

Quelques Watts sur 5,7 Ghz

FCDPH CTS 6

Le 6cm est une bande très peu utilisée en France et même en Europe. L'OM intéressé par les Hyperfréquences a tendance à passer du 1296 Mhz ou 2300 Mhz directement au 10 Ghz, laissant de côté cette bande qui a des atouts importants. La bande débarrassée du guide d'onde imposé par le circuit imprimé sur verre téflon, les transvertis, préamplis et amplis sont facilement réalisables et reproductibles. Les Fet fonctionnent très bien à cette fréquence avec une bonne stabilité et un gain important. Il en résulte une certaine facilité de construction et de réglage. Quant au trafic, beaucoup d'essais restent à faire. En contests, des multiplicateurs seraient les bienvenus.

Pour résumer, le 6cm est une bonne base pour construire et trafiquer en hyper. Je renverrai les OM intéressés à la revue DUBUS (1) ou les équipements 5,7 Ghz sont largement décrits.

Mais revenons à nos Watts! Le prix raisonnable d'un Fet AsGa préadapté de 12 Watts en 7 Ghz (à Weinheim et à Auxerre) m'a permis de construire l'ampli décrit ci-dessous. La description se veut adaptable à d'autres opportunités et reproductibles. Le Mylar est disponible pour du verre téflon 0,8 et 0,5 (Er 2,5).

Description

a) Ampli

L'ampli se compose de deux transistors : MGF 2172 (2,5 Watts à 8 Ghz) et d'un FLM 6472-12 (12 Watts à 7 Ghz) placés dans des lignes 50 Ohms. L'adaptation se fait par positionnement de petits stubs. Le mylar ne tient pas compte des emplacements des transistors pour installer ce que vous trouverez...

b) Alimentation

L'alimentation largement décrite par DB6NT (2) est intégrée dans le boîtier, elle est construite autour d'un LT 1083CP (7,5A réglable en tension), largement dimensionné, mais bon!... Avec les résistances indiquées, la tension est de 9,5 Volts. Cette tension est coupée si le -5 Volts de Polar viendrait à manquer. La polar est réalisée par un 78L05 et un 7660. On peut utiliser des composants conventionnels ou des CMS.

c) Boîtier

Le boîtier est réalisé en alu fraisé avec une semelle épaisse. L'ensemble est très rigide! Tous les éléments sont fixés par des vis M2 ou M3 directement taraudées dans le boîtier. L'emplacement des transistors est fraisé à la hauteur des pistes 50 Ohms du CI. Un morceau de mousse absorbante est collé à l'intérieur du couvercle. Un radiateur est fixé sur la semelle du boîtier. Les prises d'entrée et de sortie sont des SMA.

Montage

L'état de surface du fond des emplacements des transistors et de la semelle où s'adapte le radiateur doit être très fin pour un refroidissement efficace. Il faut se servir du CI pour marquer les trous à percer et à tarauder. Ne pas oublier les quelques rivets de masse Ø 0,8. Le CI préparé est monté dans la boîte en appliquant un peu de colle à l'argent (si vous avez!) et par les vis M2. Le régulateur est monté directement sur le fond de la boîte par une vis M3. Montez tous les composants sauf les transistors, vérifiez les alimentations, et si la sécurité -5 fonctionne!

Avant de continuer le montage des AsGa, une petite bière est nécessaire (la bière annule les effets statiques, hé oui!)

Montez les transistors en prenant les précautions habituelles, boîtier à la terre, fer débranché le temps de la soudure et l'OM à la masse (ça on savait!). Utilisez de préférence de la soudure pour CMS en pâte (seringue).

Réglage

Les transistors utilisés ont fait preuve d'une très grande stabilité. Réglez les courants comme indiqués dans les notices, injectez la HF, chargez et mesurez la puissance. Promenez des petits bouts de clinquants sur les pistes 50 Ohms, d'abord en sortie puis en entrée. Reprenez les réglages des courants pour le maximum de sortie. « Tune for max with out smog! ». Avec 500mW d'entrée, la puissance de sortie est de 12 Watts

Pensez à inclure dans votre transverter un isolateur entre l'entrée de l'ampli et la sortie antenne. Quelques watts plus une bonne antenne entraîne un danger pour vous et les personnes environnant l'antenne. TAKE CARE

Je remercie les OM qui m'ont aidés de près ou de loin à cette réalisation dont F5JEB, F5JBP.

A bientôt sur 5,7 Ghz.

Philippe F6DPH

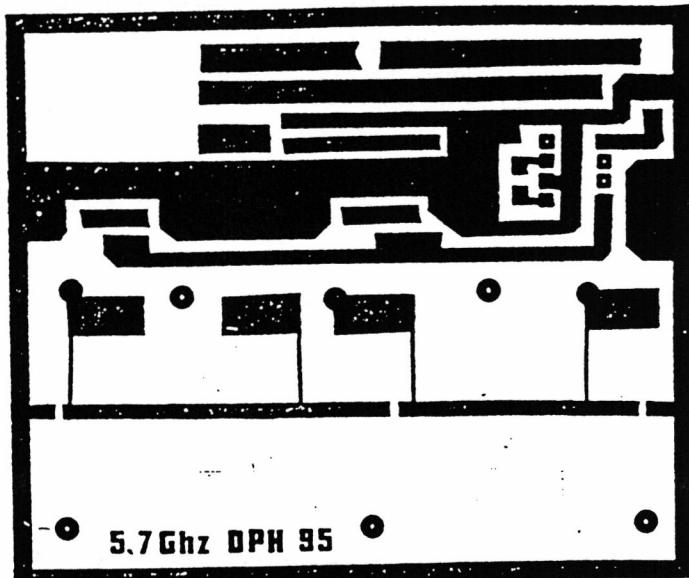
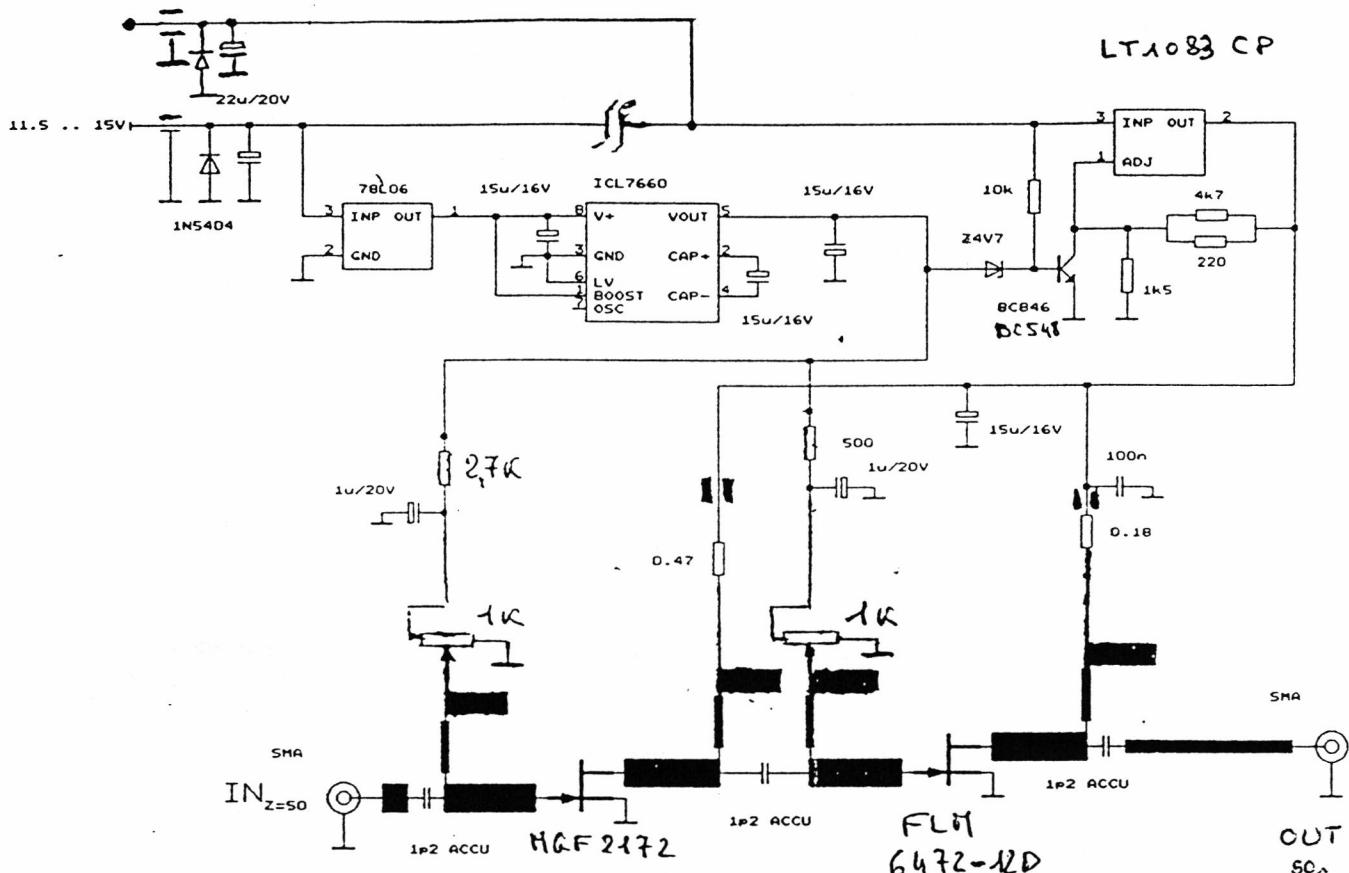
(1) DUBUS : Patrick MAGNIN, F6HYE Marcorens, F-74140 BALLAISON

(2) DB6NT : DUBUS Technik III

11.5 - 15V

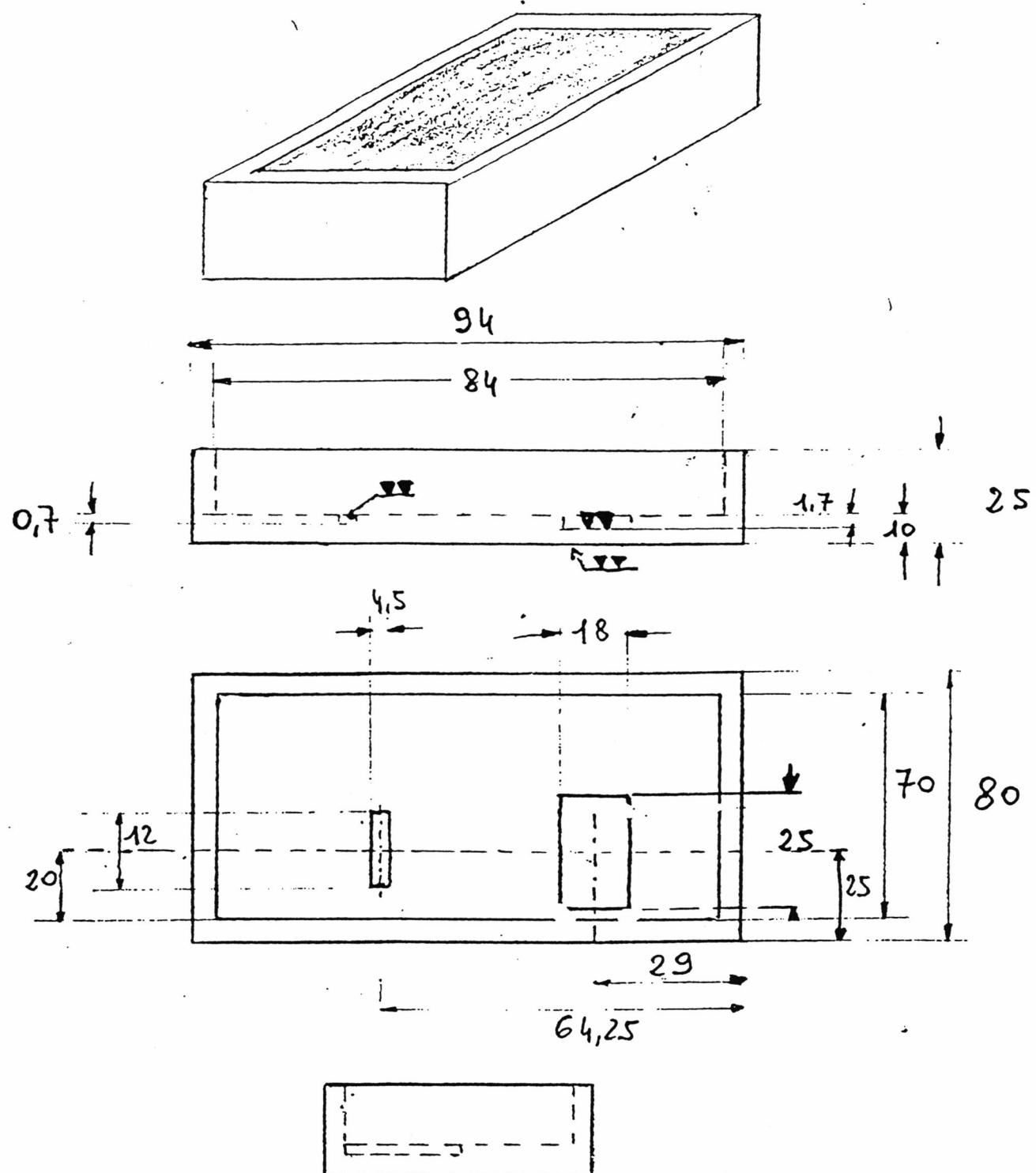
TX

FNP 5,7 CH3 12W.

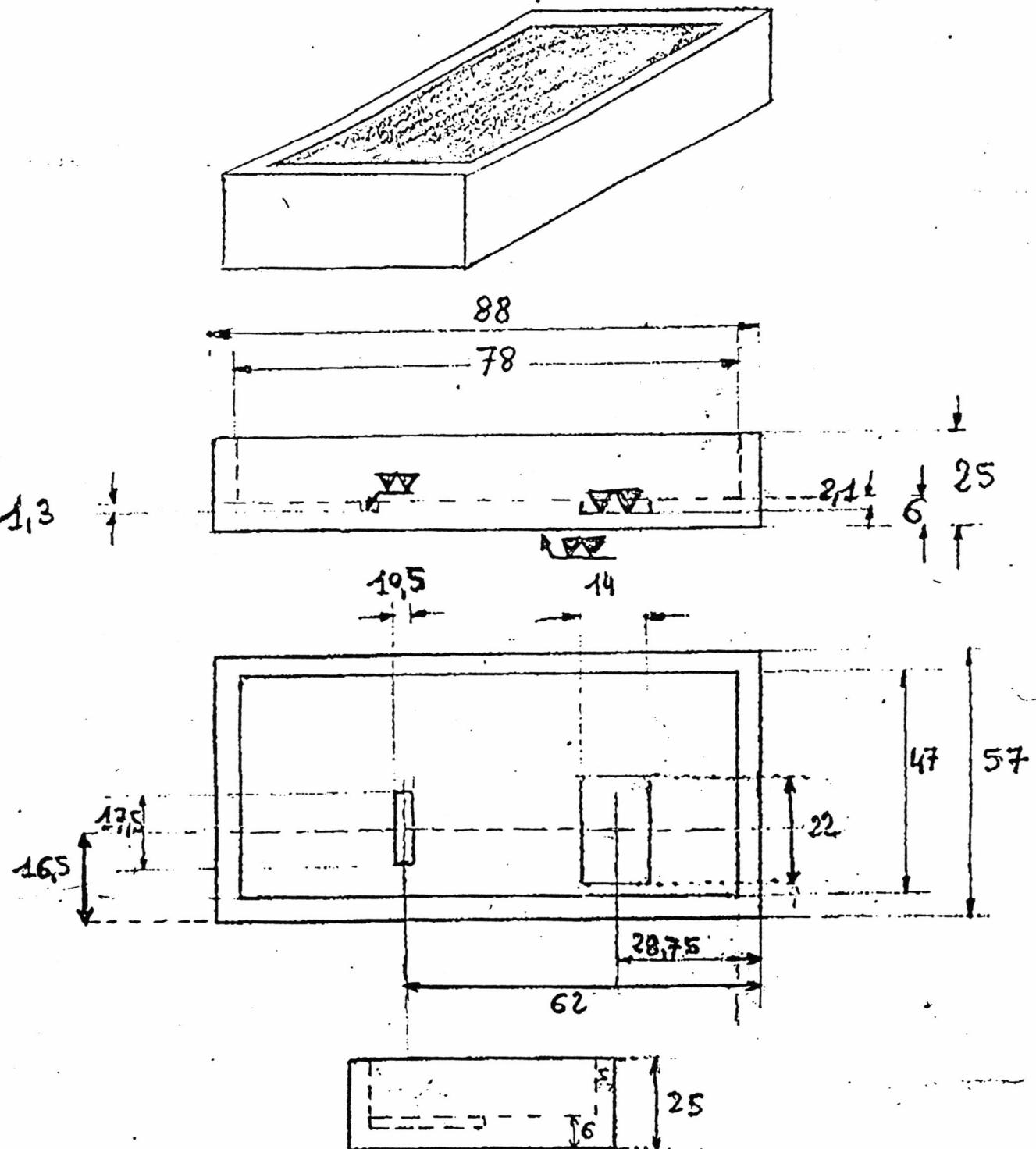


- Sources : DL2AM - DUBUS 1/95
- BB6UT - DUBUS TECHNIK III
- DL1RQ - VHF com. 1/95

SCHEMA Boitier 5,7 Ghz 12W
Pas à l'Echelle



Alu



Boîtier pour AMP 8W 10 GHz.

ALU

DL2AM DUBUS 1/1995

F6DPH - CJS6

*Proceedings of the 21st conference of the
central states VHF society Arlington Texas 1987*

A Solid State Power Amplifier for 5.7 GHz

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Grapevine, Texas 76051

Abstract

A power amplifier based on combining low power GaAs FET devices to increase the output power is presented. A power supply that provides proper sequencing for the bias and drain voltages is also described.

Introduction

Early in 1987 Les Whitaker, W7CNK, and I decided to set up and run some EME experiments on 5 GHz. Shortly after our initial success with high power TWT's, both units suffered tube failure. We had to find a way to develop a moderate power output to replace the dead TWT's, or our moonbounce efforts would be QRT. After searching for a month or so, we could not find any replacement TWT's. It was decided to try and develop a solid state replacement.

About a year ago, Al Ward, WB5LUA, and I designed a power amplifier for 3.4 GHz using a pair of IMFET's. These are internally matched power GaAs FETS made by Avantek and several other microwave active device manufacturers. These devices are typically matched to 50 ohms on the input and output over about 500 MHz of bandwidth, and are available from about 2.9 GHz all the way up to approximately 14 GHz. Several devices are available that cover either the 3, 5, or 10 GHz amateur bands. Typical input and output SWR is 2:1 over the operating bandwidth in a 50 ohm system. These devices run class A, so current drain is fairly constant after the devices are biased on. Internally matched FETS are available from less than 1 watt out to in excess of 20 watts

output. Most published specifications state the power output at the 1 dB compression point.

Power Amplifier

About the time we started looking at developing this amplifier, I was fortunate to obtain some surplus Avantek IM-5964-3 IMFETS. These devices are specified over the 5.9 to 6.4 GHz band with a nominal power output of 4 watts. By combining four devices we should end up with about 16 watts, minus the slight power losses of the circuit board couplers.

The amplifier was designed using one IMFET to provide the input drive to four IMFETs. Power division and summing is done using two-section branch line couplers. (See figure 1.) This is a 3 dB coupler and contains approximately one wavelength in circumference. These can be arranged in either a square fashion or a circle. At the higher frequency microwave bands, these are generally arranged in a circle to avoid sharp transitions. If drive is applied to port A and port D is terminated, we will get two equal amplitude signals out ports B and C, but with 90 degrees phase difference between them. This 90 degree phase difference occurs only at the design frequency of the coupler, and varies approximately 5 deg over a 10% bandwidth. Isolation from port B to port C should be better than 20 dB over this 10% bandwidth. This circuit works well for power division into reflective loads as the reflections of mismatch will be terminated into the load at port D. When combining two IMFETS using a pair of couplers, the 90 degree phase shift

introduced on the input side must be removed on the output side. This is done by using the opposite port on the output coupler. (See figure 2.) By using a combination of power dividers and combiners, we take the output of the first IMFET and produce four equal amplitude signals. These signals drive the four IMFETS in the output stage, which by using signal combiners, all the power is summed back to a single RF out port.

Input and output lines to the IMFETS consist of 50 ohm microstrip. Bias lines to the gates are 1/4 wave RF chokes, with 1/4 wave stubs to provide additional decoupling. Gates are also fed through 47 ohm chip resistors and chip capacitors to suppress low frequency oscillations. Bias is provided from a -5 volt regulator and voltage divider. Do not supply gate bias from a low impedance supply as the resistor divider helps to limit gate current. Drain voltage is supplied by a small wire RF choke and bypass capacitor. Additional low frequency oscillation suppression is supplied by the series 47 ohm resistor and .001 uf chip capacitor. Use good quality chip coupling capacitors in the main RF port as RF currents present will vaporize low quality capacitors in short order. The PC board was mounted on a .25 inch thick plate with slots milled to allow the IMFET input and output leads to sit flush on the top circuit traces. This was then bolted to a large heatsink for cooling. Use static protection procedures when installing IMFET devices, as they are susceptible to ESD.

Power Supply

Proper sequencing of the voltage to the IMFET is necessary to prevent destroying the device. *Negative bias to the gate must be applied before drain voltage is applied.* Without bias applied, the IMFET'S can pull many amps of drain current, destroying the die or internal bonding wires on the substrate. The power supply should automatically

prevent drain voltage being applied until the bias has stabilized. This bias voltage is also monitored and should a bias fault be detected, immediately shut down the drain supply.

The power supply uses a pair of DC-DC invertor IC's to supply the required bias, and a high current adjustable regulator to supply drain voltage. Voltage to the high current regulator, U4, is controlled by transistors Q1 and Q2, which act as a supply switch. When Q3 saturates, it pulls the base of Q2 low, which then saturates Q2 to provide base current for Q1. Transistor Q3 can be clamped off by either a bias fault detected in Q5, or by Q6, the amplifier enable transistor. Additional protection of the IMFETS is provided by Q4, which sets the voltage out of U4 to 1.25 V whenever the amplifier is disabled. Normally the regulator output voltage goes to zero when disabled, but if Q1 and Q2 should short and the bias fail, this should help limit power dissipation in the FETS.

Power is applied to Q1 and Q2 whenever voltage is connected to the amplifier power supply. The power switch controls the bias supply and voltage for enabling Q1 and Q2. Be sure to heatsink Q1 and U4 as they dissipate about 30 watts when using the Avantek IMFETs. Additional diodes are used in the negative supply to prevent the gates from ever being driven positive or from excessive negative voltage. A 0.1 ohm resistor is used in the drain supply lead to each FET so the current can be monitored.

Alignment

Thoroughly test the power supply before connecting it to the power amplifier. Simulate the IMFET load by using a 120 ohm resistor on the negative gate supply, and a 7 to 8 ohm 10 watt resistor for each IMFET drain load. Connect +13.8 volts to the supply and turn on the power switch. There should be negative 5 volts on the 120 ohm resistor, and zero volts on the drain load

resistor. Enable the amplifier by pulling the enable line low. Adjust the voltage regulator pot for +9 volts on the drain load resistor. Open the power switch and check to see that the drain voltage goes to zero. Close the power switch and load the negative gate bias output with additional 120 ohm resistors in parallel until the bias drops to about -3 volts. Check to be sure the drain voltage goes to zero under this low bias condition. The threshold of cut off is set by the pair of 300 ohm resistors going to the base of Q5. When the power supply has been tested, connect it to the amplifier. With a good 5 GHz load connected to the amplifier output, enable the drain voltage. Check that each IMFET idles about 1.2 amps with a drain voltage of +9 VDC. Apply input drive of 1 watt maximum and check power output. If everything is correct, power output should be about 16 watts. Check IMFET heatsink temperature for proper heat conduction.

Conclusion

To date we have built a pair of these amplifiers. They were etched on .031

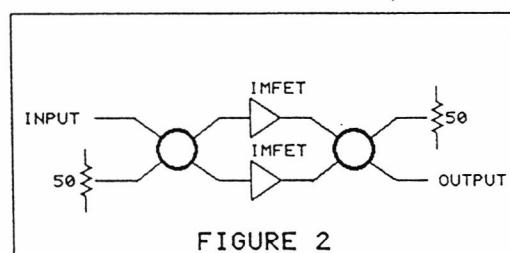
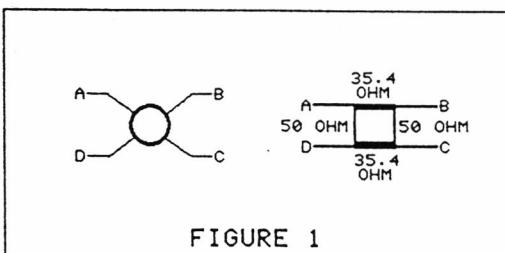
inch thick Duroid 5880, ER=2.3. With 700 milliwatts drive, the first amplifier put out 16.5 watts, the second put out 17.2 watts. A pair of these will then be combined to provide about 32 watts for each of our EME stations. These will be mounted at the dish feed, and will give us about the same power we had running the TWT's, but without the feedline loss. Thanks to Les Whitaker, W7CNK, for building and testing the first two units. They were works of art. Also, thanks to Allan Bundens, N5FZF, for assistance in producing the computer generated PC board artwork.

References

Howe, Harlan, "Stripline Circuit Design", Copyright 1974 Artech House, Inc.

Avantek, 1985 Semiconductor Device Catalog, Avantek, Inc.

IMFET is a trademark of Avantek, Inc.



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*DRAIN SUPPLY

-GATE BIAS

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RF MONITOR

HP2855

16 WATTS

50 OHM

TERMINATOR

HYPER

NUMERO SPECIAL 5,7 GHZ

PAGE 99/176

137

C

D

B

A

ALL RESISTORS AND CAPACITORS
ARE CHIP COMPONENTS

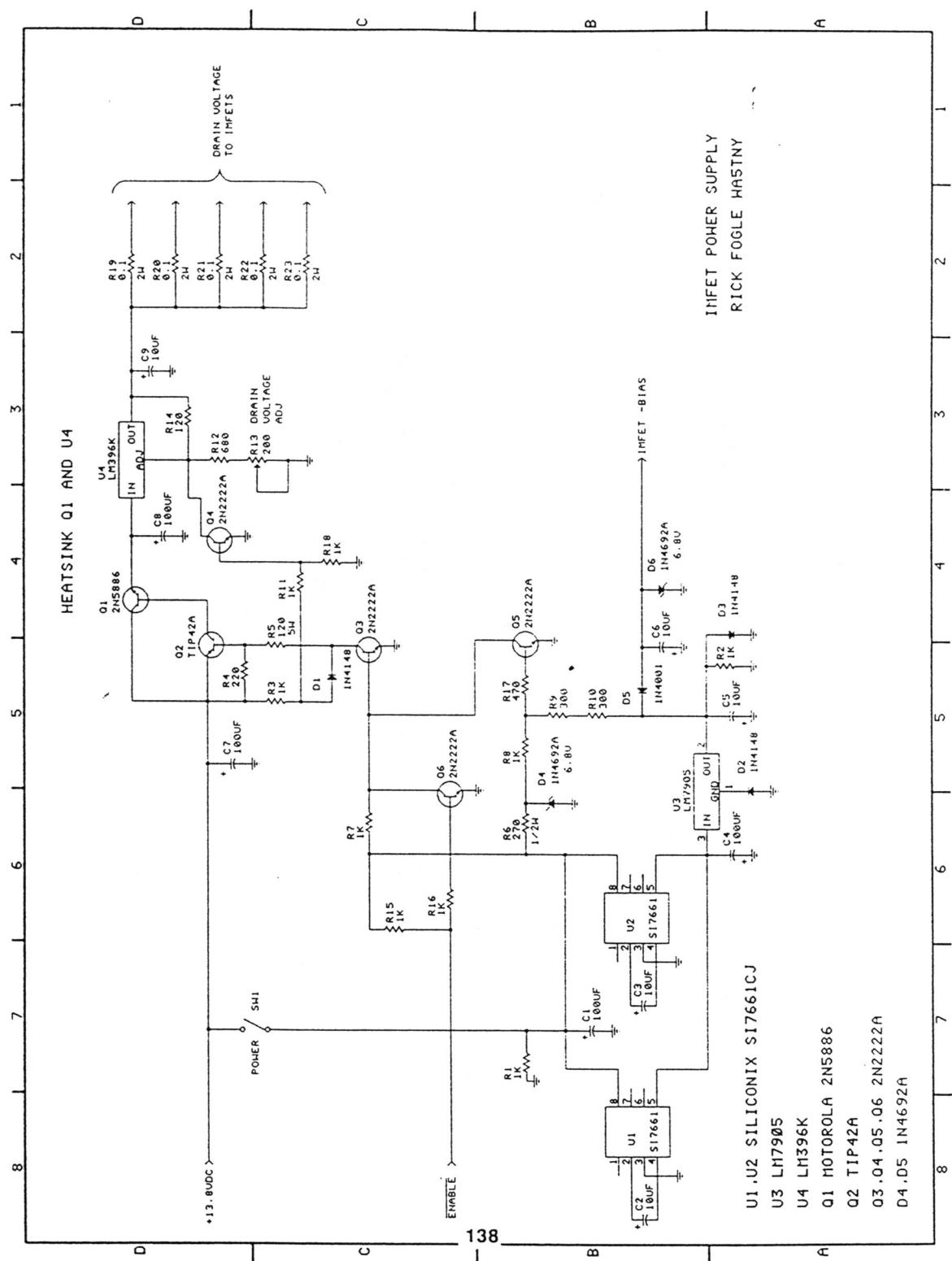
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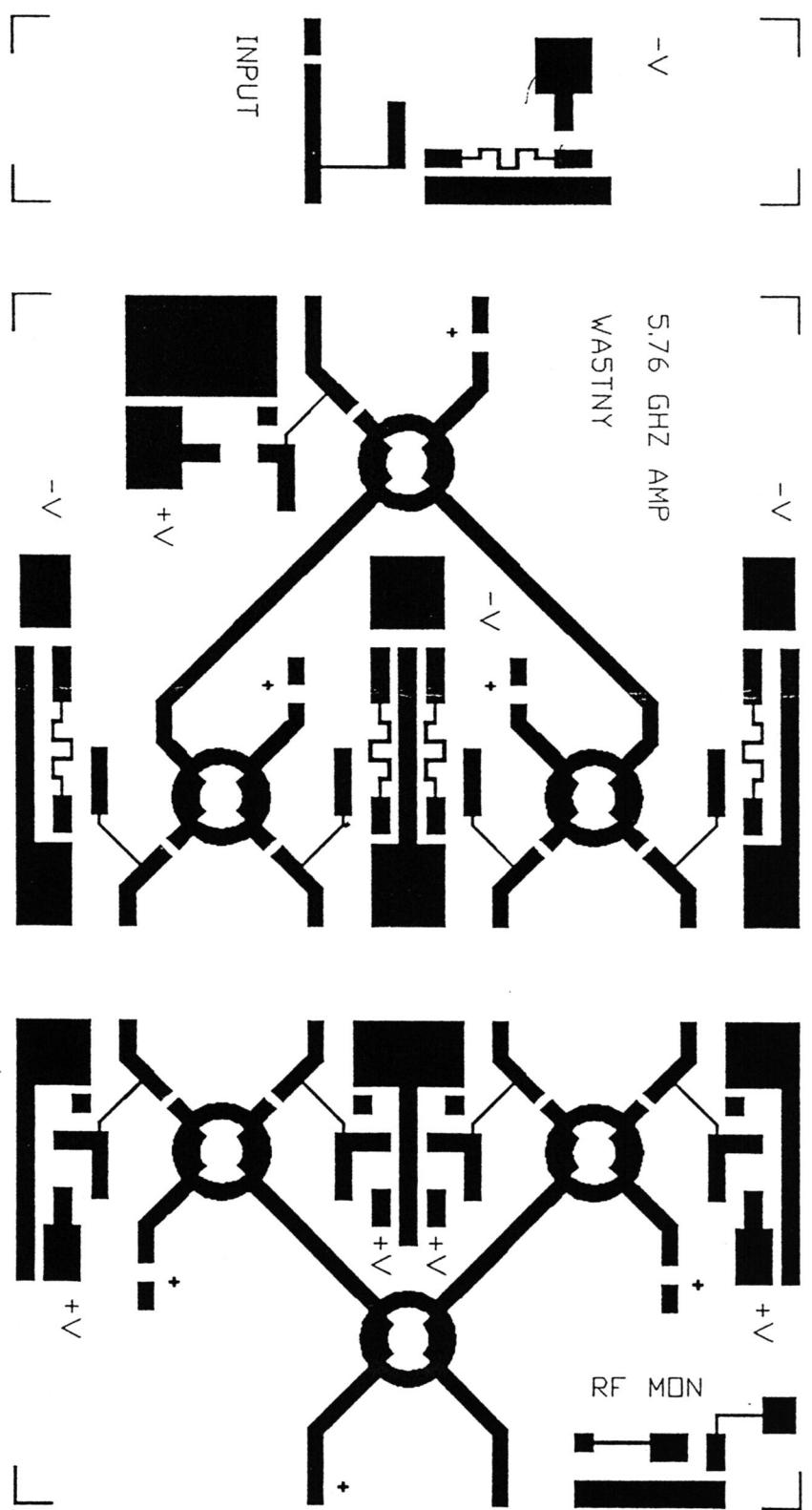
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RICK FOGLE HASTNY

5.7 GHZ. IMPFET AMPLIFIER

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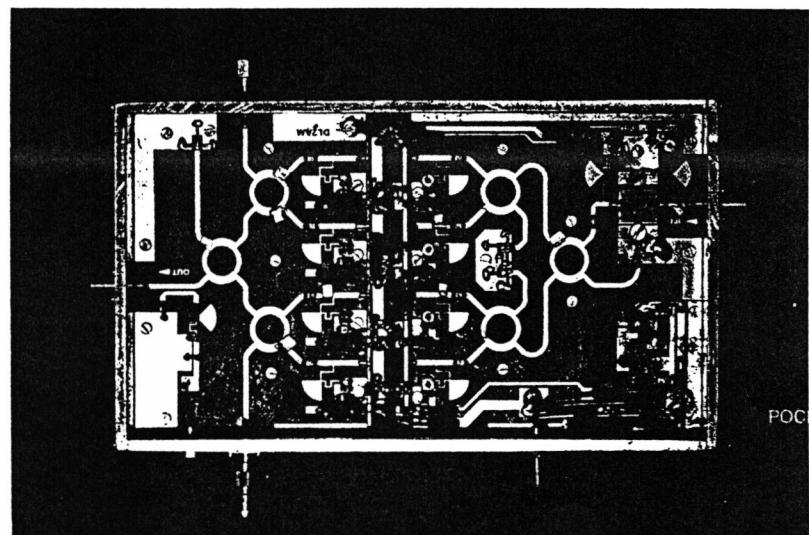
20 W GaAs-FET Power on 5.7 GHz

DUBUS 4/1994

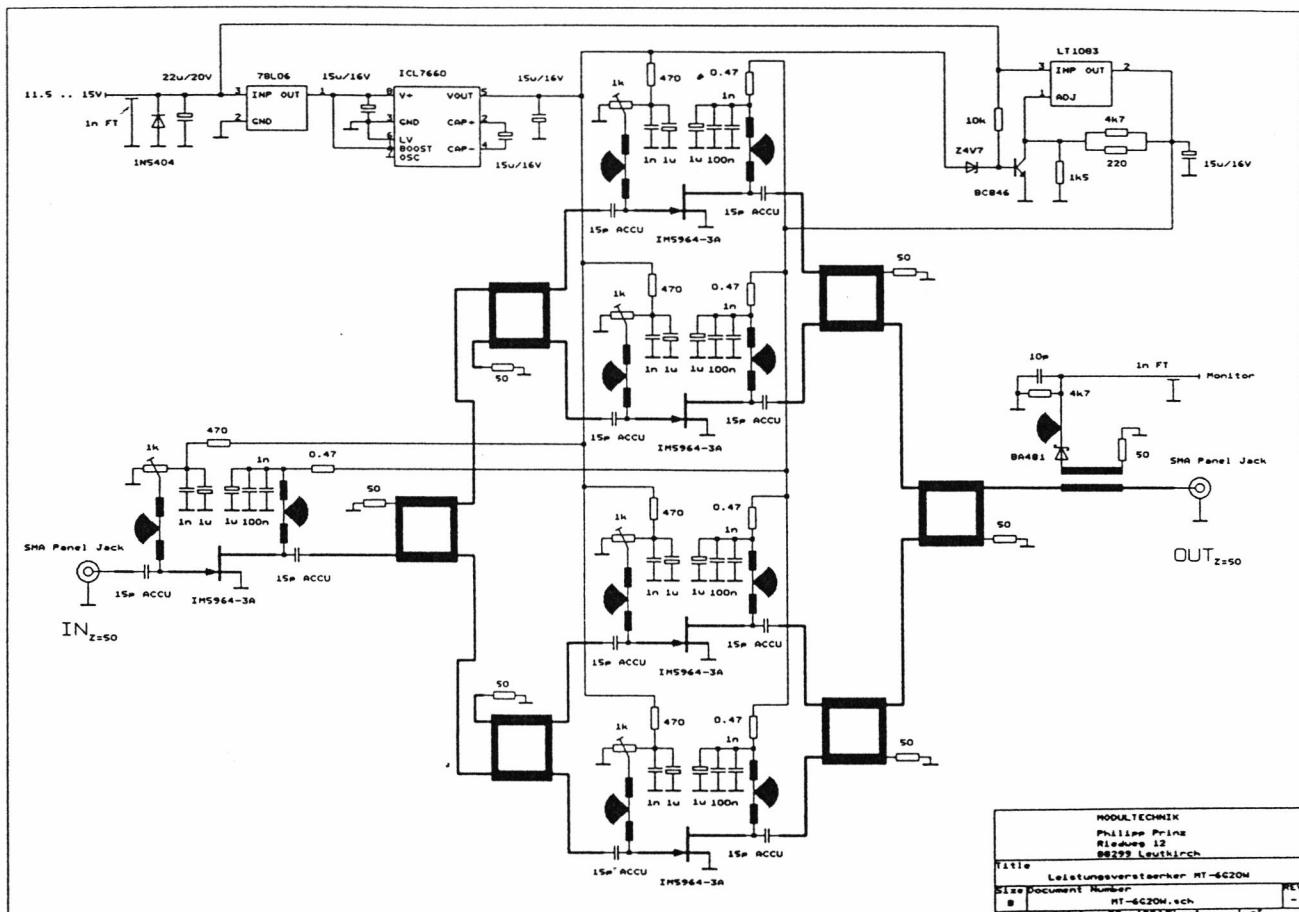
Philip Prinz, DL2AM

Riedweg 12, D-88299 Leutkirch

Abstract: The two stage power Amplifier MT-6G20W provides a 1db compression output power of 20 W on 5.76 GHZ with a supply voltage of 12 V and 18 dB gain. It uses five IM5964-3 GaAs FETs from Avantek und is constructed on Teflon board in a machined aluminum box.

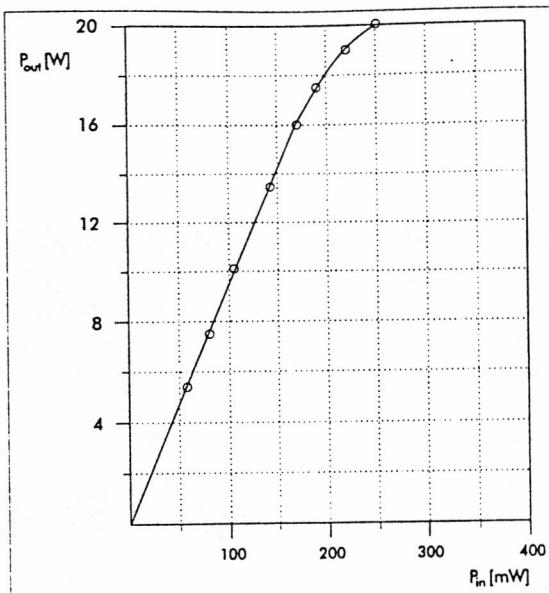


6cm Poweramplifier MT-6G20W



6cm Poweramplifier MT-6G20W: Circuit Diagram

Figure 1: Output vs Input Power



Description

The amplifier is constructed around internally matched power GaAs-FETs IM5964-3. Four transistors are coupled via 90°/3 dB hybrids and driven by the fifth transistor. The hybrids provide 0.1 dB symmetry and 37 dB input return loss. All reflections caused by different impedances and time delays of the transistors are absorbed in the 50Ω loads at the isolated ports.

The PCB is made from 0.5 mm RT-5870 duroid. An integrated directional coupler delivers a power monitoring DC-voltage. Size of the enclosure is 185 x 110 x

30mm. Supply voltage is 11.5...15 V. Supply current is 5.6 A. Bias current for the final transistors is 4 x 1 A. All voltages are stabilized internally.

Monitor Voltage vs Output Power

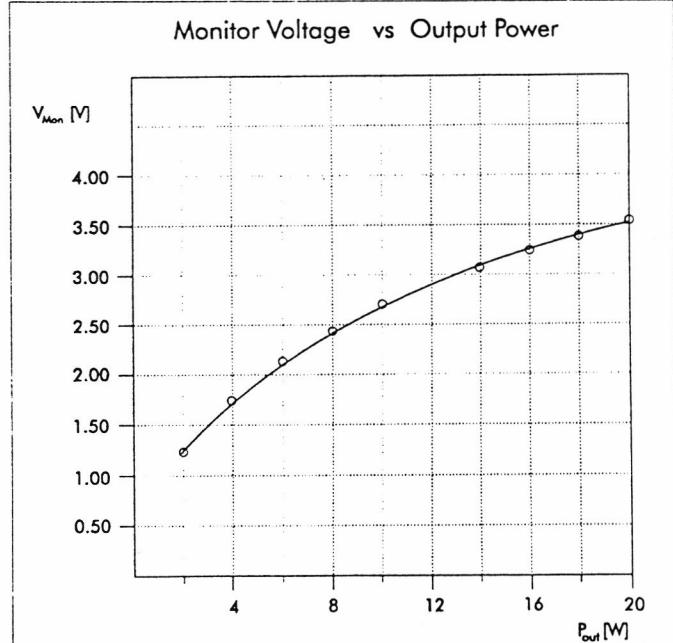


Figure 2: Monitor Voltage

4. Teile/Parts

Ready made units and parts can be ordered from Philip Prinz, DL2AM, Riedweg 12, D-88299 Leutkirch 3, Tel.: (++49)-7576-294/Fax: (++49)-7567-1200.

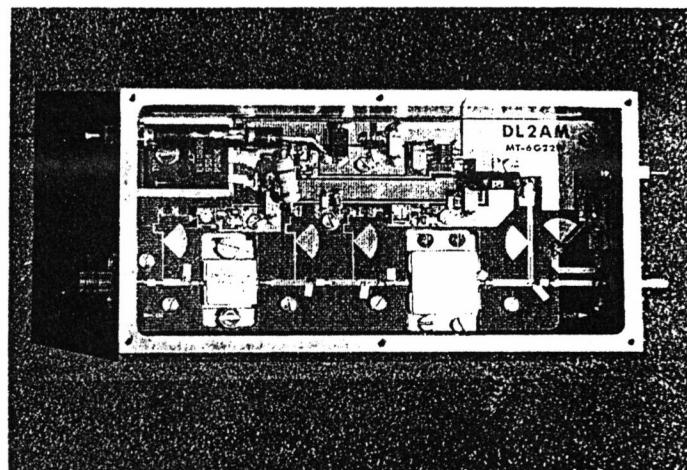
6cm Power Amplifier
 Devices: 5xIM5964-3
 Supply Voltage: 11.5..15 V
 DC-Current: 5.6 A
 Gain: 18 dB
 Output Power: 20 W

Product Review: 22 W GaAs-FET Power on 5.7 GHz

DUBUS 3/1995

R. Bertelsmeier, DJ9BV

Abstract: The power Amplifier MT5.6 GZ22W made by Philipp Prinz, DL2AM, provides a 1 dB compression output power of 22 W on 5.76 GHz with a supply voltage of 12 V and 11 dB gain. It uses the IM5964-3 and TIM 5964-16L Power GaAs FETs. It is constructed on Teflon board in a machined aluminum box.



6 cm Poweramplifier MT5.6G-Z22W

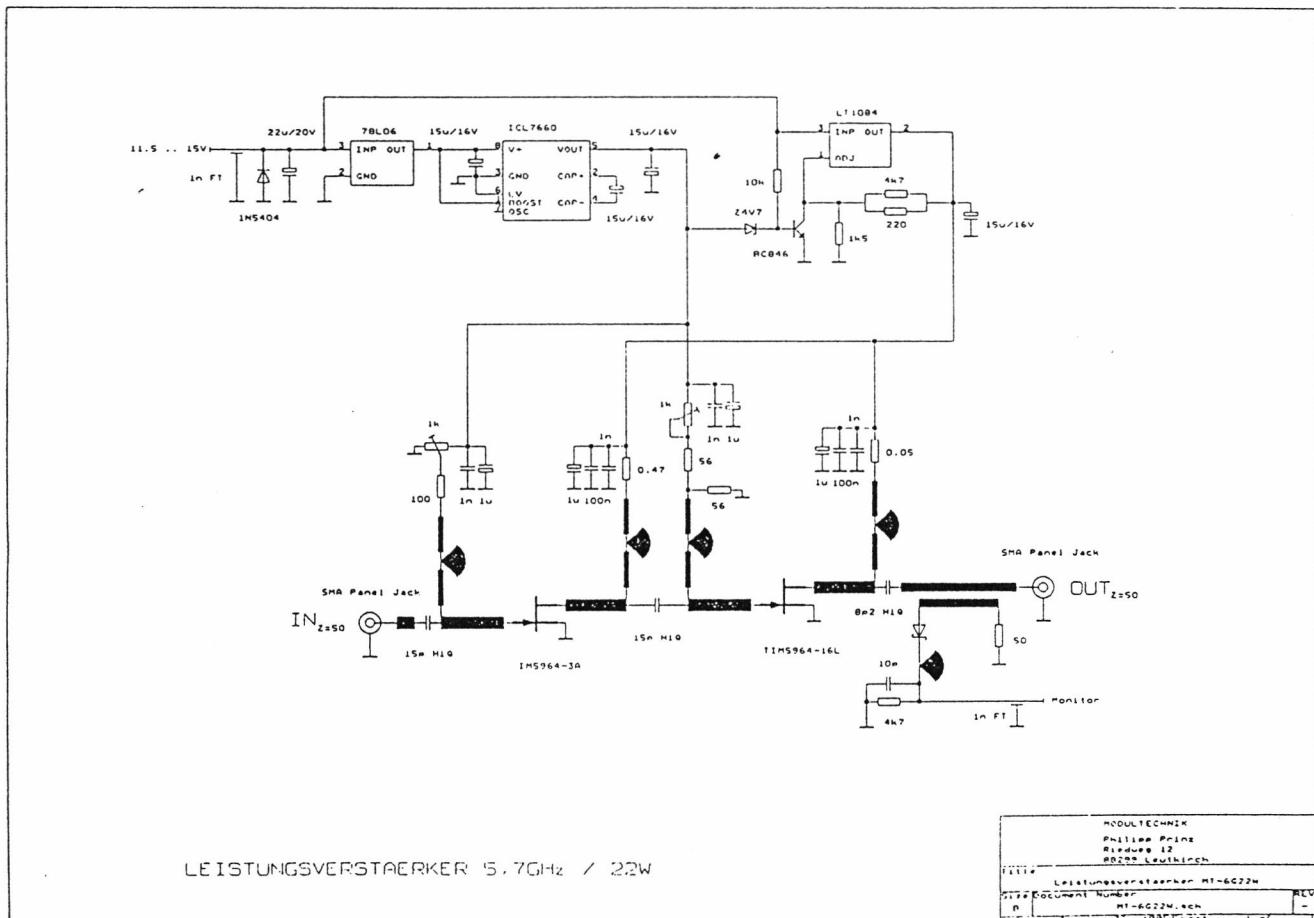
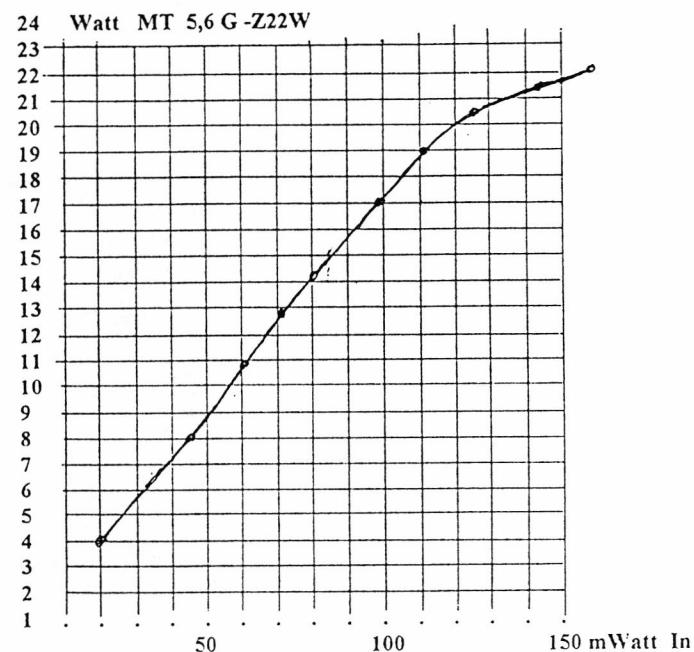
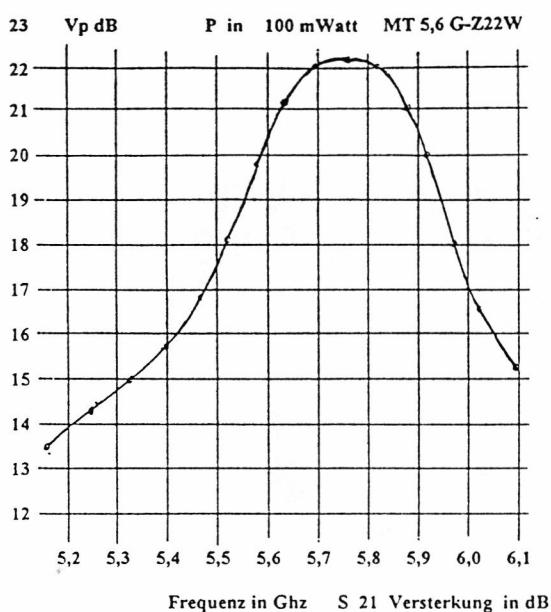


Fig. 1: 6 cm Poweramplifier - Circuit Diagram

Figure 2: Output vs Input Power

Figure 3: Gain Versus Freq.



Description

The amplifier is constructed around power GaAs-FETs IM5964-3 and TIM5964-16L. It provides an output power of 22 W at 1 dB compression.

The PCB is made from 0.79 mm RT-5870 duroid. An integrated directional coupler delivers a power monitoring DC-voltage. Size of the enclosure is 126x64x28 mm. Supply voltage is 11.5...15 V. Supply current is 4.8 A.. All voltages are stabilised internally. A fail-safe circuit¹ for a missing negative gate supply is provided.

Parts/Teile

Ready made units and parts can be ordered from Philip Prinz, DL2AM, Riedweg 12, D-88299 Leutkirch 3, Tel.: (++49)-7567-294/Fax: (++49)-7567-1200.

6 cm Power Amplifier
Devices: IM5964-3/TIM5964-16L
Supply Voltage: 11.5...15 V
DC-Current: 5.5 A
Gain: 21 dB
Output Power: 22 W

¹ M. Kuhne, DB6NT, "High Power GaAs-FET Amplifier for 9 cm", DUBUS 2/1991, p.7

C-Band Transmitter Module Delivers 55-W Output

This power module can be realized with an integrated assembly in order to minimize fabrication costs.

W.L. Peace

Microwave Consultant, 30 Gordon Rd., Chelmsford, Essex CM2 9LL, England; +44-1245-355-760, FAX: +44-1245-492-867.

CONTINUING improvement in the performance capabilities of microwave transistors has resulted in smaller and more reliable system designs. A C-band transmitter module uses driver and output stages in a cascade configuration (with four parallel transistors in the output stage) to deliver output-power levels up to 55 W.

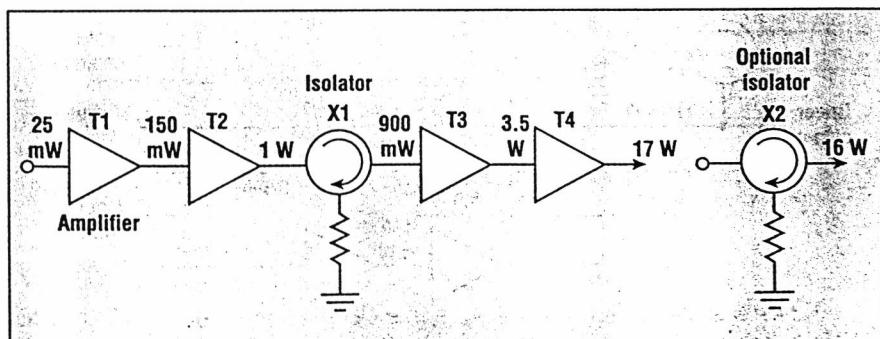
The design objective was to produce a nominal 50-W output power over a frequency range of 5.4 to 5.9 GHz. The problem was not the output power so much as it was the required gain since the available input power was only 25 mW. Because the output transistor can only produce 16-W power for a 3.5-W input, the use of a power module (composed of one transistor feeding four transistors) was required. Since the individual gain was only 6.5 dB per transistor, the losses from each device had to be taken into account. Therefore, the combination of four transistors in parallel at the output was necessary.

Figure 1 shows the initial design for the driver amplifier. The input-power level is approximately 25 mW

while the output level is 3.5 W over a frequency range of 5 to 6 GHz. The amplifier used was an update of an existing one (with the original design using an 80-mW input to produce a 1.25-W output), with additional amplifier stages at the input and output.

The modified drive amplifier worked very well without an isolator. When not driving the module, however, an isolator should be inserted in order to protect the high-power field-effect transistors (FETs).

As a general rule, no more than four stages should be cascaded in order to maintain a reasonably-good match. The isolators used in the module are of the "puck" form, thus they can be easily inserted into the sub-



1. The module's driver stage makes use of four transistors in cascade to achieve 3.5-W output from 5 to 6 GHz.

DESIGN FEATURE

C-Band Module

strate where necessary.

The driver stage uses the TIM 5359-4 device, which is internally matched to a specified impedance of 50Ω . In reality, the match impedance varies from $(50 \pm j0)\Omega$. It is interesting to note how far off the match can be while still providing adequate performance with little additional matching circuitry.

Measured S-parameters were obtained for the driver and output stages, respectively (Tables 1 and 2). The rated output of the final stage was achieved by using two very small shunt stubs in the input and output circuits.

The TIM 5359-4 exhibited the following output-power levels at 0.8-W input power, 10-VDC drain-to-source voltage (V_{ds}), 1.3-A drain-to-source current (I_{ds}), 24-percent efficiency, and 6.3-dB gain:

- 3.24 W at 5.4 GHz
- 3.35 W at 5.5 GHz
- 3.52 W at 5.6 GHz
- 3.55 W at 5.7 GHz
- 3.45 W at 5.8 GHz
- 3.22 W at 5.9 GHz

As expected, the output from this stage was sufficient to drive the transmitter's final stage so that a minimum 16-W output power was

Table 1: Driver-stage performance results

Frequency (GHz)	S_{11}	S_{21}
4.8	0.76 / -3 deg.	46 / +160 deg.
5.0	0.62 / -30 deg.	96 / +133 deg.
5.2	0.40 / -72 deg.	256 / +99 deg.
5.4	0.18 / -154 deg.	290 / +59 deg.
5.6	0.23 / +100 deg.	287 / +20 deg.
5.8	0.34 / +37 deg.	263 / +16 deg.
6.0	0.43 / -10 deg.	234 / -49 deg.
6.2	0.52 / -51 deg.	204 / -81 deg.

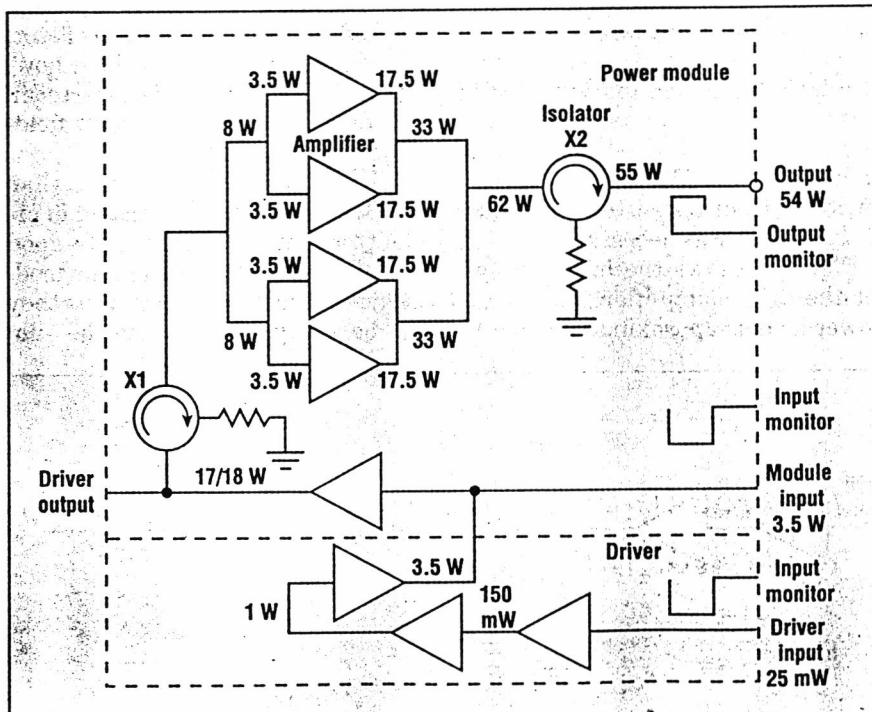
obtained after slight trimming. The following power levels were obtained from the output stage at 3.5-W input power, 10-VDC V_{ds} , 5.1-A I_{ds} , 34-percent efficiency, and at least 6.5-dB gain:

- 15.5 W at 5.4 GHz
- 18.5 W at 5.5 GHz
- 16.4 W at 5.6 GHz
- 17.3 W at 5.7 GHz
- 18.4 W at 5.8 GHz
- 15.7 W at 5.9 GHz

Figure 2 shows a schematic diagram of the complete C-band transmitter module. The module exhibits the following output power and effi-

cency at 10-VDC V_{ds} , 20-A I_{ds} (total for module), and 16/18-W input power:

- 50.2-W output power (P_{out}) and 25.1-percent efficiency (η) at 5.4 GHz
- 52.8-W P_{out} and 26.4-percent η at 5.5 GHz
- 52.5-W P_{out} and 26.25-percent η at 5.6 GHz
- 55.0-W P_{out} and 27.5-percent η at 5.7 GHz
- 54.2-W P_{out} and 27.1-percent η at 5.8 GHz
- 54.5-W P_{out} and 27.25-percent η at 5.9 GHz



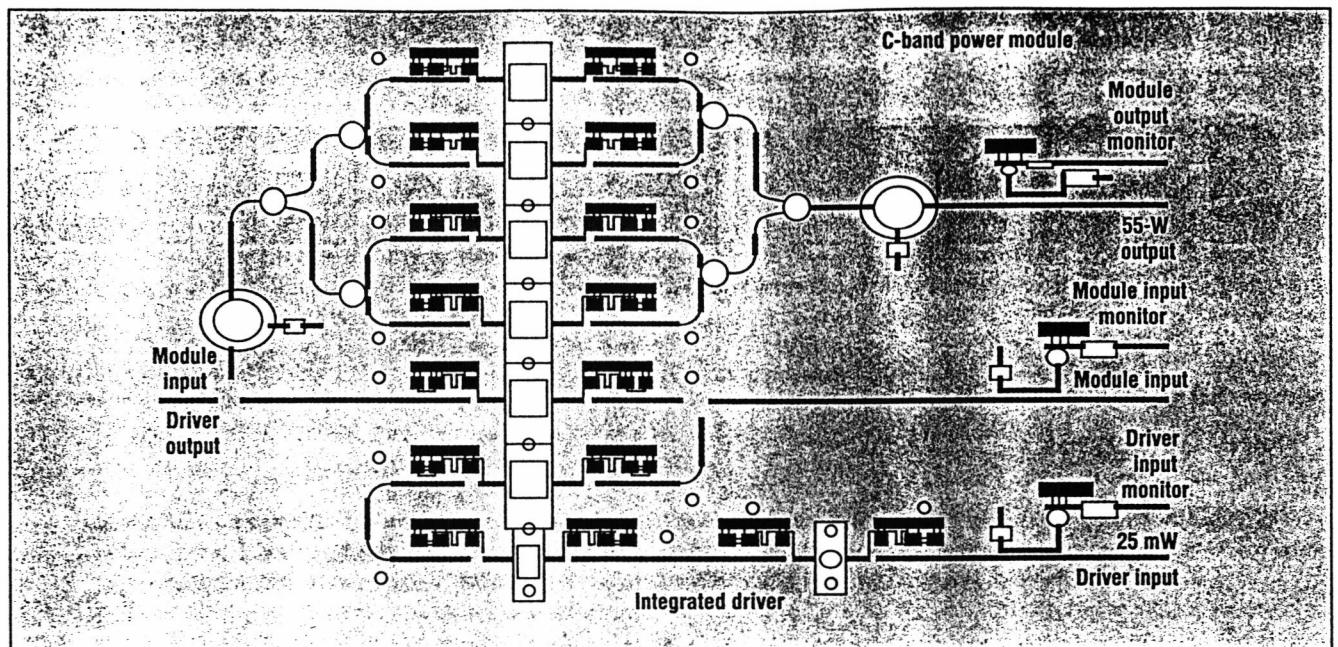
2. The C-band module incorporates a driver stage and output stage (formed with four transistors in parallel) to produce more than 50-W output power.

AN ISOLATOR IS PLACED AFTER THE DRIVER FET TO PROTECT THE PARALLEL DEVICES FROM THE DRIVING DEVICES.

Figure 3 shows the final layout of the module, which uses one device to feed four devices in parallel. As the layout shows, the first isolator is situated after the driver FET. In the layout of Fig. 1, the isolator was placed before the driver FET. This was done in the initial layout to protect the unknown Toshiba FETs from the known MSC FETs. In Fig. 3, however, the isolator is used to protect the parallel devices from the driving devices (from possible bad

DESIGN FEATURE

C-Band Module



3. As the design layout illustrates, the output stage uses one device to feed four devices in parallel, with an isolator placed before the parallel devices.

mismatches).

For further protection, the Wilkinson splitter/combiner in parallel with each device is used in a quadrature configuration. As a result, each device is operating 90 deg. out of phase with the adjacent device. This increases isolation between the devices and provides improved reliability.

The module has a substrate thickness of 1.27 mm with a relative dielectric constant of 10.8. The aluminum backing is 6.35 mm thick, while the overall size of the module is 220 × 220 mm.

The layout was configured to provide two design options:

(1) The output-power module could

be separated from the driver to enable four modules to be fed from one module (which would be used as a drive module). This would result in a theoretical 200-W output power.

(2) The integrated layout would enable the entire module/driver to be fabricated on a single piece of substrate with one machining operation and a common assembly.

One drawback of an integrated assembly is the possible pickup of a high-power field onto the low-power driver. This problem can be avoided through the use of correct packaging. Another obvious disadvantage to this integration is that one flaw on the substrate could render the entire

circuit unusable.

If the output is pulsed at a 20-percent duty cycle, there is no need for a heat sink. However, if the output is continuous wave (CW), then an adequate provision for heat transfer must be made in order to maintain the chip temperature below 127°C. Depending on the application, liquid (water) cooling is generally more effective than air cooling (although air is far easier to handle than water).

It is believed that Toshiba is now working to produce power FETs with a nominal 30-W output level. If successful, this would allow the use of only two devices in parallel to achieve more than 50-W output. With the configuration described here, a nominal 100-W output level could be realized. This is a natural progression with time. The primary problem is cooling the module since there will be twice as much heat to lose. ••

Table 2: Output-stage performance results

Frequency (GHz)	S ₁₁	S ₂₁
4.9	0.71 / +30 deg.	1.97 / +50 deg.
5.1	0.54 / -52 deg.	2.27 / +26 deg.
5.3	0.31 / -77 deg.	2.56 / -10 deg.
5.5	0.07 / -98 deg.	2.67 / -44 deg.
5.7	0.13 / +32 deg.	2.65 / -80 deg.
5.9	0.28 / +13 deg.	2.68 / -113 deg.
6.1	0.36 / -16 deg.	2.58 / -147 deg.
6.3	0.42 / -54 deg.	2.53 / -178 deg.

TECHNICAL REPORTS

Edited by DL7APV
DVBUS 4/83

6 cm LINEAR AMPLIFIER

by Hans-Joachim Senckel, DF5QZ

E.: TWTs are very rare and expensive, so here is a description of a cavity resonator power amplifier with the tube YD 1060. The tube YD 1060 (Telefunken), RH 7 c (Siemens) is a triode, (air blown cooling), metall ceramic type, useably up to 7 GHz. The anode voltage should not cross 450 V, and the cathode current 70mA.

The amplifier is a grounded-grid circuit, which is profitable for mechanical construction and it has better RF qualities at this frequencies. The anode- and cathode circuit are placed into another. The input power and the heat voltage supply line are coaxial in the cathode anchor. The anode is "RF cold" outside of the cavity. The grid has the output voltage and the cathode the input voltage. The output coupling is inductive, near the grid. Tuned is by two shorting plungers. The anode circuit is $3/4 \lambda$ and the $5/4 \lambda$.

All mechanical pieces have to be very smooth and are polished. This is very important to get a good tuning and contact. The Q of the circuits is dependent for the surface quality. The holes of the anchor of the shorting plungers must be very exact. Input and output jackets are mounted with a thread, so it can be tuned. Then cut a thread into the both shorting plungersplates (M3 anode M2,5 cathode). There you mount the tuning bar, later. The spring contacts (firm Feuerherd/Berlin) should soldered on the shorting plunger plates. Spring contacts should also soldered on the grid anchor. The shorting plungers are the most difficulty and very important, when the amplifier will work correct.

At the end of the cathode anchor is placed the ground capacitor. In the cathode jacket of the anchor is the cathode connection isolated with a teflon foil (0.2mm). This little anchor is glued with the foil into the cathode anchor. The anchor is a holder for the tube. Use an old tube for glueing as a pattern. This anchor tooks the cathode pin into and has an isolated wire to outside of the cavity. Before glueing the anchor is soldered with one end of the wire. The heater anchor is fixed with teflon jackets or glued into the cathode anchor. The rf input is capacitive with a lengthening of the BNC-jacket into the cathode anchor. The anode-ground capacitor is mounted with 0.5mm teflon foil and an isolated pin (450V!). PAY attention! Before soldering the cathode shorting plungers with the upper plate, mount the shorting plungers into the cavity, because the cathode anchor can take the shorting plunger only from one side into the cavity. It is very important, that you understand the drawings!

Adjust the cathode current to 35mA and tune with a 5760 MHz signal to maximum cathode current with the cathode shorting plunger. With a rf-meter tune to maximum output, it will be a very small dip. Also adjust the BNC-jackets to maximum power output. The anode output loop dip only a little into the anode cavity, because if it is too deep into it will give wild oscillation. Dont cross 80mA cathode current, only for a few seconds. The cavity is very stable if used a good blower. Block the cathode and heater wires at the outside end of the cathode anchor, with lnF to ground, because some "hot" tubes had some wild oscillation.

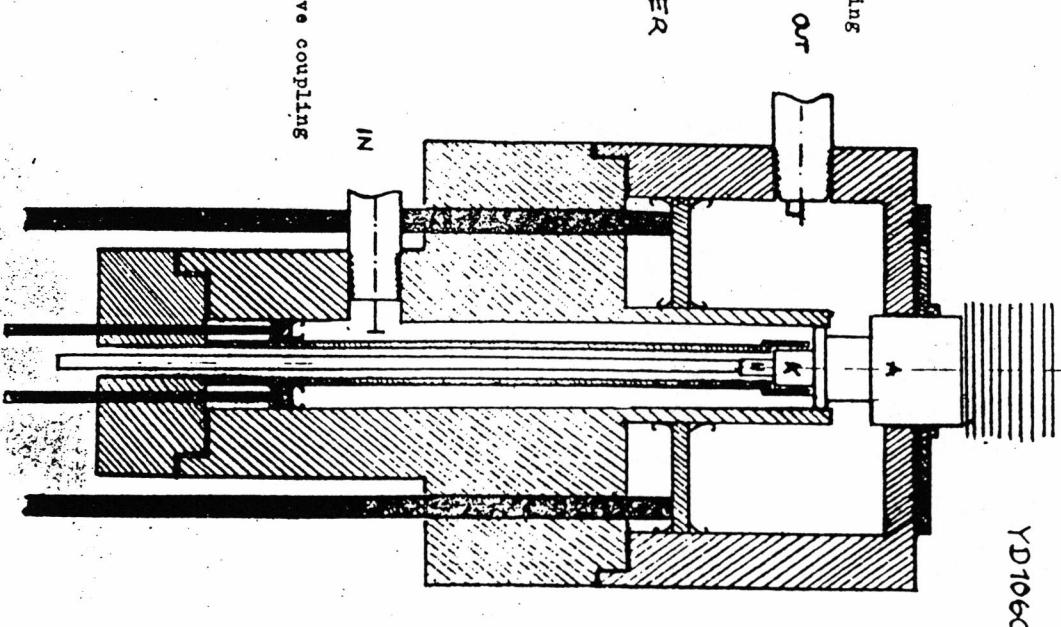
At an input of 18mW into the driver cavity we got 380mW output (13db gain), the following pa-cavity could not measured. But it has more than 6db gain.

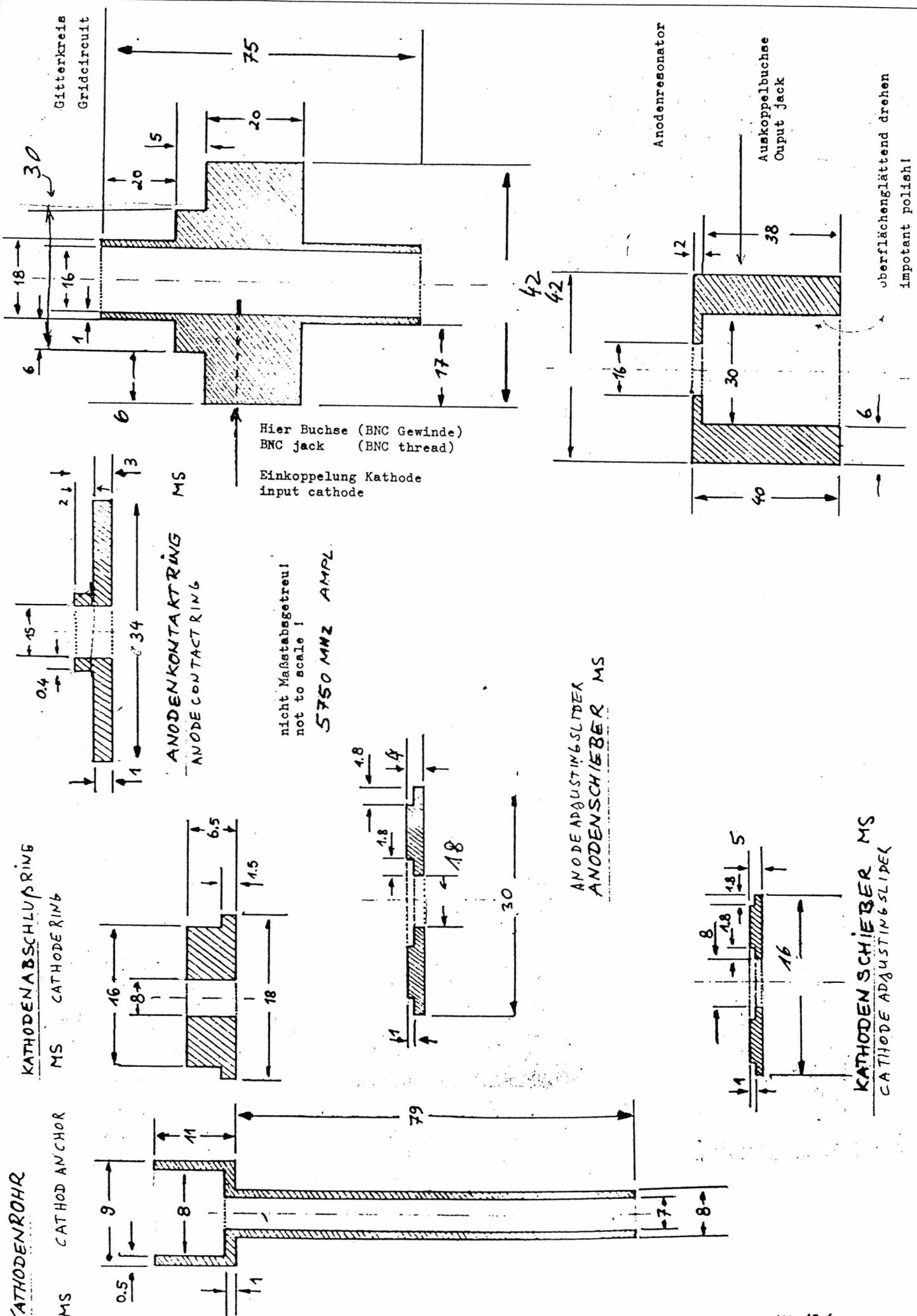
Thanks to DCDDA for measurement and Ulrich Weissenberg for fotos. The cavity is obtainable by Hans-Joachim Senckel/Borbergstraße 27/ 4700 Hamm 1 (silvered for 280 German marks)

Output
inductive coupling

OUT

5750 MHz AMPLIFIER





Sender-Endstufe für 5760 MHz mit der YD 1060

Skizzierung eines modernen 6-cm-Transverters

YD1060. 30
(Desale... ne le ver...
de...)

UKW-BERICHTE 2/87

Dieser Artikel soll einen weiteren Beitrag zur Aktivierung des 6-cm-Bandes leisten. Er beschreibt den Bau einer Röhren-Endstufe in Koaxialtechnik (Bild 1), die wegen ihrer Ausgangsdaten eine gute Alternative zu Kleinleistungs-Wanderfeldröhren darstellt.

Um die unerwünschten Zuleitungs-Induktivitäten zu eliminieren und gleichzeitig den Aufbau so einfach wie möglich zu halten, wurde gänzlich auf Kontaktfedern und aufwendige Koaxialschieber verzichtet.

Den mechanischen Zusammenbau beginnt man mit der Montage der Führungshülse (5) für die Ausgangsbuchse (6) und der gegenüberliegenden Gewindebuchse (7) für die Abstimmsschraube (8) in das Haupt-(Anoden)-Rohr. Die beiden Teile werden nach Möglichkeit in das Hauptrohr eingepresst und verlötet. Danach wird der Anodenresonator ausgedreht, um die nach innen überstehenden Teile der Buchsen zu entfernen. Jetzt erst wird das Innenrohr mit dem bereits aufgepressten Ring in den Anodenresonator gepresst. Einspeisung und Abstimmung des Kathodenresonators werden ähnlich dem Anodenresonator realisiert, wobei die Hülse für die Einspeisung (9) und die Abstimmsschraube (10) durch beide Röhre gehen. Die erforderlichen Einzelheiten sind den Bildern 4...6 zu entnehmen. Die folgende Stückliste nennt die wichtigsten Teile.

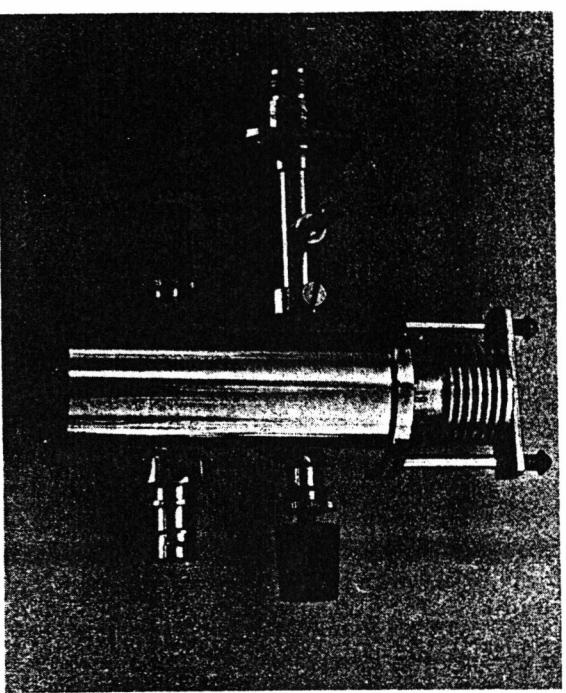


Bild 1:
Eine fertig aufgebauten
Endstufe mit der
YD 1060

Den Hauptteil der Stufe bilden zwei Messingrohre die mit Hilfe eines gedrehten Rings ineinander gepresst werden (Bild 2). Um einen zentrischen Aufbau erreichen zu können, wird das spätere Innen-(Gitter)Rohr (3) in einem Arbeitsgang innen auf 13,20 mm (Sitz für den Gitterring) und außen auf 16,60 mm (Passung für den Zwischenring) gedreht (Bild 3). Der vorbereitete Ring (4) wird nun mit Hilfe eines Schraubstocks auf das Innenrohr aufgepresst und eventuell sauber verlötet.

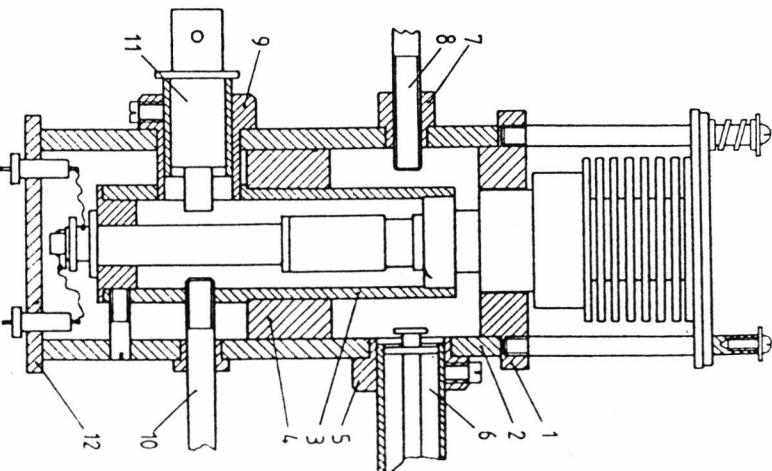


Bild 2: Übersichtszeichnung der Endstufe für das 6-cm-Band

Stückliste der wichtigsten Bauteile

- | | |
|---------------------------|-------------------|
| 1) Anodenkopfdeckel | 18) Splint |
| 2) Anodenrohr (Hauptrohr) | 19) Deckel |
| 3) Gitterrohr (Innenrohr) | 20) U-Scheibe |
| 4) Zwischenring | 21) Teflonscheibe |
| 5) Führungshülse | 22) Teflonscheibe |
| 6) Ausgangsbuchse | |
| 7) Gewindebuchse | |
| 8) Abstimmsschraube | |
| 9) Führungshülse | |
| 10) Abstimmsschraube | |
| 11) Eingangsbuchse | |
| 12) Unterer Deckel | |
| 13) Kathodenkontaktring | |
| 14) Kathodenanschlussrohr | |
| 15) Außenkathodenrohr | |
| 16) Heizungsstift | |
| 17 a, b) Teilscheiben | |

Der Anodenkopfdeckel (1), der mit dem Anodenring der Röhre und der dazwischenliegenden PTFE-Folie gleichzeitig den Abkapsch-Kondensator bildet, wird mit sechs Schrauben M 2x10 auf dem Hauptrohr befestigt. Auf die Oberflächengüte des Hauptrohrs und des Anodenraumdeckels ist besonders zu achten. Der untere Deckel des Rohres, der die beiden Durchführungs kondensatoren für Kathode und Heizung aufnimmt, wird entsprechend montiert.

Bild 3:
Das Hauptteil: Anoden- und
Gitter-Rohr mit Führungs-
hülsen für Buchsen und
Abstimmsschrauben

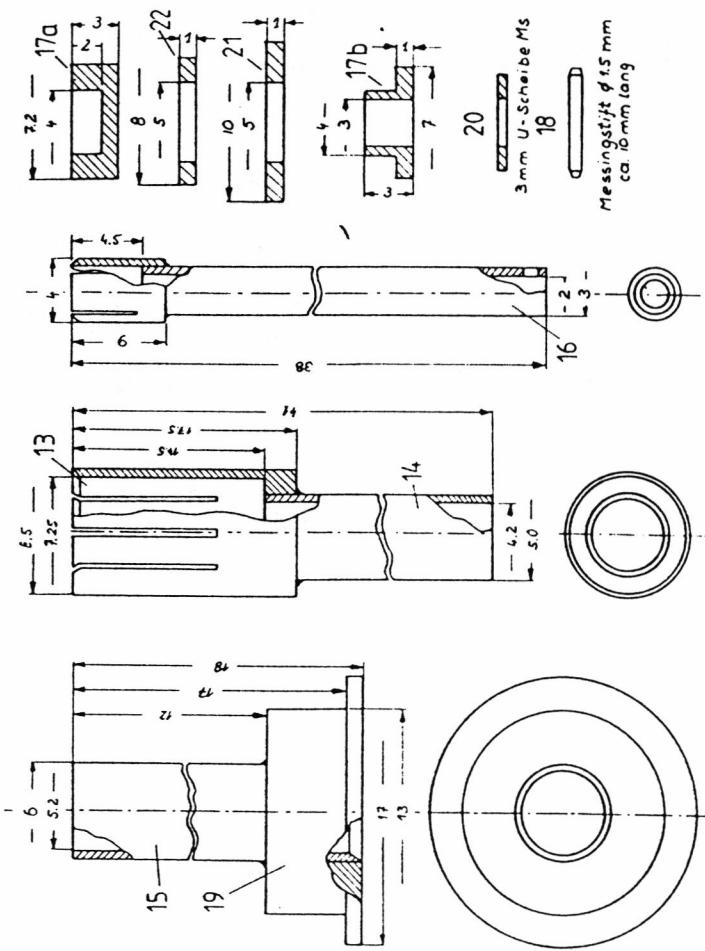


Bild 6: Einzelteile des Kathodenkreises

1.1. Kathodenresonator

Bild 5 stellt die Einzelteile des Kathodenresonators dar. Der Kathodenkontaktring (13) wird auf das Rohr (14) von 5 mm Durchmesser gelötet und mehrfach längs geschlitzt. Das handelsübliche Rohr (wie alle anderen Rohre bis 12 mm Ø in Modellbaugeschäften erhältlich) wird stramm mit PTFE-Folie umwickelt und in das Außenkathodenrohr (15) mit 5,2 mm Innendurchmesser geschoben.

Der Heizungsstift (16) wird in zwei Teflonscheiben geführt (17 a, b), am Ende durchbohrt, mit einem Splint (18) aus Draht (1,5 mm Ø) gesichert und mit der Anschlußleitung verbunden. Der Deckel des Kathodenresonators (19) wird zur besseren Kontaktgabe mit etwas Leitfähigfarbe versehen. Dann wird das Ganze in den Kathodenresonator geschoben.

Der Anodenstecker (20) wird in das Außenkathodenrohr eingedreht. Der Abstand zwischen dem Anodenstecker und dem Resonator muß ca. 1,5 mm betragen.

1.2. Ein- und Auskoppelbuchsen

Die beiden Resonatoren werden kapazitiv gekoppelt. Entsprechend präparierte BNC-(besser N-Norm)Buchsen werden mit Messingrohr 10x1 versehen, um saugend (schleifen und polieren) in die Führungshülsen der Resonatoren zu passen. Die Ausgangsbuchse, die mit einer 5 mm großen Scheibe abgeschlossen ist, ragt etwa 1,5 mm tief in den Anodenresonator hinein. Der Abstand des Einkoppelsliftes (Röhrchen 4 mm Ø auf den Innenleiter der Buchse gelödet) zum Kathodenrohr beträgt ca. 2 mm. Die Bilder 7, 8 und 9, mit den teilweise montierten Teilen des Verstärkers sollen die nicht gänzlich leicht zu beschreibende Mechanik anschaulicher machen.

1.3. Einbau der Röhre

Der Anodenteil wird mit PTFE-Folie

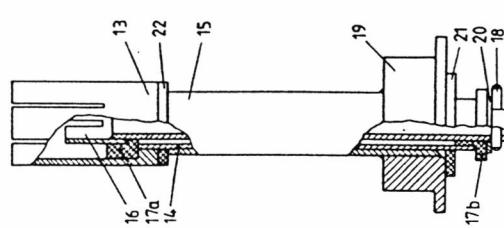


Bild 5:
Kathodenkreis für die 6-cm-
Endstufe mit YD 1060

Bild 4:
Anodendeckel,
Abschlußdeckel,
Zwischenring

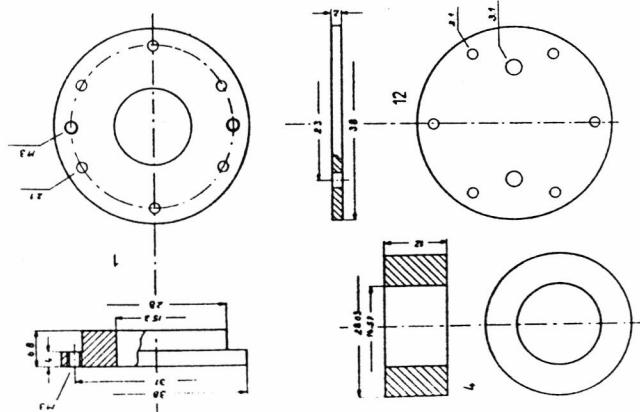


Bild 7:
Unterer Deckel und die Teile
nach Bild 6

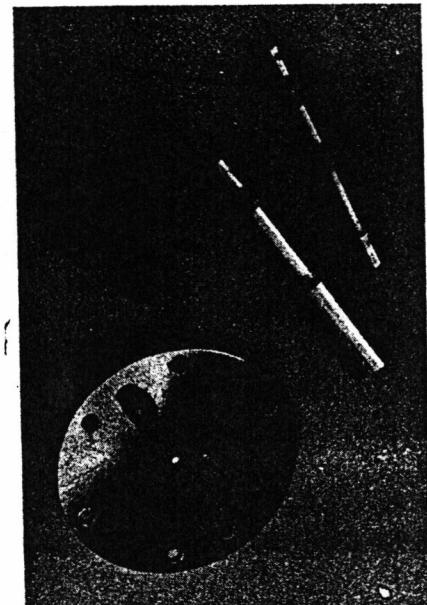
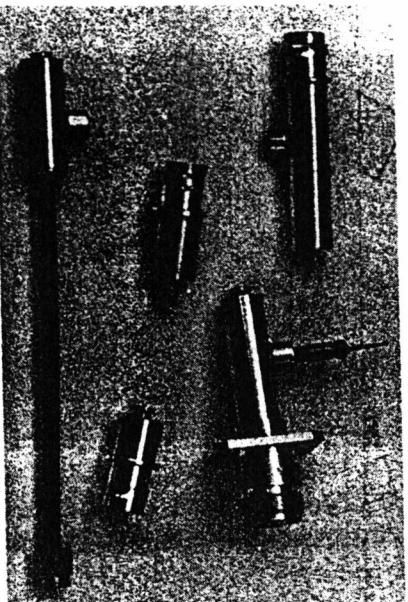
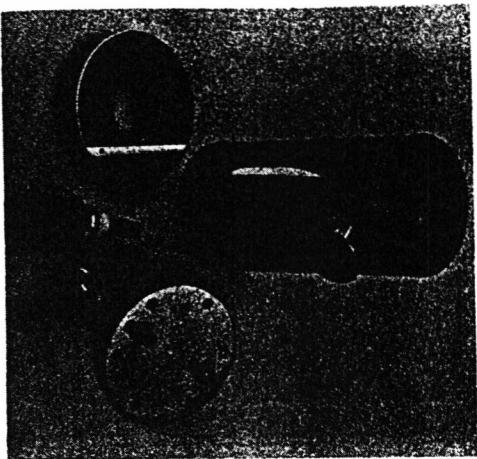


Bild 8:
Verschiedene Ein- und
Auskoppel-Anordnungen

umwickelt und stramm in den Anodenkopfdeckel gedreht. Von der Verwendung einer dünnen PTFE-Folie, die üblicherweise als Dichtungsmaterial für Rohrverschraubungen dient, muß abgeraten werden, weil sich die mechanischen Eigenschaften dieser Folie bei höheren Temperaturen deutlich ändern und die Röhre ihren festen Sitz verlieren könnte. Sehr gute Eigenschaften zeigte an dieser Stelle 0,08 bis 0,10 mm dicke Teflon-Seide. Der Gittersitz und der Gitterring werden mit Leitsilber bestrichen und die Röhre samt Anodenplatte auf den Aufbau gesetzt und verschraubt.

2. INBETRIEBNAHME UND ABGLEICH

Der Ausgang wird mit einem geeigneten Leistungsmesser verbunden und die Heizspannung von 6 V angeschlossen. Der Arbeitspunkt wird mit Hilfe eines Konstantspannungs-Zweipols in bekannter Form eingestellt. Bei einer Anodenspannung von ca. 400 V, soll ein Ruhestrom von 20 mA fließen.

Nun wird der Verstärker angesteuert und der Kathodenresonator abwechselnd mit der Abstimmsschraube und durch Verändern der Tiefe der Einkoppelbuchse auf maximalen Zuwachs des Anodenstroms abgestimmt. Bei einer Steuerleistung von ca. 100 mW sollen etwa 60 mA erreicht werden.

Auf gleiche Weise, unter dauernder Beobachtung des Anodenstrom-Instruments, wird anschließend der Anodenkreis abgestimmt, bis die maxi-

Bild 9:
Teilmontierter Resonator mit
Deckeln und Abstimm-
schrauben

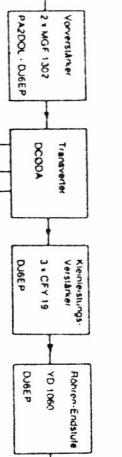


Bild 10: Blockschaltbild eines Linear-Transverters
für das 6-cm-Band

male Ausgangsleistung erreicht worden ist. Bei zu hoher Verstärkung, die vor allem von der Einbautiefe der Ausgangsbuchse abhängt, können leichte Schwingungen auftreten.

3. DER TRANSVERTER

Da der Hohlleiter-Mischer und Varaktor-Vervielfacher für das 6-cm-Band endgültig der Vergangenheit angehören, soll an dieser Stelle ein modernes Konzept kurz skizziiert werden.

In dem von mir konstruierten Gerät benutze ich den Einplatinen-Transverter in Microstrip-Technik von DCØDA. Ein Eigenbau-Linear-Verstärker mit zwei parallelen CFY 19 in der Endstufe bringt die erwünschten 150 mW, um die vorgestellte Röhrenendstufe ausreichend ansteuern zu können.

Ein modifizierter, zweistufiger Vorverstärker nach PA 2 DOL verleiht dem mit MGF 1302 bestückten Konverter eine Rauschzahl von 1,9 dB, und bringt die Gesamtverstärkung auf 26 dB. Die hier kurz beschriebenen Baugruppen (Bild 10) wurden erstmals auf der GHz-Tagung im Februar 1987 in Dorsten vorgestellt.

4. ERREICHTE WERTE

Mit dem hier vorgeschlagenen Konzept und einer Anodenspannung von 450 V sind 6 Watt Ausgangsleistung erreicht worden. Der Anodenstrom stieg dabei von 20 mA auf ca. 100 mA an, was bei ausreichender Kühlung einen stabilen Betrieb in Telegraphie oder SSB erlaubt.

Erwähnenswert ist, daß die im Sendespektrum vorhandene Spiegel frequenz und das Oszillatorkreis durch den Einsatz der Röhrenstufe um weitere 26 dB unterdrückt worden sind.

Abschließend danke ich Rolf Küppers, DL 4 JK, für meßtechnische Unterstützung, und Horst Lehrke für die Fotos.

FILTRES 6 cm

E. Resonator filters for the 9, 6 and 3cm band. Because the modern microwave components available now on market, no more waveguide assemblies like wg-mixers also are required. Filters in stripline design are often hard to reproduce and lossy in their insertion performance. Wg-filters or interdigital types are more preferred for amateurradio use at present. The disadvantages are: high insertionloss and big outlines. Resonators made from "installation material used in heating plants" (coppertubes) perform these specifications.

A piece of coppertube is cut and two square-copper plates, 2mm strong are pressed from all sides of the tube by M4 screws. For the 9 and 6cm version, the burr must not be removed. For the 3cm version the tube must be sawed very carefully because the tube should not be deformed! Fig. 1 shows the filter and Fig.2 the outlines. One plate is soldered to the tube and the other plate is prepared by a centered M4 tapped hole for the adjustment screw. About .6-.8 holes are drilled into both plates near to the outer diameter for assembling the filter by M4 screws. Now the filter has to be cleaned and may be silverplated. The couplingloops are made from silverplated copperwire (1.5mm) and must be placed as shown in Fig.1. When the coupling loop is turned, the shape factor of the filter becomes more steep and the insertion loss will increase! The 9cm filter can be used also on 13cm.

The tube can also be substituted by a revolved brass ring of similar outlines. Several reproductions of this filter, especially the 6cm version, have shown the good reproducible performance. DF9LN measured on the 6cm filter 0.4dB insertion-loss.

73 de Dk 2 AB.

H.-J. Meise, DK2AB, Kiewitsheide 55, D-4504 Georgsmarienhütte.

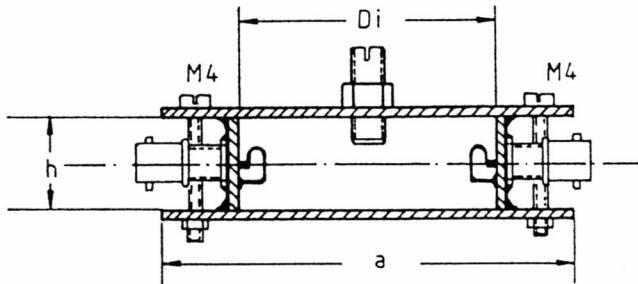


Fig.1

BAND	Di(mm)	h (mm)	a (mm)	BEREICH (GHz) RANGE (GHz)
9 cm	54	20	75	2,2 - 4,5
6 cm	32	13	50	5,5 - 7,6
3 cm	20	7	35	9,5 - 12,0

Fig.2

EVANESCENT MODE FILTER FOR 5.76 GHz

Microwave Newsletter Oct 94 by Andy Talbot, G4JNT

In the October 1991 Microwave Newsletter the design of evanescent mode filters was described using waveguide well below its cutoff frequency. Using Waveguide 16 a 3rd order filter for a 3.4 GHz transverter with 144 MHz IF was given.

Using Waveguide 18, with internal dimensions of $15.8 \times 7.9\text{mm}$, a similar design for 5.76 GHz is described here. To maintain an IF of 144 MHz with a single filter, a sharp response to adequately attenuate the image and local oscillator components is needed. A third order filter with bandwidth of 100 MHz was chosen to keep the design simple. A significantly lower bandwidth would increase the insertion loss and make tuning much more of a problem. However, since the band of interest is a narrow section in the middle of the total passband, a high filter ripple can be allowed. (For odd order filters the ripple shows minimum attenuation at the passband centre). The higher ripple gives a sharper roll off making a third order response practical.

Coupling distances between the resonator screws were found by making and measuring a test piece (the method is described in the above reference) and a diagram of the resulting filter is shown in figure 1. The measured response in given in figure 2 from which it can be seen that over 40 dB of rejection is available at the local oscillator frequency, and over 60 dB in the image band. When used with a balanced mixer, this is sufficient to provide all the spurious filtering needed in a transverter.

Alignment is best done with some form of sweep generator and display but a satisfactory response can be achieved by just tuning for 'maximum smoke'. If a means of measuring return loss is available (such as a directional coupler) then Dishals alignment method as described in the filter chapter of the Microwave Handbook will give excellent results. Tuning screw penetration is such that there is a gap of approximately 0.5mm between end of the tuning screw and the waveguide opposite face.

Cheap Microwave Filters From Copper Plumbing Caps

By Kent Britain, WA5VJB

[From Proceedings of Microwave Update '88]

5760-MHz Filters

The 1-in. filters will also tune to 5760 MHz when the tuning is about $\frac{3}{8}\text{ in.}$ into the cavity. With a $\frac{1}{8}\text{-in.}$ long probe, a 5760-MHz transverter would see about 20-dB rejection of the LO and almost 30-dB rejection of the image, with a 144-MHz IF.

A 5760-MHz filter made from a $\frac{3}{4}\text{-in.}$ cap has similar performance to the 1-in. filter, but with less insertion loss than the 1-in. filter (Fig 4).

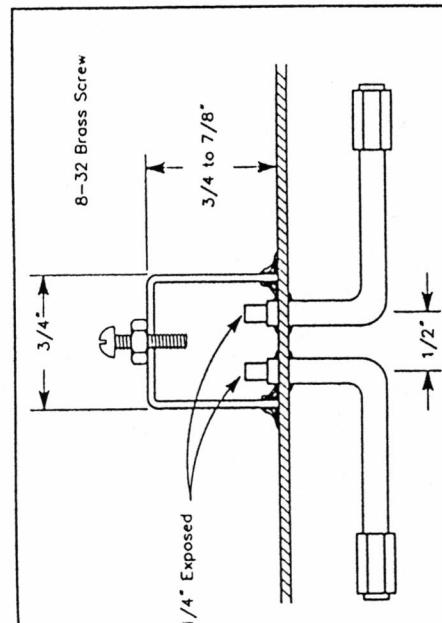
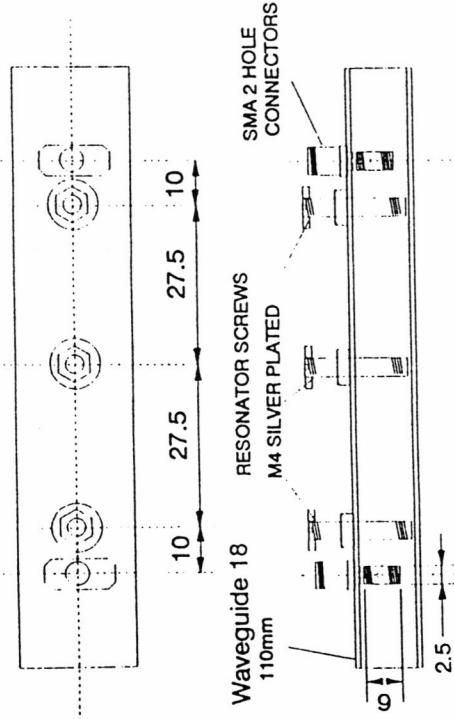
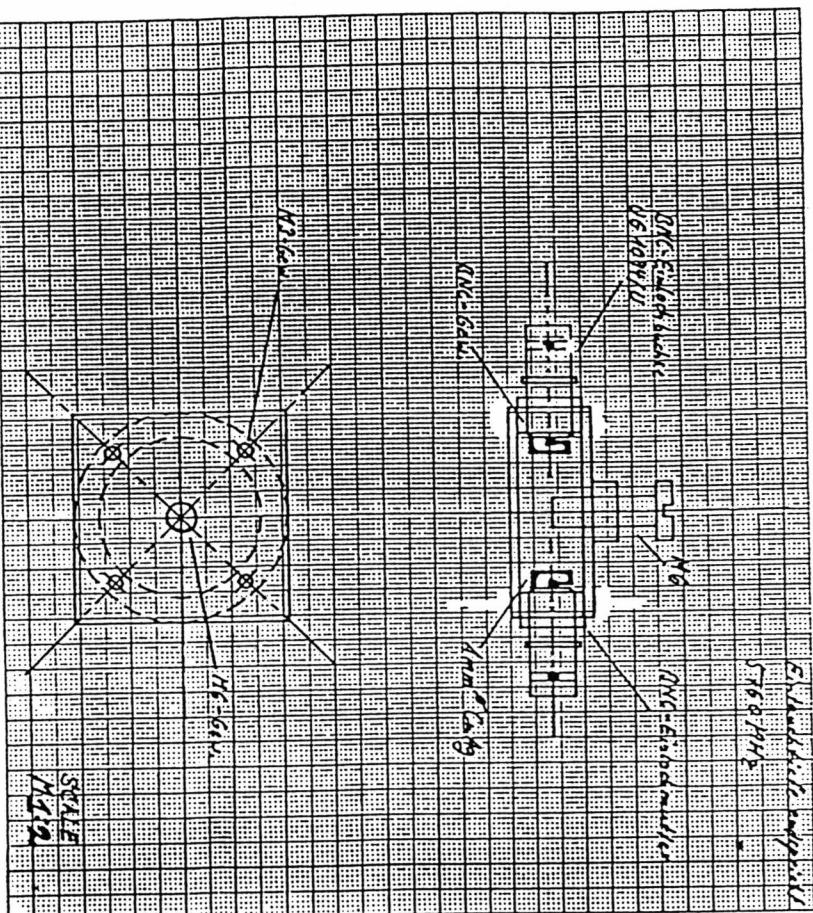


Fig 4—Mechanical details of the 5760-MHz filter using a $\frac{3}{4}\text{-in.}$ cap.

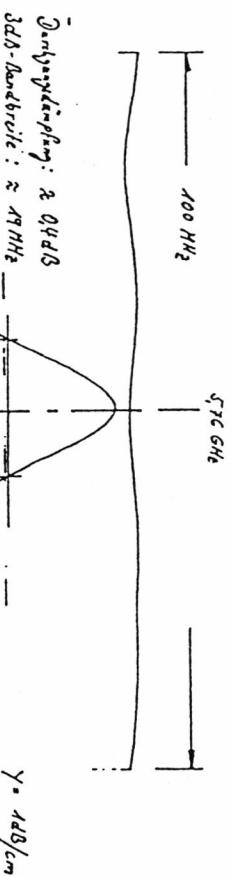


6 cm Resonator Filter by DK 2 AB

DUBUS 2/84



Resonator Ring: 32mm innen (inside), 42mm außen (outside), 13mm hoch (high).
Abdeckplatten (Bottom-/Topplate) 42 x 42mm, 2mm stark (thick) Ms.
BNC-Gewinde (BNC-tap) 3/B"-32 UNEF; B-Sinn vorbohren (drilling).
Bezugsquelle für Gewindedrehschneider (Ref. address for drilltap):
Georg Bornatash GmbH, Postfach 100434, D-4300 Essen 1. Tel: 0201/778011.



$Y = 1 \text{ dB/cm}$

Resonatorfilter
DK2AB
für 6 cm

23.9 dB
25.3 dB

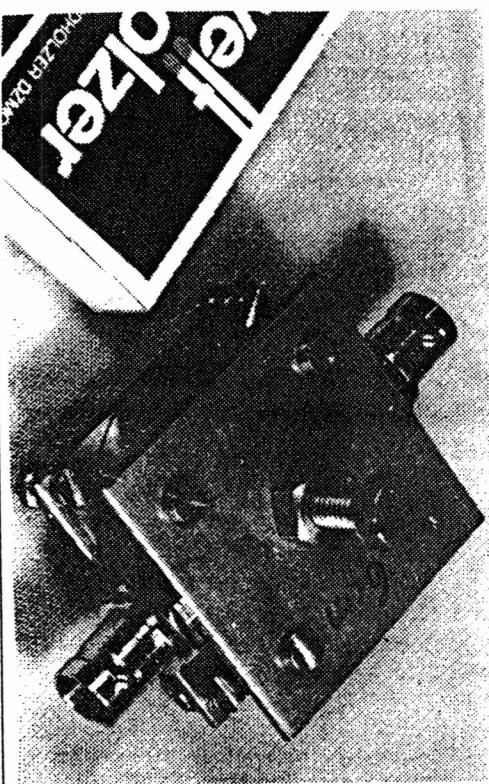


5.97
6.61
6.76
6.56 MHz

bei 5.94 MHz 2F:
Impedanzveränderung $\approx 19 \text{ dB}$
Spiegelimpedanzveränderung $\approx 24 \text{ dB}$

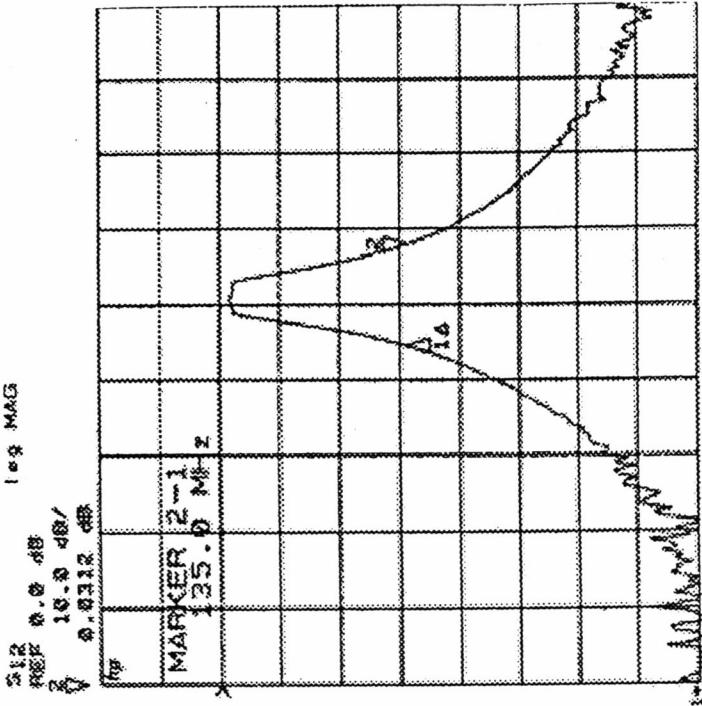
$\gamma = 2 \text{ dB/cm}$

Resonatorfilter
DK2AB
für 6 cm
23.9 dB
25.3 dB



Waveguide Band-Pass Filter

N1BWJ August 1995 QEX Number 162



environments.

If high-gain amplifiers are used, a good filter is necessary. When I added a surplus power amplifier like the one used by N2SB, the additional 40 dB of gain was enough to amplify the LO leakage through the pipe-cap filter to about 1/4-W (Note 3). Not only is this wasted power, it is also outside the ham band.

The best filter I've tried is a waveguide post filter, such as the 10-GHz ones described by N6GN. It is easily built using only a drill, tuning is smooth and non-critical and the performance is excellent. Glenn was kind enough to calculate dimensions for 5760 MHz using standard wave-guide and hobby brass tubing, as shown in Fig 5. Dimensions are for WR-137 waveguide for 5800 MHz; reducing the spacings a hair will give a little more tuning range. I built two units—the second, with careful fit and flux cleaning, had 0.4 dB of loss, while the first, with sloppy fit and soldering, had 0.5 dB of loss. Both units measured as shown in Fig 6, with steep skirts (135-MHz wide at 30 dB down) and no spurious responses detectable (>70 dB down). Tuning was smooth and easy; with high-side LO injection, the LO and image frequencies are outside the tuning range, so 5760 is the only output that can be found while tuning.

Construction hint: Make sure the holes are carefully measured and centered in the waveguide. Centerpunch lightly. Using a drill press, start the holes using a center drill, then drill them out a few drills undersize. Then enlarge them one drill size at a time until the tubing is a snug fit. Solder on a hot plate.

Fig 6—Measured performance of waveguide filter

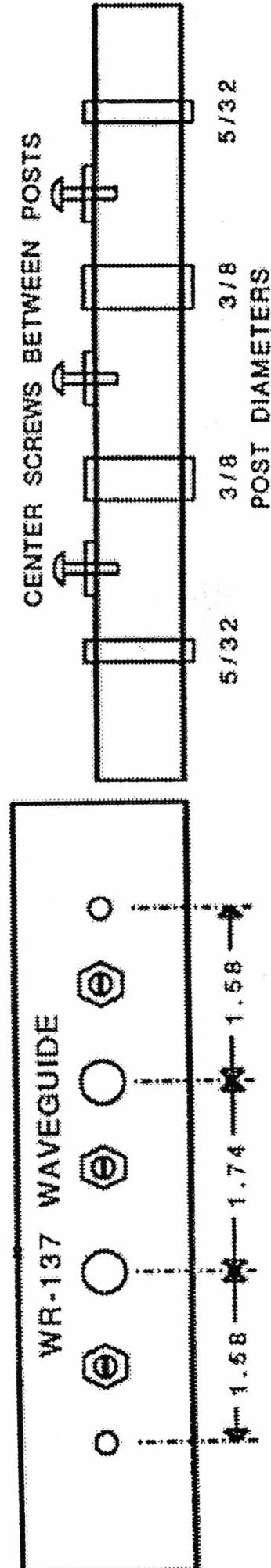


Fig. 5—Waveguide filter for 5760 MHz

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Waveguide Bandpass Filters

By James D. Green, K5JG

Waveguide filters usually fall in two categories: direct-coupled and quarter-wave-coupled cavities. This is a quarter-wave coupled filter, because requirements for precision are somewhat less than for the direct-coupled filter.¹ For those who are interested in the area inside the guide, the space between a set of posts acts like a resonant section or cavity. The distance between sets of posts is the coupling line. A set of posts may be viewed as a simple parallel-tuned circuit, with the tuning screw located halfway between the post set as the variable capacitance of the tuned circuit. Penetration of the screw into the cavity lowers the resonant frequency and effectively increases the cavity length or, in this case, the distance between the posts. Cavities are usually constructed somewhat shorter than required. The capacitive screw allows for frequency variation, as with any other filter. Since screw penetration lowers the cavity Q, avoid excessive screw penetration.

A Word About Plating

All screws should be silver plated, to minimize filter losses.² Contrary to popular belief though, plating the interior walls and posts of a waveguide filter of this type is not worth the time, trouble or expense. A poor plating job, which is more likely than not, is worse than no plating at all.³

Construction

Filter construction is simple and straightforward. Measurement accuracy is important. All measurements should be made with accurate calipers. Use a very sharp metal scribe to indicate all lines and locations. Remember that small scribing errors can amount to many MHz deviations in the finished product. Cut a section of waveguide to the proper length as shown in Fig 1. Measure and scribe a center line down the middle of the guide. Scribe the location of the first post hole and with the calipers measure and scribe each succeeding post and screw hole. Mark all holes to be drilled with a very sharp center punch. Do not use an automatic punch since there is a danger of bowing or bending the waveguide wall. Lightly punch all hole locations. Secure the waveguide section in a small vise while drilling holes. Do not attempt drilling with a hand drill. All holes may now be drilled to the proper size. Remember that holes for the posts are drilled through the top

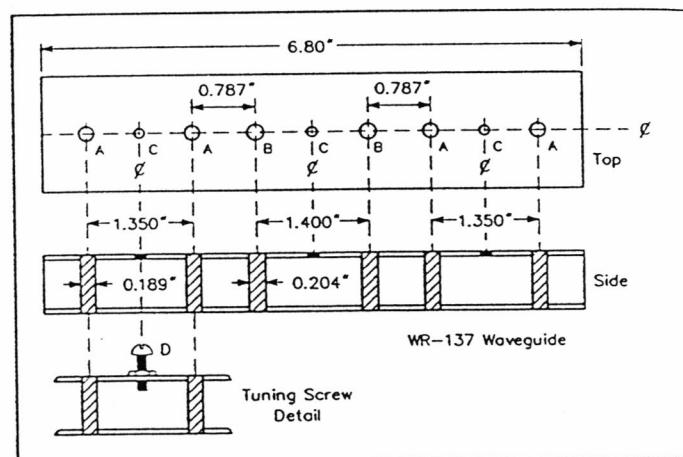


Fig 1—5.7-GHz Waveguide Bandpass Filter. Locations of holes and components are A: No. 11 drill for 0.189-in round brass rod; B: No. 6 drill for 0.204-in. round brass rod; C: No. 36 drill for 6-32 screw; D: 6-32 × 5/8-in. screw with 5/16-in. nut (3 required).

and bottom of the guide, screw holes only through one face. Holes for the 6-32 screws should now be tapped. Burrs should be removed from the inside of the guide using a very fine file, taking care not to leave any deep scratches on the interior surface. The brass posts should be cut to length and inserted in their proper holes. Soft solder can be used to solder posts in the guide; however, silver solder is highly recommended. Using silver solder eliminates the possibility of posts dropping out when you are attaching flanges. Soft solder also tends to run inside the guide and form a dome around the post ends. It also runs down the outside of the posts, leaving a glob which tends to drastically change the cavity frequency. Silver solder reduces these problems. Immediately after soldering, dunk the entire assembly in a 10% solution of sulfuric acid for a few seconds. Then rinse thoroughly. This will remove all flux and leave the assembly clean, with a nice pink color. The filter is now complete and only flanges need be added. Either soft solder or silver solder may be used on the flanges. After the flanges are attached it would be wise to run the assembly through another dunk-rinse cycle. After drying, the filter int-

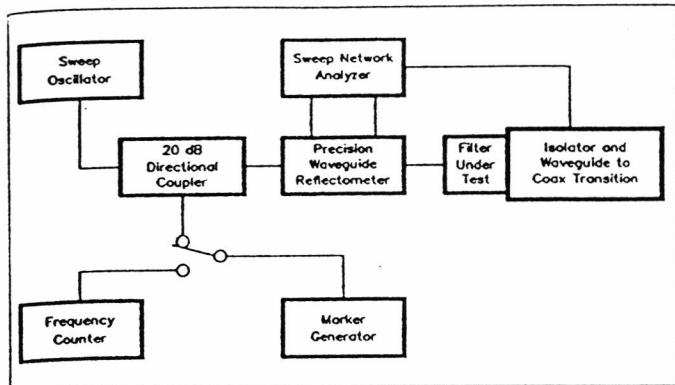


Fig 2—Ideal filter test setup.

rior should be checked for any metal shavings or other obstructions that might have lodged in the guide. Needless to say, protective goggles should be worn during the entire process.

Alignment

Tests and alignment of this filter were conducted using the test set up shown in Fig 2. This is a fairly common arrangement in the commercial field. It is the most convenient way of rapidly determining filter parameters, including return loss, response curve and insertion loss. The average ham usually is not lucky enough to have access to such equipment. With this fact in mind, numerous tests were conducted using the simple set up shown in Fig 3. The filter was aligned first on the band edges and then the band center. After alignment on each frequency, I used a network analyzer to determine if the band pass characteristics and SWR would be satisfactory for amateur use. Although the simple alignment method is not perfect, I found it satisfactory for most uses. The signal source should have at least 10-dBm output and the power meter should be capable of reading down to at least -25 dbm. Although you can't measure SWR, when I used the simple method of alignment, SWR never exceeded 1.4:1. The response of a perfectly aligned filter is shown in Fig 4.

Before starting alignment, place the filter in a small table vise or anchor it in some way. Nothing should move but the screws you will be adjusting. Thread oversize ($\frac{1}{16}$ -in.) nuts on the silver-plated screws, all the way up to the screw head. With the signal source adjusted to the desired frequency, measure and record the power output of the source, by connecting the two coax-to-waveguide transitions face to face. Reconnect the transitions to the filter. It makes no difference which end of the filter goes to the source or load. Common practice for UG-344 or UG-343 flanges is that the cover flange faces the source and the choke flange faces the load. Set the power meter for maximum sensitivity. Insert only the screw for the middle cavity, and slowly turn it inward while watching the power meter for a very slight upward movement. This will depend on the power output of your source. Turn slowly and watch carefully. Once this small peak is found the battle is half won. Gently run the nut down to the waveguide surface and finger tighten, being sure not to lose your peak. The input and output cavity screws may now be inserted. Alternately adjust the input and output cavity screws for maximum power meter reading. If things are going well, you should have had to change power-

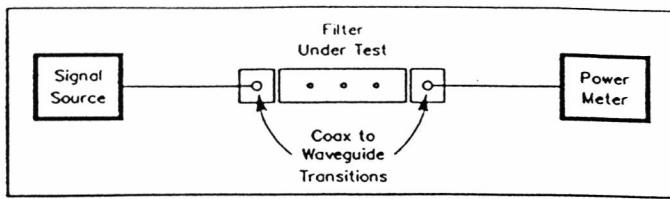


Fig 3—Filter test setup adequate for amateur applications.

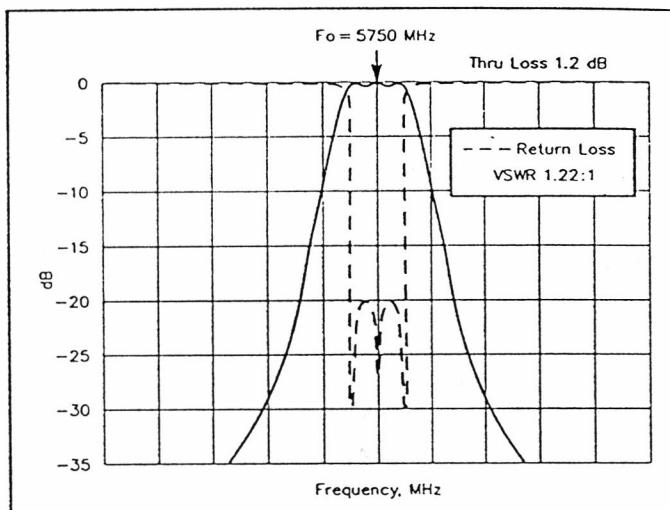


Fig 4—Filter response curve.

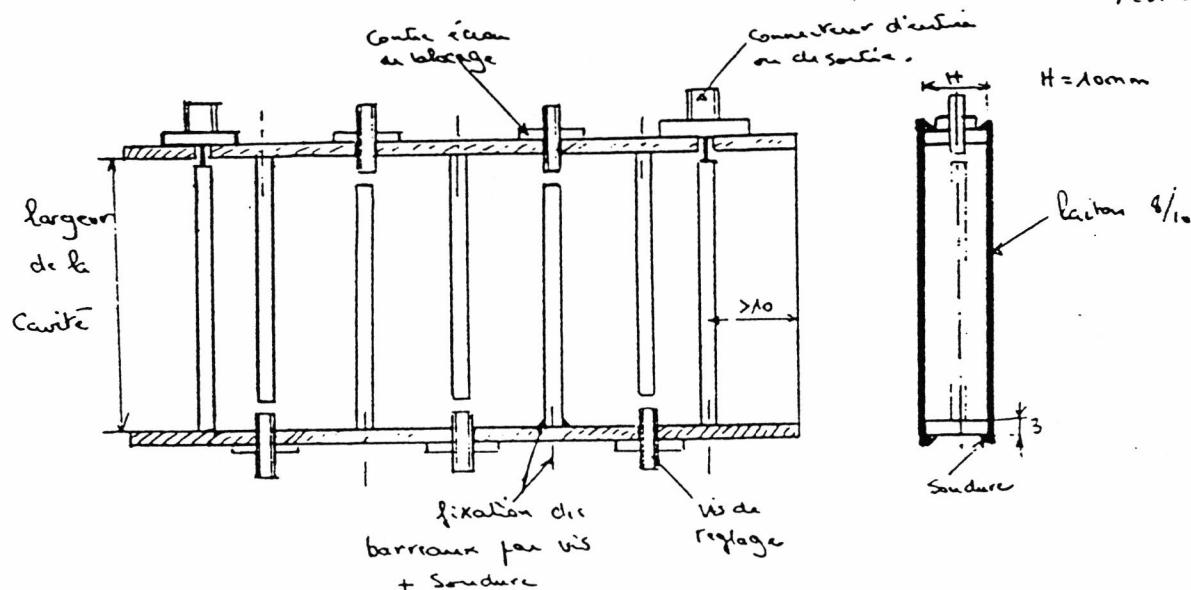
meter scales a couple of times. You will find that just finger tightening the screws during this portion of the alignment saves a great deal of time and is much easier on the soft copper threads in the waveguide. After you are satisfied that there is no more to be gained from the input and output screws, readjust the middle cavity screw for a peak power reading. Then, alternately adjust input, middle and output in that order for maximum power. You'll have to do this a number of times, as the tuning screws interact. To get an idea of the filter loss, compare the power meter reading against that recorded earlier. Final adjustments should be made with a small wrench on the nuts. Be careful not to overtighten. If you do have an accident and strip the waveguide threads, all is not lost. Rethread the hole for an 8-32 screw and proceed. This filter has been used with screws up to 8-32. When the alignment is complete, check the source power again, to accurately determine the filter passband loss. In most cases, if the pass-band loss is no greater than 1.3 dB, the skirts, stop-band attenuation and SWR should be satisfactory for most amateur work. If you need to paint the filter, be sure that all the screws and nuts are masked, so you may can shift frequency later.

Notes

- ¹R. M. Fano, "Microwave Filters Using Quarter-Wave Couplings," *Proceedings of the IRE*, Nov 1947, pp 1318-1323.
- ²E. Tahan, "Microwave Filter Design Techniques," *Microwave Journal*, Mar 1962, pp 111-116.
- ³G. L. Ragan, *Microwave Transmission Circuits*, pp 126-127 (Vol 9 of the MIT Radiation Laboratories Series, New York: McGraw-Hill, 1946).

FILTRES INTERDIGITES -FIEHN

MURCINFOS N° 30
Fevrier 88



les barreaux sont espacés de $\lambda/2$

Dist CAC est la distance de centre à centre

Représente deux barreaux.

73. FIEHN

Calcul d'un filtre interdigital

$F_0 = 5760.00000$ $R_P = 400.00000$ $R_{LP} = 0.30000$ $N = 5$

G₁: 1 := 1.481677
G₁: 2 := 1.299208
G₁: 3 := 2.309513
G₁: 4 := 1.299208
G₁: 5 := 1.461677
G₁: 6 := 4.000000

	1	2
36.67	36.67	
36.67	36.67	
36.67	36.67	
36.67	36.67	

	1	2
4.223621	4.223621	4.223621
4.223621	4.223621	4.223621
4.223621	4.223621	4.223621
4.223621	4.223621	4.223621
4.223621	4.223621	4.223621
4.223621	4.223621	4.223621
4.223621	4.223621	4.223621

N = 5 \Rightarrow 12.22202

Numéro	Diamètre/H	Espacement/H	D.C.A.C/H	Diamètre	Dist.C.A.C
	K	DBG(K)	SBT(K)	C(K)	DBH(K)
1	0.525200	0.49568	0.94818	5.25000	9.48179
2	0.380000	1.24075	1.62575	3.80000	16.25750
3	0.390000	1.31176	1.70176	3.90000	17.01759
4	0.390000	1.31176	1.70176	3.90000	17.01759
5	0.390000	1.24075	1.62575	3.90000	16.25750
6	0.380000	0.49568	0.94818	3.80000	9.48179
7	0.525200			5.25000	

Barreau 2	Longueur =	8.62	Diamètre =	3.80mm
Barreau 3	Longueur =	8.62	Diamètre =	3.90mm
Barreau 4	Longueur =	8.82	Diamètre =	3.90mm
Barreau 5	Longueur =	8.82	Diamètre =	3.90mm
Barreau 6	Longueur =	8.62	Diamètre =	3.80mm

Largeur de la cavité
(Lambda/4 à F_0)

13.02mm

