PicATUne

- an intelligent antenna tuning unit

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THIS MONTH concludes the construction phase with the building of the case, the logic board, the system wiring and the capacitors.

BUILDING THE CASE

THE POLYSTYRENE CASE comprises four sides, each 8cm high - and a top and bottom cover. The sides are glued together with polystyrene cement. The top and bottom covers are not built until after final test. They have a 5cm external lip all round and are clamped together by bolts passing outside the enclosure.

Allow at least a 1mm tolerance gap all round to the RF deck and cut the four side panels accordingly. I used 244 x 80mm and 222 x 80mm, both twice.

I butt jointed the corners and also cut in a 14mm square fillet half way up each side at each corner. With hindsight, this latter was probably not too good an idea since it adds another environmental leak risk, but at the time I was unsure of the bonding strength and wanted to add more rigidity. I suggest you simply glue in a 10mm square fillet to each internal corner. The component side of the RF deck rests on these, secured with M3 nylon nuts and screws as required.

Using emery, remove the polished finish from the polystyrene where it is to be glued; ensure you allow for the joints to be butted the right way round. Glue together the sides firstly into two pairs of Ls, including the gusset - and when set, into a square. Do not attempt it in one go! A polyethylene bag over a finger tip helps to draw out a clean fillet and ensures there are no gaps either internally or externally.

Radius the corners of the RF deck and fit to the case, with the component side resting on the gussets. At this stage RFC1 can be bonded to the board, clearing the gusset.

Make up some means of housing some silica gel. **Fig 19** shows a suggested approach. It is mounted above RL17 on the casing wall. The nylon gauze referred to in the caption is the engineering term for lady's tights.

Take two pieces of PCB about 3 x 1cm and solder them at right angles to the board to pick up the track to the antenna and counterpoise terminals. Drill a pilot hole right through the case and the PCB for each terminal - about 2cm from the board face. Drill also pilot holes for the input and output sockets, for the coax lead to the dummy load and for the silica gel chamber.

Remove the board and fully drill the holes. For the SO239 sockets I first used a 19mm flat wood bit - from the outside - to a depth of about 1mm. Although SO239s nominally fit a 4mm thick panel, you only get the backing nut on about half a turn - and in any event, you also need to allow some depth for waterproofing compound later.

Refit the board and fit all the external connectors, dry at this stage. Wire up the output SO239 socket to the output terminals using some 2mm wire. Wire up the input socket using 2mm wire to link the washer to the board ground - and a trivial length of RG58 for the inner.

Cut a piece of single sided PCB (87 x 78mm) for the base of the logic board. It also clamps up on the gusset in the logic board corner. Place it hard into the corner on the component side, copper side facing out. Mark positions for four holes which will foul neither the logic board assembly nor the earthy plates of C9-C11. Cut six pieces of polystyrene about 1cm square to use as spacers and drill four of them and the holes in the board at 4mm dia. Glue the spacers to the board using the two undrilled ones to provide even spacing over C9-C11. Secure the base to the RF board using M3 nylon screws and nuts - and clamping up on the corner gusset. Run a short heavy ground link from the base plate to the hole provided on the RF sense section.

Fit the dummy load to its heatsink with

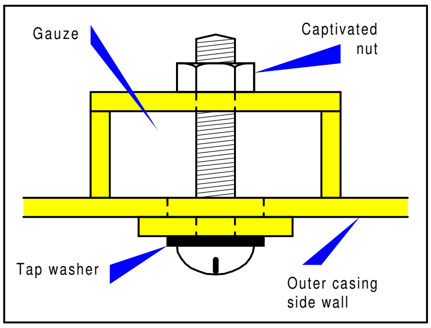

Fig 19: Suggested silica gel chamber construction - approx 25 x 12mm - made from polystyrene with nylon gauze bonded over the two open sides. The nut is bonded with epoxy resin to captivate it (liberally grease thread with DC4 first). The access hole in the casing is about 5mm and is sealed with an external polystyrene 'washer' and some bathroom sealant. The screw is sealed with a tap washer.

some thermal transfer compound. Then mount the heatsink to some polystyrene sheet with nuts and bolts. Then glue the polystyrene to the casing and when set, make off the coax lead on the dummy load.

Fit a length of RG58 from RL21 to the input end of the L-match. The braid should be grounded at both ends. To this end, I soldered a short stub of PCB at right angles to the main board to pick up the connection to the 'earthy' end of the L-match capacitors - and made off the braid of the coax to this stub.

BUILDING THE LOGIC BOARD

ANY PCB TECHNOLOGY can be used for this board. A technique for using an iron-on etch resistant mask produced directly from the artwork, described by Ed, EI9GQ [7] is particularly appropriate.

Referring to **Fig 20**, the holes for transistors Tr1-Tr21 should be drilled 0.6mm; the remainder at 0.7mm. Lightly countersink the holes on the ground plane side. Having drilled the board, I masked the ground plane side with spray paint and then used indelible pen for the tracking.

The only critical element is the 0.1" pitch lines to take Sk1. These all line up on one or more of the holes so using a piece of strip-board as a guide, you should have no trouble.

For the finer tracking around the BC517 transistors, I penned in additional horizontal lines at right angles to the wanted tracks and then used a scalpel blade to remove the ink and restore the gap between the holes.

It is also worth while casually filling in any larger unused areas. This helps to achieve an even etch and reduce etchant consumption.

Having etched the board and cleaned it, make up the three vertical side panels from some double sided PCB - about 25mm high. Note the T junctions where they meet, ensuring that both faces of the sides are grounded. Seam solder the internal and external corners and mount the logic board about half way up the partition, soldering the edges of the ground plane.

Populate the board, fitting firstly the four through board links, C24, C51, C53, C54, R24, R25 and then the IC sockets.

Cut the tails on Sk1 so that they are as long as possible consistent with both not touching adjacent track and mounting Sk1 hard up to the board edge. Solder quickly into place without melting the insulation. Fit all other components and the two links on the track side. The earthy ends of C24, C26-C46, R45 and C54 are soldered to the ground plane only and do not pass through the board. Depending on the size of your decoupling capacitors, C26-C46 may be better fitted diagonally. X1 lies flat on the board to reduce height.

Soldering in the transistors needs a steady hand. You may find it easier to leave short tails on their leads on the copper side (especially the grounded emitter lead) - and solder them to the track a short distance from the holes.

Make off the three flying leads as illustrated. The RF sense lead is wired in miniature coax; the Cmd and Ref lines preferably in miniature audio cable. They are routed in/outside the enclosure as illustrated and made off under the board.

Do not fit IC4-IC6 in their sockets at this stage.

TESTING THE LOGIC BOARD

AT THIS POINT it is possible to verify basic operation of the PIC and its memory.

After the usual checks, connect a short ' antenna' to the inner of the RF sense lead and loosely couple it to your receiver antenna - on one of the LF bands. Plug in IC2 and IC3 and then apply 12v to the board - between the +12v pins and ground.

Immediately on powering up you should be greeted with the following message in CW:-

HI de PicATUne AR K

The text of the message has been read from memory verifying that the PIC and memory are at least basically functional. At the end of the message, the ' READY' LED should light.

If you enjoyed that, try dabbing the inner of the Cmd lead on and off IC4 socket, pin 16 (+5v) - simulating the operation of your Command Switch. You should hear:-

M U S I C

which is the main menu. Its significance will be fully discussed later. Suffice it at this stage that you hear the CW message. Should you hear actual music, then something is badly wrong.

RELAY WIRING

FIRSTLY, YOU NEED a mating connector to fit SK1 on the logic board.

I ' manufactured' a free plug by soldering a 28-way SIL plug (Pl1) to a piece of 0.1" pitch stripboard. The stripboard is 28 strips wide by 4 holes high with the SIL plug at one edge, the opposite edge copper cut back to avoid earthing - and with the wires soldered to the middle of each strip. The purpose of the stripboard is to add some marginal mechanical strength and to give you something to push against when mating with Sk1.

The relevant tracks for the relays are routed to a central location on the main PCB. I used SIL plugs and sockets to make off wire leads on the component side, but it is an unwarranted luxury. You might just as well solder the wires directly to the board since there is a connector at the other end of the leads anyway.

Either way, cut 20 lengths of hook-up wire, 17cm long and bare both ends. Some colour variety is useful. Make off all the leads on the main PCB. Use one wire for the common +12v lead.

I then passed all 20 leads through an old PA balun core to tidy them together and perhaps offer some reluctance to RF. I would doubt if it does much.

With the logic board assembly tack soldered in position and Pl1/Sk1 lightly mated, start from the RL9 (C1) end of the connector (the shortest lead). Use a continuity meter to locate the correct lead, cut it to length (with little excess) and make

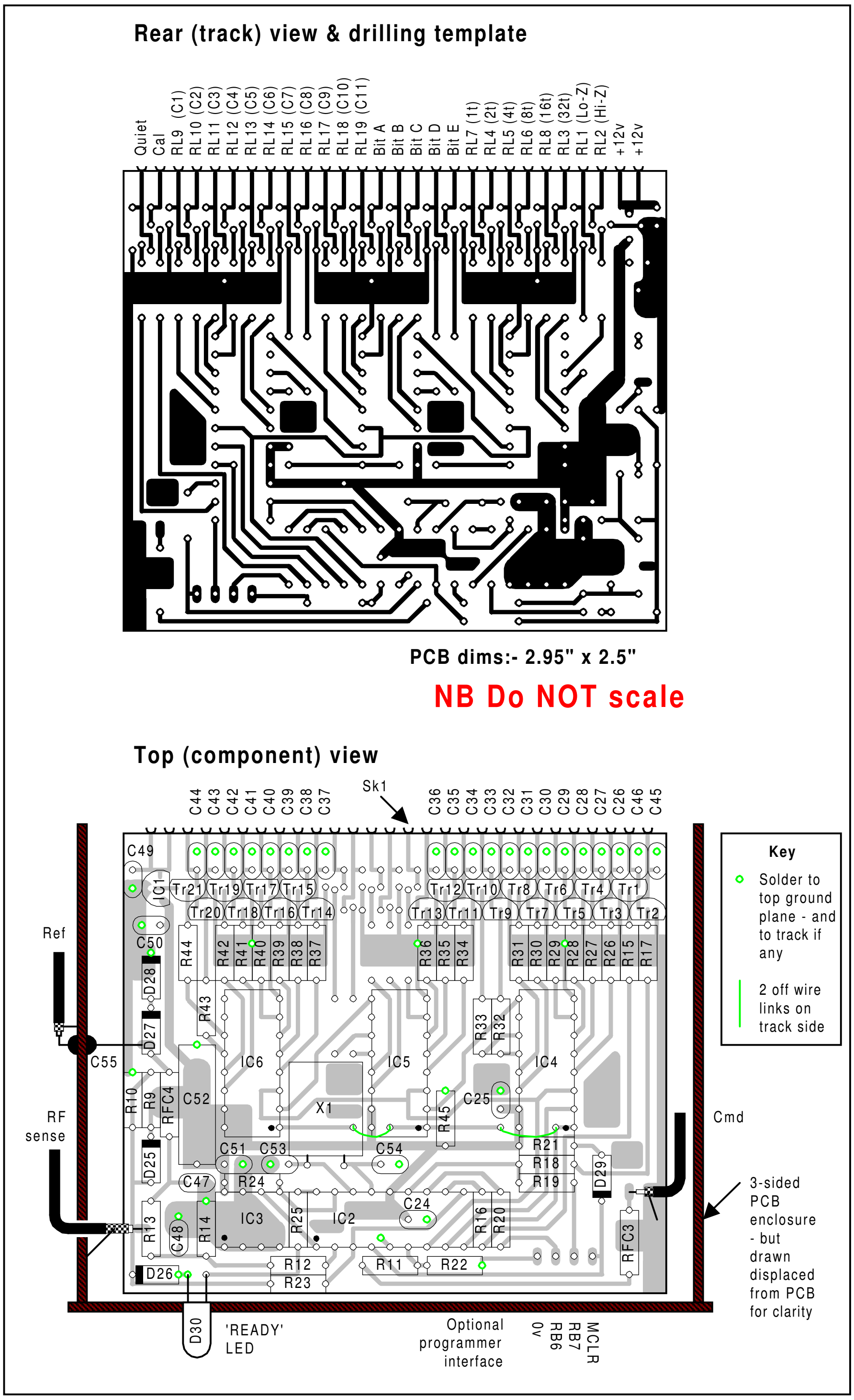

Fig 20: Logic board PCB. This is a double-sided PCB with the component side of the board completely unetched, providing shielding and ground connections. Note four through board links adjacent to R40, R36, R28 and pin 5 of IC2 - which bring ground through to the track side of the board. The PCB is shown etched for the optional bit outputs - but illustrated unpopulated.

off its end on Pl1.

Proceed along the plug remembering to leave a 5 pin gap near the middle (Bits A-E). Note also that the relays are not in any ' obvious order' and it is vital to get this right first time. Subsequent diagnostics if you get your wires crossed will be next to impossible, so check and check again. At the same time, check that all the protective diodes are fitted the right way round.

You will be left with one wire, the common +12v feed to the relays. Leave this free at this stage since it is needed for capacitor building.

BUILDING THE CAPACITORS

THESE ELEVEN CAPACITORS are built up on the copper side of the board. As a preliminary, finish cutting and drilling the clamp plates for C3-C11. Trial fit them all at the same time and using an indelible pen, write "C3", "C4" etc on each plate so that you will always fit the same clamp plate the same way round subsequently.

INTRODUCTION

The two smallest capacitors, C1 and C2 are air-spaced. The remainder use a polyethylene dielectric as illustrated in **Fig 21**.

Now for the science bit. Although the capacitor values follow the binary series 1, 2, 4 .... 1024pf, you must not attempt to build to those values. This is because two forms of stray capacitance will conspire to foil you.

There are general strays which you can observe just by watching a capacitance meter while waving your hand around inside the casing. Every effort has been made to minimise these but there is an irreducible minimum which you get between any two lumps of conductor in the same box.

Then there are the insidious switched strays. These are mostly the capacitance across the open relay contacts in series with the capacitors. These strays have the interesting property of progressively disappearing as the relay contacts are closed - and largely don' t even exist until the capacitors have been built.

The build process described removes potential errors from both these sources provided only that you stick to this simple rule:-

The measured value of any one capacitor when switched in on its own .... must always be greater than .... the measured value of all its smaller valued capacitors when switched in at the same time.

For example C4 must be greater than (C1+C2+C3). Note that (C1+C2+C3) is not the sum of their individual values. It is the single value of them acting collectively - which, because of the strays, is different.

The rule arises because when the software sends out the bits to demand an increase or decrease in capacitance, it has to assume that the opposite has not actually happened!

Doubtless this sounds complicated, but in practice it is very simple. The process and rule were hard won - and if you don' t observe them your ATU may well not work. So don' t abuse them.

SETTING UP

Before starting the build my general advice to you is to have a good clean up and vacuum thoroughly. You don' t need clean room conditions or to positively pressurise your shack, but conversely the dielectric properties of the odd dog hair are somewhat unpredictable.

Establish three distinct working zones. One for handling the polyethylene, one for the brass shim and one for assembly.

In the latter, stand the ATU on its edge, having first removed the logic board, its base plate and ground link.

Make up a test lead with an eleven way (or more) SIL socket - all pins joined together - and connect it to the -ve lead of a 12v supply. Connect the +ve supply lead to the common +12v feed to the relays. Note that you can now energise any one relay by mating this socket at right angles to Pl1 - or you can energise any consecutive number of relays at the same time - by mating the connectors in the usual way but with an appropriate offset. The ' rule' is falling into place.

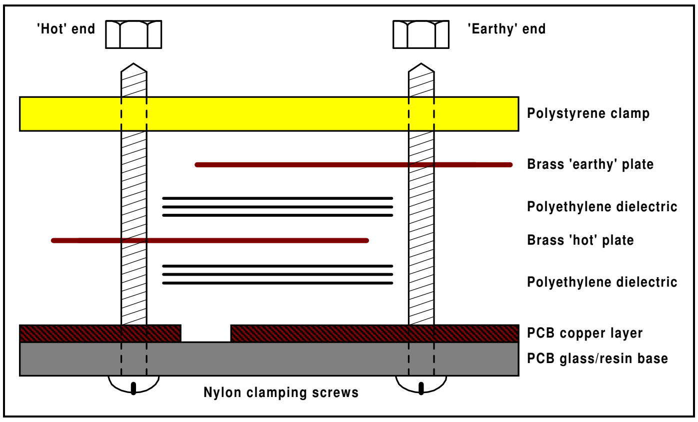

Fig 21: Generalised form of capacitor construction for C3-C11. Note that the PCB copper always forms one earthy plate. This is therefore a 3-plate capacitor (ie 2 layers of dielectric). Three layers of polyethylene film are illustrated per dielectric layer. The brass plates are soldered to each other and/or the PCB copper layer at their respective ends.

Connect your capacitance meter, one lead to the counterpoise terminal, one temporarily soldered to the bus-bar running along the capacitor switching relay bank.

In the polyethylene zone, set up a cutting surface at least 30cm square. Glass over newsprint (to give optical contrast) is ideal and old kitchen worktop works well. Do not use grained wood. Use some anti-static cleaner if you have some.

Remove the polyethylene bags from their box and cut off about the first five which will have been marked by the freezer ties provided - and return them to kitchen stock. Never attempt to tear bags along the dotted line. Only cut them with a sharp blade - or sharp scissors for coarse work. Never use the portion of the bag with the white contents and date label, nor the hard crease at the edges of the bag. Always inspect by eye and reject any film with obvious inclusions. I never found any! Small creases and stretch marks are OK.

Apply a film of DC4 grease to the glass. Squeeze out about 1cm from the tube and spread it using a flexible spatula. The long edge of a credit card is ideal. Try to get the grease film even and just wetting the surface.

Cut some strips of polyethylene about 70mm wide. Lay one film thickness on the grease. Now apply a wetting layer of grease to the film and it should become practically invisible. If not, there are probably two layers of film and an air gap. Lay a further layer of film on top - roughly aligned - and grease that also. Repeat for a third layer. That establishes some base stock of dielectric with three layers of film. You are now ready to trim dielectric to size - which is easier done when greased first. Trim the strip width down to 40mm (long edges roughly parallel) - which is the size needed for C7-C11.

In the brass zone, you need the brass shim stock, a 4mm drill, some soft wood, fine wet & dry and a vice. Also some cleaning solvent (I used cellulose thinners) and a lint free rag. To cut the brass either use a pair of tin snips or buy a cheap pair of scissors from the market and be prepared to write them off.

To drill a hole in the shim, mark the hole by eye, clamp it in the vice and drill against soft wood backing. Do not attempt mass production because you will end up with mass twisted shim instead.

The order of events is to cut the plate, drill the hole, radius the corners, rub down flat any sharp edges (most of them) and clean. The size of the plate, all right angles etc can be judged perfectly well by eye. Anything more subtle is a waste of time and you will be there for weeks.

GENERAL TECHNIQUE

See **Fig 22** for a view of the finished result. The film width is cut to clear the two clamping holes. Use the clamping plate to judge the other dimension. Lay one edge of the film into the capacitor, line everything up and 'roll' it into place. Smooth out any wrinkles or bubbles with a finger tip.

Then prepare a plate. Line it up with a screw through the hole and press it onto the dielectric. It should stick to the grease. Quickly tack solder it at the screw end. Press the centre with the plastic end of a screwdriver to get a rough measurement.

Proceed applying alternate layers of dielectric and plate (alternate ends). When you get close to the desired value, apply the clamping plate before taking a measurement.

The clamping plate is secured with M3 nylon screws and nuts. Torque them up finger tight only on the nut or you will strip the thread. When you get near to the desired value, go over the top and then trim back the final plate - unsoldered to start with. Also consider slipping in an extra layer of film to pull the value back somewhat.

COARSE BUILD SEQUENCE

The main purpose of this step is to crudely

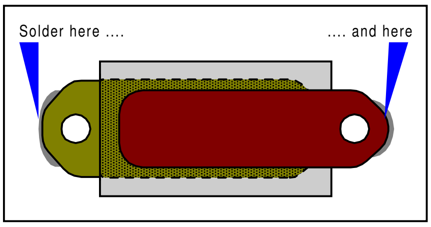

Fig 22: PCB plate construction viewed from below. The critical parameters are:- 1) the plate corners are arbitrarily radiused, 2) the dielectric is larger than the plate overlap zone by at least 3mm in all dimensions, 3) the cut edges of the plates are rubbed smooth and 4) the plates are different widths so that the long edges are not aligned. Thereafter, the absolute size and shape of the plates is completely unimportant.

build up the larger capacitance values (not observing the 'rule' yet) - so that the strays are established.

At switch on, you should be looking at about 15-20pf of residuals.

C1 and C2 are air spaced and it is easiest if these are crudely built first. Cut a full sized plate for C2 (about 27x12mm) and solder it to the 'hot' end with about 20mm overlap on the copper ground plate. Slide a piece of 2mm wire between the plates and use it to bend the shim so that the plates are roughly parallel and about 2mm apart. Repeat for C1, but with a shorter plate giving only about 8mm overlap.

Now for the big ones, starting with C9, 10 and 11. These can share common dielectric layers, at least to start with. They could also share shim ground plates, but the latter is more trouble than its worth.

Energise RL17 (C9) only and build up C9, C10 and C11 - applying the same number of plates to each - until C9 measures about 200-300pf. Clamp up C9.

Energise RL18 (C10) only and build up C10 and C11 - applying the same number of plates to each - until C10 measures about 500-600pf. Clamp up C10 and C11.

Energise RL15 (C7) only and build up C7 and C8 - applying the same number of plates to each - until C7 measures about 50-80pf. Clamp up C7 and C8.

Trim some 3-layer dielectric to 25 x 70mm and lay it across C3-C6. Without soldering them, add one full sized 'hot' plate each to C5 and C6 - one full width, half length plate to C4 - and one half length, half width plate to C3 - clamping up each one in turn.

You now have some sort of capacitor bank with the larger values (C6-C11) under sized and the smaller values somewhere near. A good start.

FINE BUILD SEQUENCE

From now on observe the rule! Draw up a table along the lines of **Table 1**. Date stamp it for your records. The table also shows the actual values achieved on my capacitor bank. For each row, the 'Alone' column is the value of a single capacitor. The 'Cumulative' column shows the value of that same capacitor - and all the smaller ones - all engaged at the same time.

The 17pf value represents the minimum capacitance achievable - and 2472pf is the maximum value with the full bank engaged. The theoretical maximum is just over 2000pf, so there is 400pf of excess - ie useful safety margin - in there somewhere. I doubt that it would be possible to build an air spaced variable to this specification.

So, applying the 'rule', the 'Alone' value of every capacitor must be greater than the 'Cumulative' value in the previous row. Obviously, the 'Alone' and 'Cumulative' values in the first two rows must be equal.

The next question is, if the value must be greater, how much greater? The answer for the smaller values is definitely 1pf. For the larger ones, some 2-5% but not critical.

You are trading off gaps in the capacitance range if you add too much - versus risk of breaking the 'rule' if there is any drift.

If you look at my C8, you will see that it observes the rule, but needs watching since if there is any drift the rule is at risk. By inspection, the safety margin could be improved by slightly reducing C7 and/or C6 and by increasing C8 by about 5pf. In the event, C8 drifted a few pf higher after a few days of use (they never drift lower) and all was well.

The 'Alone' value is measured by mating the connectors at right angles. The 'Cumulative' value, by in-line mating with the appropriate offset. In this case, always measure the voltage across the relay coils to make sure they are all energised, since with the connectors gently mated, it is possible to miss some.

	Alone	Cumulative
None	17	17
C1	18	18
C2	19	21
C3	22	25
C4	26	33
C5	36	50
C6	55	86
C7	94	162
C8	164	311
C9	320	615
C10	624	1228
C11	1251	2472

Table 1: Format of table for building capacitor bank - and my achieved values.

Start at the top of the table and work down. C1 needs to be 1pf more than your base residual value. Bend the plate to achieve this. Write in the actual measured value. Then C2 needs to be 1pf more than C1. Again bend the plate of C2. With both C1 and C2, you shouldn't let the gap fall below about 2mm or there is some risk of subsequent flashover.

Now energise both C1 and C2 and write the result in C2 cumulative. Add 1pf to it and pencil it in as the target for C3. Energise C3 alone and achieve the target with the clamping plate fitted, erring on the high side if anything - and write in the achieved 'Alone' value. Now energise C1 and C2 and C3 - write the result in C3 cumulative and the result plus 1pf as the C4 target .... and so on .... until you finish C11.

SOME TIPS AND OBSERVATIONS

• If you get too much grease on the dielectric, the capacitor will tend to drift higher in value over time as the excess grease distributes - and ultimately gets squeezed out of the edges.

• One approach to speeding up this drift if it is serious is to clamp up the capacitor with metal screws and nuts and leave it overnight. This is good practice at the end of a day's work anyway - and then just touch up the values next morning.

• Otherwise, regard the clamp plates as mere dust covers. Ideally the capacitance value should not change with or without the clamp plates and irrespective of the applied torque. These are not compression trimmers! In practice, and especially on the higher values, you can indeed alter the torque to trim the value by a few pf.

• Another trick is to apply a few extra layers of dielectric to the middle of the clamp plate - to increase the pressure on the plate overlap zone.

• Revisit the capacitors after about a week and repeat the full set of measurements. Correct any serious drift and keep good records so you can spot any trends. One of mine had moved quite a lot and I actually had to remove a whole plate to get it back. The others had barely moved at all. Thereafter there has been no significant movement - and believe me, it has seen a lot of use.

• You need to form a judgement as to how often you need to check the values, but in my experience, once they settle down, they stay settled. Whatever happens, if it all works, don't touch it!

• Once you are happy, run a trivial drop of epoxy resin under an edge of C1 and C2 to hold the spacing - and apply some non-setting thread locking compound to the M3 screws.

COMPLETING THE WIRING

BEFORE REFITTING the logic board take the opportunity to fabricate a top cover. Use either brass shim with external lips or oversized double sided PCB.

Drill a small hole for D30 in the top cover (to let the light escape!) and orient the LED. Do not fit the cover at this stage.

Refit the logic board base and its earth lead. Place the logic board assembly in position and solder it to the bottom plate at no more than three points. Connect up the three flying leads and the Cal and Quiet leads to the sensor section, and a short link to the two +12v pins. Dress the longer leads along the casing wall, next to the dummy load.

Fit a spark gap across the two output terminals, either across the coax output socket or external to the casing. Adjust it for a few thou trivial gap at this stage - and you are ready to go!

COMMISSIONING

AT THIS POINT the entire project is built and fitted - with the exception of IC4-IC6, cover plates and environmental sealing.

Connect a 100Ω 2W carbon resistor across the ATU antenna and counterpoise terminals. Connect your Tx/Rx via your SWR bridge to the Command Unit with 50Ω coax. Run a further length of coax from the Command Unit to the RF input connector of the ATU. Put your Tx/Rx on one of the LF bands. Connect the supply (13-14v DC) to the Command Unit.

Immediately on powering up the Command Unit the Quiet and Cal relays will energise and you should hear the greeting message as previously described.

The relays will then de-energise and the 'READY' LED will light.

PHASING T1 AND T2

Power off PicATUne. Connect a high impedance voltmeter or 'scope to the Ref line at C55 (the feedthrough), looking for a few hundred mV DC. Switch on PicATUne and only while it is sending the greeting message, apply about 10W of carrier on 80m. The voltmeter should read 150mV or less. If substantially more, swap over the winding leads of either T1 or T2 (but not both) and repeat.

Your SWR head is now sensing reflected (as opposed to forward) power.

USING PicATUne's MENUS

The operation of your Command Switch depends on the type of switch fitted. If a toggle or slide switch, a command is issued by changing it to the opposite position. If a non-latching push button, then a press and immediate release is required. For the sake of brevity the term "Press the Command Switch" should be read as "Issue a command according to the type of switch fitted." So, without further ado, press the Command Switch.

The relays will energise again and you will hear:- '**M U S I C**' which is the main menu. Its significance will be fully discussed later.

Transmit a brief carrier at about the 2W level. Note that there is some reflected power and that the 100Ω resistor gets hot. This verifies that the Tx is connected through to the dummy antenna.

On key-up, PicATUne may well respond with '**X K**' continuously repeated, which simply means it has searched for a pre-stored matching solution and, not surprisingly, has failed to find one. Acknowledge and cancel any XK sequence by pressing the Command Switch.

Now for a menu selection command. At this stage you are being invited to test the system by rote and not to understand much about what is going on. That will follow.

So, press the Command Switch to bring up the main **MUSIC** menu again - and as you hear the second (or first) dash of the **M** press the Command Switch again.

PicATUne will respond with '**R M**', which means roger, got your command, **M** was selected. '**M**' will be continuously repeated. For your interest, you have now entered the "Match from Scratch" mode.

Transmit a carrier at about the 5-10w level (in bursts of no more than 3 seconds) and note that your SWR bridge shows something close to 1:1 SWR. This verifies Quiet match operation - with the vast majority of the Tx power being routed to PicATUne's dummy load - and not to the dummy antenna. On each key-up, PicATUne will send '**M**' continuously which means, again - not surprisingly - that you have not been transmitting long enough for it to find a matching solution. Given that IC4-6 are not yet fitted, it never stood much chance! Press the Command Switch to cancel the M sequence.

On the sockets for IC4 and IC6, connect one end of a jumper lead to pin 16 (+5v) and then dab the other end on pins 4-7 and 11-14 in turn. One relay should energise each time, and it might be wise to check it is the correct and only one. Repeat for IC5's socket, but for pins 4-6 only. Do not proceed if there are any issues here.

All being well, power off, wait a few minutes, fit IC4-6 in their sockets and power back on again.

And now for the next tune .....

MATCHMAKER, MATCHMAKER ...

... make me a match! Get back to repeated '**M**'s as just described but this time when you supply a carrier, let PicATUne actually find the match for your 100Ω dummy antenna. During this process you will hear an amazing rattling of relays, much like a Gatling gun. When the relays all start to bang on and off at about 1Hz - and the Command Unit LED is flashing at the same rate - key up and PicATUne will send you '**R K**'. Your first match achieved!

Then transmit a brief burst of carrier and note that the SWR is acceptable. The power is being matched into your dummy antenna at this stage and it will heat - and maybe overheat if you are not quick.

If you experience anything unusual here, monitor the Ref line (at C55 in practice) using an oscilloscope with a high impedance probe, set to DC using 200mV sensitivity and the timebase on 10mS. As PicATUne searches for a match, you should see a triangular waveform moving up and down on a varying DC pedestal. The DC level represents the reflected power and PicATUne is attempting to minimise it.

At the end of the matching process - and after key up and down again - it should go to the lowest value you (and it) observed.

As a final confidence test, power off, wait 20 seconds and power on again. After you hear the greeting, supply a brief burst of carrier. PicATUne should leap to the matching solution - as soon as you key up.

REFERENCES

[7] http://www.qsl.net/ei9gq/