MICROWAVE NEWSLETTER

An Amateur Radio publication for the Microwave enthusiast, published by the Radio Society of Great Britain and edited by G3PHO and G8AGN

Lambda House, Cranborne Road, Potters Bar, Hertfordshire, EN6 3JE

FROM THE EDITORS

March 1994

We are very pleased to publish a "scoop" this month.....the G4DDK009 3GHz source. Full details of this little gem, ideal for multiplying up for 24GHz use, take up the bulk of this issue. We have some more interesting technical articles coming up in the next few issues. Many thanks indeed to all contributors. Keep on sending in **your** articles!

COMPONENT SERVICE NEWS

The G4JNT 1.3GHz low power transverter module has now completed its Beta tests and will be available from the Microwave Components Service at a price to be announced soon. A 20 watt PA has been successfully breadboarded.

In December 1993, the G3WDG007 1 watt 10GHz PA was released and over 20 kits have so far been sold. The price to RSGB members is **£118.85** and to non-members it is **£140.25.** These prices can be maintained for the next ten kits or so, after which an increase may be necessary since the cost of the FET is likely to rise when Charlie next reorders.

Progress with the redesigned G3WDG001 oscillator board for 11.5/12GHz has been steady and it is hoped to beta test it very soon. The new design, the WDG009, uses a printed microstrip filter in place of the cavity, thus easing construction. MGF1302 devices replace the Birkett "black spot" GaAsFETs used in the original version. The multiplier has been arranged to go x5, so that the existing G4DDK004 LO source can be used. Two designs are being developed, the G3WDG009S and 009L. The S version is designed to cover an output frequency of 11.9 to 12.1GHz and can be used for onward multiplication to 24.048GHz or 24.192GHz. The L version will produce output at around 11.5GHz so that a 1296MHz intermediate frequency may be used for the 24.192GHz gear. So far three development models of the L version and two of the S version have been built. All have given 40mW or more output.

For further details of these and other Microwave Component Service items write (enclosing an s.a.s.e) to:

Petra Suckling, G4KGC,
314A Newton Road,
Rushden,
Northants, NN10 0SY,
U.K.

or telephone: 0933 411446

ALL WRITTEN CONTRIBUTION TO THIS NEWSLETTER SHOULD BE SENT TO:

Peter, G3PHO, 146 Springvale Road, Sheffield, South Yorkshire, S6 3NU

or to

Barry, G8AGN, 345 Redmires Road, Sheffield, South Yorkshire, S10 4LD

BY THE LAST FRIDAY OF THE MONTH

SILENT KEY

It was with deep regret that we learned of the death of Cyril, G3VVB. His good friend Mike, G8ATK, has sent us the following obituary:

VHF/UHF and Microwave Amateurs will be saddened to learn that Cyril died on 22 January 1994, after a short illness.

Cyril, until his move to Cornwall, was a member of the Echelford ARS, where he was a "topband" and two metre enthusiast. When he and his wife retired to Cornwall, the first thing Cyril did was to buy a small boat to indulge his passion for things nautical. It is reputed that, whenever Cyril put out, the North East Wind did blow!

After a short spell of things nautical, Cyril was asked to make a filter for 23cm, which was the catalyst for things to come.

A proliferation of requests soon followed, ranging from Morse keys to a ring of six 2C39A for 23cm. It was therefore Cyril's dedication to our hobby which enabled many amateurs, all over Europe, to explore 23, 13, 9 and 3cm with his professionally-machined cavities and filters.

Cyril was an active member of both the English China Clays Radio Club and the Mid-Cornwall Repeater and Beacon Group. GB3MWB, on 1296.860MHz, will remain as a tribute to his dedication to Amateur Radio.

A simple service was held at Truro Crematorium on the 26th January, conducted by his son-in-law, the Reverend Colin Morris. Members of the ECC and MCB groups were in attendance to mark the passing of a dear friend.

To his wife Ruby and daughter Sandra, we extend out sympathies.

G8ATK

HELP WANTED

Mike, G3LYP, would like to hear from anyone who has designed a circuit for use with reed position sensors on a satellite antenna elevation jack (e.g. the Superjack III or similar). Please contact Mike QTHR, or ring 0494-881298.

FOR SALE & WANTED

Steve, G4LRT, has the following for disposal:

Spectrum Analyser - Tectronix 547 Oscilloscope with:-

1A2	Dual Trace scope
1L20	10MHz - 4.2GHz
1L30	925MHz - 10.5GHz
	plug-in units

Price £500

Steve **WANTS**;
Hewlett Packard Harmonic Mixer type 11517A and WG adapter type 11519A, 18-26.5GHz. For 8555A Plug-in.
Please write to him at: "Hillview", Stanford Close, Cold Ashby, Northants.

A HIGH QUALITY SOURCE FOR THE 2.8 - 3.5GHz FREQUENCY RANGE G4DDK009

by Sam Jewell, G4DDK

For several years I have been collecting waveguide 20 (WG20) components with the eventual aim of putting them to use in a 24GHz transverter. This was very much a background activity until DB6NT published his simple MkII 24GHz transverter in Dubus 1/93. Dave, G4FRE, quickly built one up and showed it to work extremely well. Dave used a commercial phase locked source at 11448MHz as the local oscillator. Good as these sources are, they can be noisy and need a +20 volt supply. Although 20 volt supplies are often available in the shack, they can be inconvenient when operating portable. I felt that if I was to build a DB6NT system, I would need a smaller and better local oscillator.

To generate 11448MHz, requires (in my scheme) a source at 2862MHz. However, this is just beyond the upper limit of my previously published DDK004 source. Several amateurs had reported modifying a DDK004 source to produce an output at over 3GHz, but output level was generally low and these modifications required some difficult to obtain trimmers for the output filter. I decided to design a completely new source for the 2.8GHz to 3.5GHz range. I first presented the resulting G4DDK009 at the November 1993 Martlesham Microwave Round Table.

Although the original requirement was for 2862MHz, I felt that a 24GHz source would be a more useful starting point, so the following description assumes that the source will be used to generate 3024MHz. This, when quadrupled, will give 12.096GHz. A DB6NT doubler to 24GHz can then be used to produce a very useful 5 to 10mW output at 24.192GHz.

The DDK009 design follows my usual arrangement of Butler oscillator, operating at 94.5000MHz, with TR2 quadrupling to 378MHz. TR3 then doubles to 756MHz. A two stage TOKO helical filter is used to select the required second harmonic. This is similar to the arrangement used by DB6NT in his 12GHz source in Dubus 4/90. I had to work hard to obtain anything like a good match between the BFR91A output and the filter input. This shows as a slightly different tuning position for the two ceramic tuning elements in the filter, compared to when the filter is ideally terminated in a 50R load.

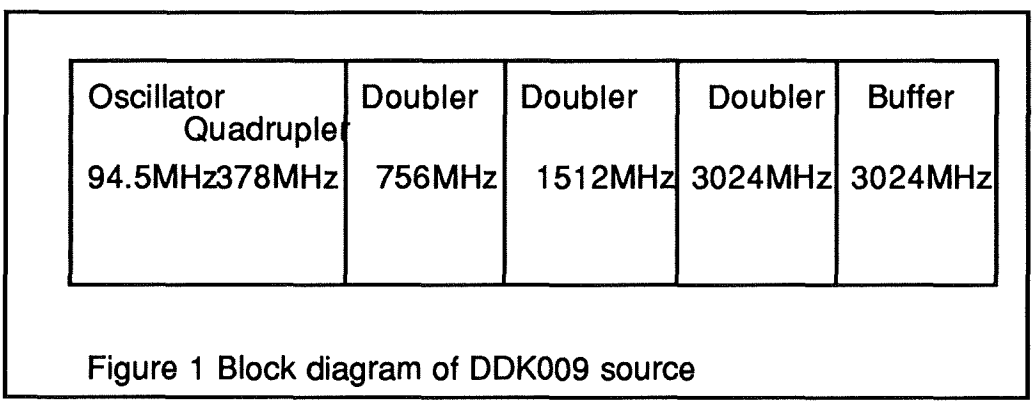


Figure 1 Block diagram of DDK009 source

TR4 doubles to 1512MHz, and the required harmonic is selected by the double tuned filter consisting of two printed lines and TC3/4. All critical decoupling around the doublers is by means of surface mount 1000pF, 0805 size ceramic capacitors. These have proven effective and nicely replace the 'old' trapezoidal capacitors which have now become difficult to obtain.

I chose to use a GaAs FET for the final doubler to 3024MHz. Past experience with bipolar transistors at 3GHz had not been good and GaAs FETS were known to work effectively as doublers at these frequencies. G4JNT used a similar arrangement in his 3.4GHz transverter local oscillator published in the Microwave Newsletter in October 1992. The 'filter' that follows the GaAs FET is a brass resonator to the dimensions given by DB6NT in his article on * his 5·7GHz Trnsvtr. These are repeated in figure 2.

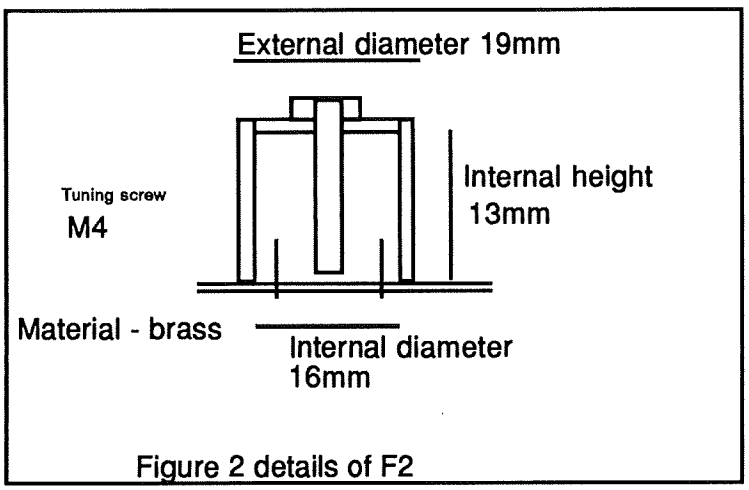


Figure 2 details of F2

Probably due to insufficient drive at 1512MHz, I found that using the DB6NT 'no bias' scheme on the GaAs FET doubler did not work. Efficiency was low and highly dependant on the value of the drain resistor used. I decided to use a negative voltage generator bias scheme based on the 7660 IC. This allows the bias on the GaAs FET to be adjusted for best doubling efficiency and removes any need to select devices.

I was not too happy with the idea of connecting the resonator directly to the output. Again experience had shown that 'filter' performance is critically dependant on the output match. Small changes in loading often required substantial re-tuning of the resonator for maximum output. Clearly a buffer was needed.

After discussion with G3WDG it was decided to try a MODAMP as the buffer. Now, modamps don't work too well at 3GHz, with both gain and output power shown on the data sheets as low. Even so, the use of a Modamp can be beneficial in ensuring stability and reproducibility.

In my two prototypes an MSA0404 gave +4dBm output, an MSA0910 gave +8dBm and an MSA 0885 gave +12dBm. Normally I avoid MSA08's because of stability problems. However, in this design the MSA0885 behaves itself and gives a useful level of output, even at 3.5GHz. The MSA04 and 09 output would be well down at this frequency. I have no hesitation recommending the MSA0885 for use in the DDK009.

The source is built-up on a 1/16th inch fibreglass PCB. All components except the supply feedthrough capacitor mount on the PCB. The PCB is seam-soldered into a 148 x 37 x 30mm tinplate box, type 7756, available in the UK from Piper Communications, 4 Severn Road, Chilton, Didcot, Oxon, OX11 0PW.

Because of the height of F2 the ground-plane side of the PCB must be mounted 20mm below the rim of the box. This will give sufficient clearance

* Dubus 3/91 p. 18

for the M4 adjusting screw and half lock nut. An SMA connector connects directly to the output track.

TR1 and 2 are surface mount BFS17 devices. TR4 and 5 are BFR91A. TR5 is a MGF1302. IC3 is the Modamp. All of these parts, plus L4,C15,16,24,25,26,27,28,29 and 30 mount on the track side of the PCB. Three pins are used to locate the brass resonator F2. The resonator probes are 1mm diameter Veropins (RS 433-854) used full length, and soldered on the track side only.

Connect +12 /+13.5V to the input feedthrough capacitor.
Confirm +9V at the output of IC1.
Confirm +5V at the output of IC2.
Confirm -5V available at pin 5 of IC4.
Set RV1 to give <>1mA through R18.

Alignment of the source is easy, and follows the guidelines given with my earlier designs.

Use a wavemeter, scanner receiver or FM band 2 radio to confirm the 94.5MHz oscillator is operating. Don't worry too much about absolute accuracy at this stage. A few kHz error can be corrected later. Use a MOVING COIL voltmeter (please, please, please, not a DVM) and measure the volts across R11. Adjust TC1 and 2 for a peak reading (<> 0.5V). Confirm with a wavemeter or scanner receiver that you have peaked TC1/L2/TC2/L4 at 378MHz. Transfer the meter to across R16 and peak the ceramic tuning cores of F1 for maximum reading (<>0.7 - 1.5V).
Move the voltmeter to across R18.
Adjust TC3 and TC4 for peak reading across R18. (<>0.7 - 1.5V).
Connect an absorption wavemeter or milliwattmeter to the output. If using a wavemeter, tune to 3024MHz. Adjust F2 screw for maximum output. Re-adjust RV1 to maximize the reading. If you are using a broadband milliwattmeter i.e. HP430/1/2 etc. confirm with a frequency counter, spectrum analyser or wavemeter you have selected the correct frequency from the wide range available at the output! You should expect to obtain at least +10dBm output

It may be worth slightly re-adjusting all the trimmers for maximum output. If more than a very small amount of re-tuning is required, something is probably wrongly aligned. Go back and start again.

Use a frequency counter to set the oscillator output frequency to 94.500000MHz. If the frequency comes out high, and output falls rapidly as you pull down onto frequency, try shorting out C8. If this doesn't work you probably have a *odd* crystal.

I currently have my first prototype tuned on 3256MHz for use with a 3400MHz transverter and 144MHz IF. Output is +12dBm.
The second prototype is on 3024MHz and gives +11dBm output.
This is followed by a prototype G3WDG009S (coincidence!) 3 to 12GHz quadrupler. Output is +15.4dBm at 12.096GHz from this combination.
This is followed by a DB6NT doubler to 24192MHz, giving 10mW output for a test source. The carrier at 24GHz produces an excellent T9 note.

The TOKO helical filter quoted in the component list will not allow the source to be tuned to 2862MHz because the output from the first doubler stage needs to be at 715.5MHz, and this is outside the tuning range of that filter. The following table shows which filter to use for a number of

G4DDK009A 17-1-1994 COMPONENT LIST

DESIGNATOR	PATTERN	VALUE
C1	RAD0.1	1n CERAMIC
C2	RAD0.2	0.1 uF TANTALUM
C3	RAD0.2	1.0 uF TANTALUM
C4	RAD0.1	4p7 CERAMIC
C5	RAD0.1	15pF CERAMIC
C6	RAD0.1	22pF CERAMIC
C7	RAD0.1	18pF CERAMIC
C8	RAD0.1	10pF CERAMIC
C9	RAD0.1	1n CERAMIC
C10	RAD0.1	1n CERAMIC
C11	RAD0.1	10n CERAMIC
C12	RAD0.1	2p2 CERAMIC
C13	RAD0.1	1n CERAMIC
C14	RAD0.1	220pF CERAMIC
C15	SMD0805	220p CERAMIC
C16	SMD0805	10p CERAMIC
C17	RAD0.2	0.1uF TANTALUM
C18	RAD0.2	1uF TANTALUM
C19	RAD0.1	18p CERAMIC
C20	RAD0.1	100p CERAMIC
C21	RAD0.1	22uF TANTALUM
C22	RAD0.1	10uF TANTALUM
C23	RAD0.1	22uF TANTALUM
C24	SMD0805	1n SURFACE
C25	SMD0805	1n SURFACE
C26	SMD0805	1n SURFACE
C27	SMD0805	1n SURFACE
C28	SMD0805	1n SURFACE
C29	SMD0805	1n SURFACE
C30	SMD0805	100p SURFACE
F1	TOKO-5HWA	367MN-104A
F2	Brass resonator internal diameter 16mm internal height 13mm probe height 6mm (see figure 2)	
IC1	TO92	78L09
IC2	TO92	78L05
IC4	DIL8	7660
IC5	HP Avantek	MSA0885
L1	MC120	MC120 GREEN IN CAN + Aluminium core
L2/ L3	COIL 250X300	3turns 20SWG Au plated Cu wire. 3mm i.d
L4	COIL	19mm length of 0.315mm diameter enamel covered copper wire bent as shown in component overlay. Press close to PCB.
R1	AXIAL0.4	1K
R2	AXIAL0.4	1K
R3	AXIAL0.4	560R
R4	AXIAL0.4	470R
R5	AXIAL0.4	1K
R6	AXIAL0.4	680R
R7	AXIAL0.4	390R
R8	AXIAL0.4	18R
R9	AXIAL0.4	22K
R10	AXIAL0.4	1K2
R11	AXIAL0.4	27R
R12	AXIAL0.4	10R
R13	AXIAL0.4	15R
R14	AXIAL0.4	22K
R15	AXIAL0.4	2K2
R16	AXIAL0.4	39R
R17	AXIAL0.4	100nH MOLDED
R18	AXIAL0.4	100R
R19	AXIAL0.4	150R
RV1		2K potentiometer Cermet single turn miniature round
TC1	SKYCAP	10PF (BLACK) SKY
TC2	SKYCAP	10PF (BLACK) SKY
TC3	SKYCAP	5PF (GREEN) SKY
TC4	SKYCAP	5PF (GREEN) SKY
TR1	SOT23	BFS17
TR2	SOT23	BFS17
TR3		BFR91A
TR4		BFR91A
TR5		MGF1302
X1	XTAL1	94.500MHZ 5TH
OVERTONE HC18/U		

Miscellaneous items

Tinplate box type 7756 from Piper Communications, 1000 - 5000pF feedthrough capacitor for supply filtering, two hole mounting SMA socket. Veropins type 1mm diameter (RS stock number 433-854)

alternative output frequency ranges. If you have a requirement that is not shown, it would be wise to consult a TOKO coil and filter catalogue to determine the correct filter to use.

Output frequency	Doubler 1 output frequency	TOKO filter required
2862MHz	715.5MHz	367MN-102A
3024MHz	756MHz	367MN-104A
3256MHz	814MHz	367MN-105A
3400MHz	850MHz	367MN-105A

At last I have a use for all those WG20 bits sitting in the shack. Perhaps I will see you on 24GHz nb this year?

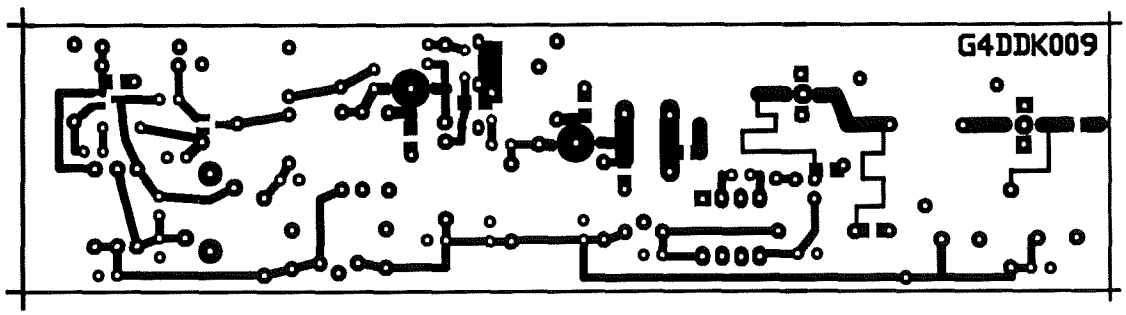
If you are interested in building a DDK009 source I am prepared to produce a limited number of hand made PCBs. Alternatively, if you have your own PCB production facilities, I would be prepared to provide the artwork for you to produce your own prototype boards.

If anyone is willing to make a small number of the brass resonators for other constructors, please let me or the Newsletter editors know.

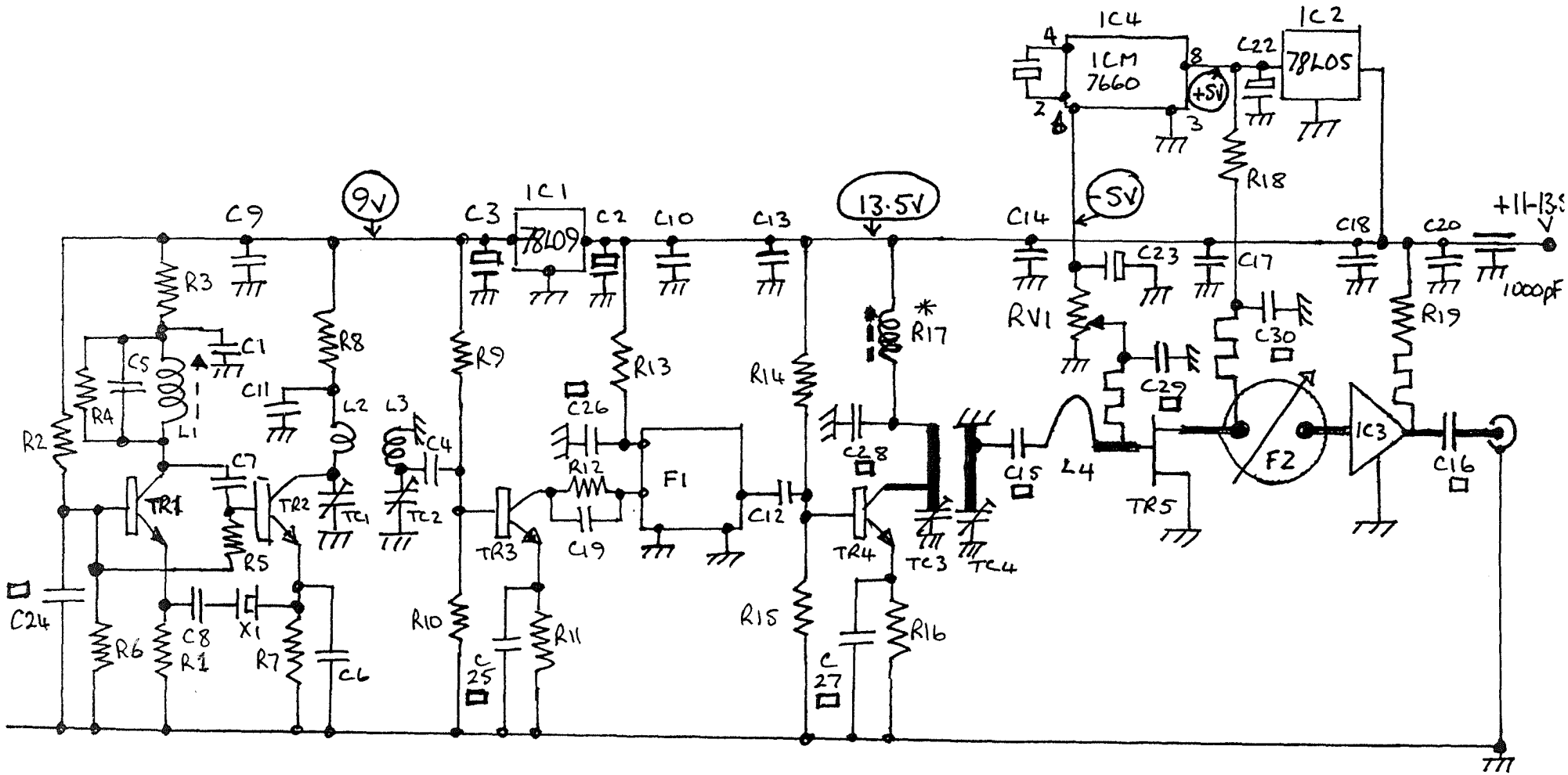
I can be contacted at:- 56 Meadowlands, Kirton, Ipswich, IP10 0PP.

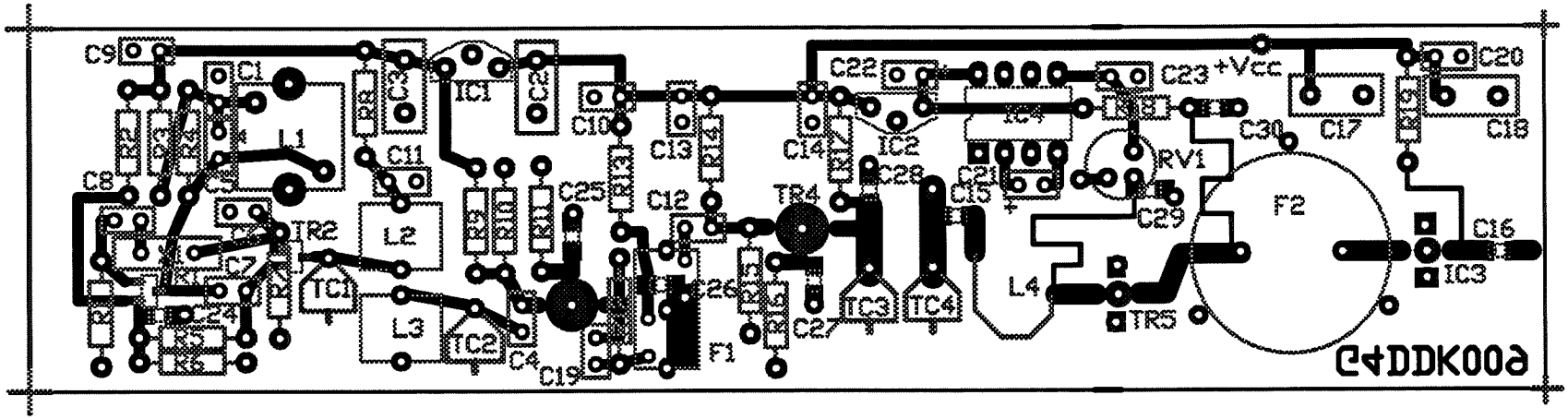
Good dx in '94
73 de Sam

PCB LAYOUT:



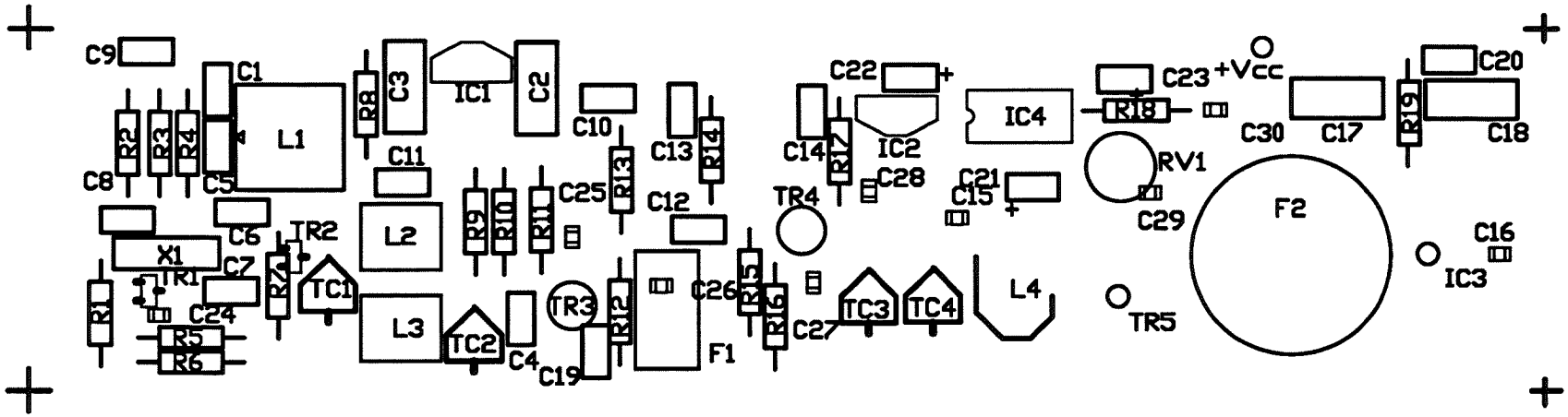
G4DDK 009 3GHz Local Oscillator





G4DDK009 3GHz local oscillator

DDK009A Check Plot



G4DDK009 3GHz local oscillator

DDK009A Overlay

ANOTHER WAY OF ALIGNING THE WDG003 TX CONVERTER

by Dave Robinson, G4FRE

Having finally lost patience with the intermittancy of my much hacked original Beta model of the WDG003 Tx converter I finally decided to build up a new board. Previously I had used the original alignment notes which were ok if you had patience and a trained AVO. There must be an easier way, where the performance of each stage could be checked individually. I found my WDG001 beta unit which still gave 70mW on 10368.185 and decided this would make an excellent alignment source. By soldering in the FETs in stages working back from the output, injecting a signal in the space not occupied by the "last missing FET" and using a power meter on the output the unit could be aligned. The procedure is as follows:-

Build the TX converter with omitting F1 to F6

Connect power meter/detector to the output. I used an HP432A with 10dB pad, my 436A is harder to use to peak things, (much akin to aligning Pye gear using a DVM on the test points)! The source is connected initially by a 10dB pad, increasing this as necessary to keep the output stage out of compression.

Solder in F5 and F6, set the bias and verify DC operation is OK. Temporarily disconnect L11 and L12 from the RF tracks (to avoid the risk of shorting out anything vital). Inject the signal where F4 should be, using 0.085" semi rigid (the size SMALLER than UT141) to try and limit the step discontinuity. The centre conductor of the coax is connected to the PCB track leading to FL4, the outer conductor is soldered either side to the source pins of F4. Align FL4 for maximum output.

Reconnect L11 and L12. Disconnect L9 and L10. Solder in and check F4. Connect the semi rigid in the space of F3 injecting the signal onto track input to FL3. Align FL3 for maximum output, then check alignment of FL4 which may need the SLIGHTEST of tweaks.

Reconnect L9 and L10. Disconnect L6 and L8. Solder in and check F3. Inject in the space of the mixer FET F2. Align FL2 for maximum output, then check the alignment of FL3 which may need a slight tweak.

What you have now is a selective 10368MHz amplifier chain. How do you align FL1? Use the process in reverse.

Disconnect L6 and L8. Solder in and check F1.Inject the 2.5G at J1 as normal. Connect the power meter, via the piece of semirigid in place of F2, connecting the centre conductor to the OUTPUT track of FL1. Align FL1 for maximum.

F2 the mixer fet is then soldered in and biased as per the instructions and the power meter connected to the output. Applying 144Mhz drive will give an indication on the output. On all 3 units now aligned using this method the power was over 50mW which is was impossible to improve on!

ACTIVITY NEWS
NEWS AND VIEWS FROM THE WORLD ABOVE 1000MHz

Not a great deal of news this time but first of all we have a red face due to the typing error on page 10 of last month's issue where we showed the GB3CMS frequency as being in the 19GHz band!!! It is of course on 10368.960MHz. We were also rapped hard on the wrist by G4FRE for implying on page 12 last month that he domiciled in Lowestoft, apparently "not the done thing" in the Suffolk region! He lives,**as everyone knows,** in Felixtowe.

Steve, G4LRT, (Cold Ashby, Northants), reports the beacon GB3LES as being off the air for a couple of weeks at the end of February due to a lightning strike at the site. This burnt out the mains earth lead but all is back to normal now. Steve also says the licence for GB3LEF (9cm) has been received. It uses hardware built up from the old 3.4GHz beacon, GB3UOS. Its frequency will be 3400.955, with an output of 2 watts. Feeders and antenna still have to be installed at the site (same at GB3LES) but it is hoped it is QRV later this year.

Steve has comments regarding the recent bandplan listings which show an alternative narrowband segment for the 6cm band as 5668-5670MHz. He thinks this is unwise as the crystal required for a 144MHz IF is around 92.0666 or 115.08333MHz. If the band were lowered to 5664-5666 then the crystal would be 92.000 or 115.000MHz, the same as used for 3456MHz. It could mean that, in the future, modes such as Spread Spectrum or Phase Coherent transmission will be in vogue and a need will exist to phase-lock the transverter crystal to an off-air standard. This would be impossible if the 5668 band is used.

Charlie, G3WDG, (Rushden, Northants, reports further EME activity. VE7CLD was worked on 7 January 1994 at 0310z with M reports both ways. VE7CLD, Gunter, has a 12 foot dish and just under 20 watts output, with a 0.8dB receive preamp. He receives 14dB of sun noise. Conditions during this first G/VE contact on 10GHz were not very good, with some cloud attenuation evident at times. The dish mount was tested by 40-50mph winds at the time(!) but, apart from a slight wobble on the moon noise meter in the strongest gusts, it wasn't much of a problem.

Charlie found further evidence of cloud attenuation on 31 Dec 93 when XYL **Petra, G4KGC,** worked WA7CJO for the first time. She had problems with the TWT helix current tripping out owing to low line voltage and was therefore limited to "only" 10 watts output. On two overs her signals were inaudible with WA7CJO due to incoming rain clouds on the path. As it started to rain the signals went up to O copy as by then the cloud was not in the path. From similar experiences on 11GHz Sat TV, Charlie concludes that the weather can severely affect lower power EME stations on 10GHz.Finally he lists useful windows for G/USA EME on 10GHz at 0030-0130 on 23 March and 0130-0200 on 27 March. Take a listen!!

Steve, G4KNZ(Bracknell, Berks.) used 24GHz during the January Winter Cumulative, operating from a site about 10km east of Winter Hill (Lancs) and worked G8KMH/P at Long Mynd (path length 126km). Narrowband was used. A wideband qso was obtained with G3FNQ who was at home. On 13 February, Steve worked G3LQR over a 12km path from a portable site at Otley, Suffolk to Simon's home QTH. He also heard G4DDK's 24GHz beacon at 17km from the same site. Once again, narrowband on 24.192GHz was used.

That's it for this month....73 Peter, G3PHO