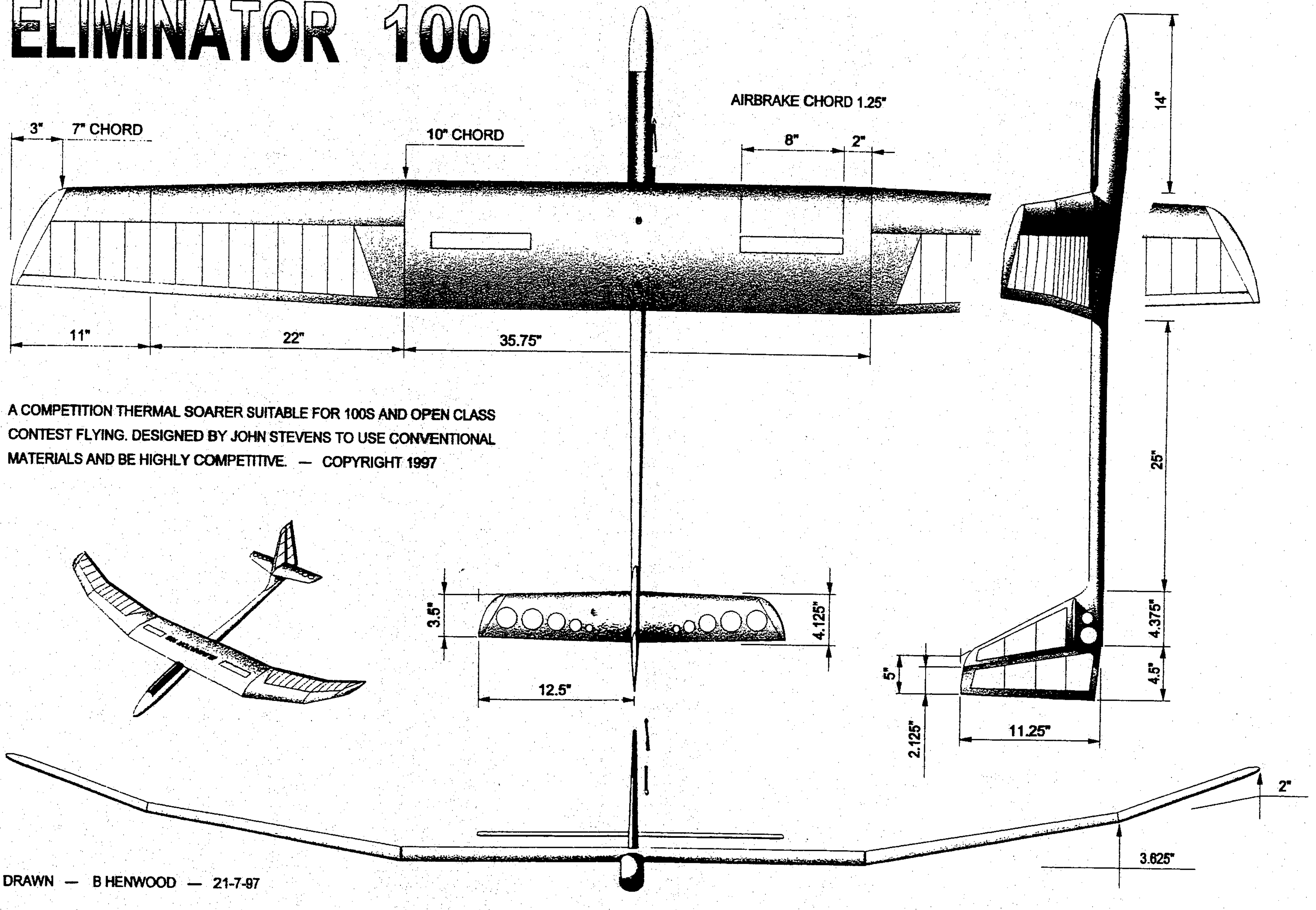
35 MHz is the preferred frequency band for model flying in the UK. 27 MHz 'solids' can be used but this band is not recommended for flying models. Below is a list of 35 MHz channel numbers and their matching transmitter and receiver frequencies. Certain types of modern equipment (Multiplex, Futaba FC series, etc.) actually use a lower frequency crystal in the transmitter, and use a doubler circuit, so you may find that you have a transmitter crystal that actually reads half that shown here (e.g. 17.575 MHz instead of 35.150 MHz for channel 75).

Receiver crystal frequencies are different since the internal intermediate frequency (I.F.) into account. This is 455 kHz for standard receivers nowadays. Double superhet (DS) receivers use a second 10.6 MHz I.F. as well as the 455 kHz I.F. (some of these crystals may well read 10.6 MHz lower than those shown in the table. GW

CHANNEL NUMBER	TRANSMITTER FREQUENCY	RECEI
60	35.000	34.54
61	35.010	34.55
62	35.020	34.56
63	35.030	34.57
64	35.040	34.58
65	35.050	34.59
66	35.060	34.60
67	35.070	34.61
68	35.080	34.62
69	35.090	34.63
70	35.100	34.64
71	35.110	34.65
72	35.120	34.66
73	35.130	34.67
74	35.140	34.68
75	35.150	34.69
76	35.160	34.70
77	35.170	34.71
78	35.180	34.72
79	35.190	34.73
80	35.200	34.74
81	35.210	34.75
82	35.220	34.76
83	35.230	34.77
84	35.240	34.78
85	35.250	34.79

E-MAIL HOME

ELIMINATOR 100



A COMPETITION THERMAL SOARER SUITABLE FOR 100S AND OPEN CLASS CONTEST FLYING. DESIGNED BY JOHN STEVENS TO USE CONVENTIONAL MATERIALS AND BE HIGHLY COMPETITIVE. —

DRAWN — B HENWOOD — 21-7-97