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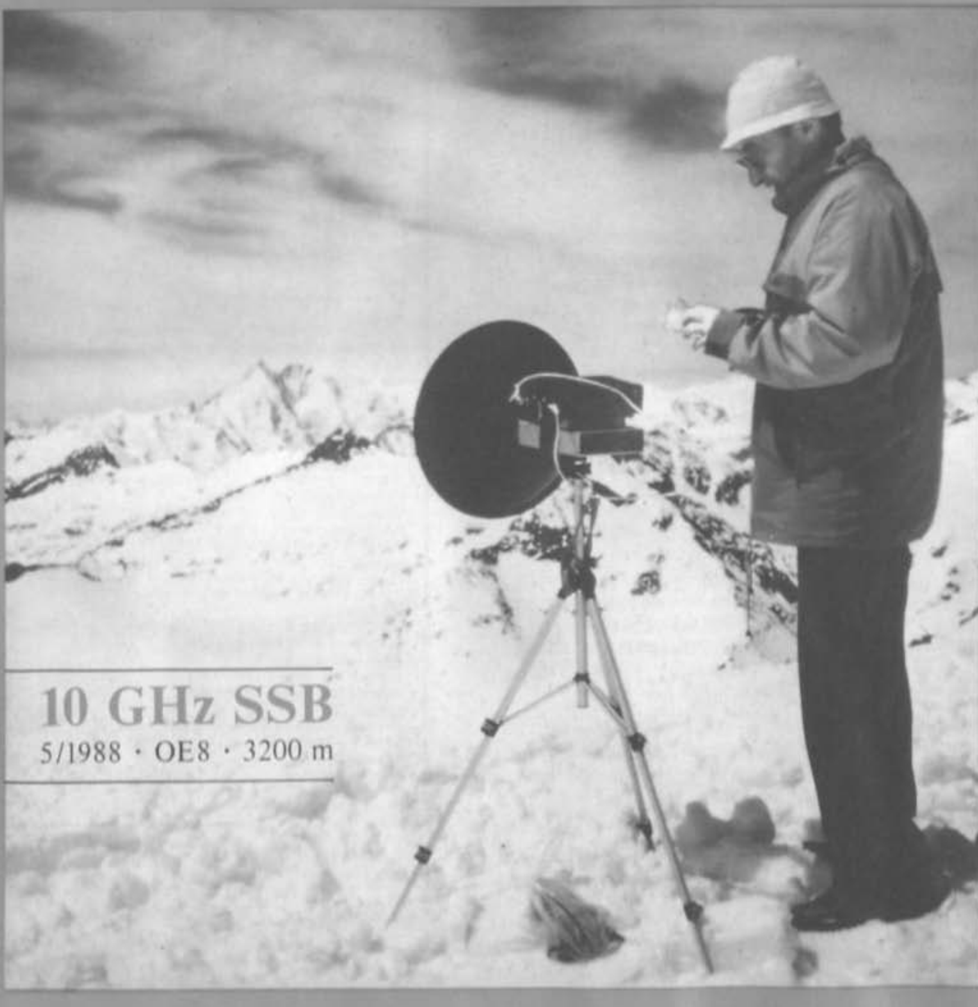
A Publication
for the Radio-Amateur

Especially Covering VHF,
UHF and Microwaves

VHF communications

Volume No. 20 · Autumn · 3/1988 · DM 7.50



VHF communications

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Published by: TERRY BITTAN OHG, P.O.Box 80, Jahnstraße 14, D-8523 BAIERSDORF
Fed. Rep. of Germany
Telephone (9133) 47-0 Telex 629 887
Telefax 0 91 33-47 18
Postgiro Nbg. 30455-858

Publishers: TERRY BITTAN OHG

Editors: Corrie Bittan
Colin J. Brock (Assistant)

Translator: Colin J. Brock, G 3 ISB / DJ Ø OK

Advertising manager: Corrie Bittan

VHF COMMUNICATIONS The international edition of the German publication UKW-BERICHTE is a quarterly amateur radio magazine especially catering for the VHF / UHF / SHF technology. It is published in Spring, Summer, Autumn and Winter. The 1988 subscription price is DM 25.00 or national equivalent per year. Individual copies are available at DM 7.50 or equivalent each. Subscriptions, orders of individual copies, purchase of PC-boards and advertised special components, advertisements and contributions to the magazine should be addressed to the national representative, or – if not possible – directly to the publishers.

Printed in the Fed. Rep. of Germany by R. Reichenbach KG Krelingstr. 39 · 8500 Nuernberg.

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Verlag UKW-BERICHTE, Terry D. Bittan
POB 80, D-8523 Baiersdorf / W. Germany
PSchKto WIEN 1.169.146

Australia
W.I.A. P.O. Box 300, South Caulfield, 3162 VIC,
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Kto. 469.253-41; PSchKto. ZÜRICH 80-54.849

Leo Kälin, HB 9 CKL, Funktechnik
Alte Landstr. 175, CH 8708 Männedorf
Tel. 01-9203535

United Kingdom
Mike Wooding, G 6 QIM, 5 Ware Orchard
Barby, nr. Rugby, Warks CV23 8UF, Tel. 0788 890365

USA
Timekit, P. O. Box 22277,
Cleveland, Ohio 44122, Phone: (216) 464-3820

ISSN 0177-7505

Contents

The **front cover** shows OE 6 AP/8 with his 10 GHz CW/SSB station at about 3200 metres on the summit of Scharek. The pyramid-formed mountain on the left of the dish antenna is the Grossglockner. OE 8 MI/8 and OE 8 TPK/8 were 200 metres away on a neighbouring peak. For details of this expedition see "BRIEFLY SPEAKING...".

UKW**berichte** T. Bittan OHG · Jahnstr. 14 · P.O.Box 80 · D-8523 Baiersdorf
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Dieter Schwarzenau and Bernhard Kokot

A 1.5 GHz Plug-In for the DL Ø HV Frequency Counter

The digital portion of the DL Ø HV frequency counter accomodates plug-in units with division factors of 1 : 1, 4 : 1 and 10 : 1. A plug-in without scaling was also described in (1). The following article describes a plug-in which has a scaling factor of 10 and extends the measurement range of the counter up to 1500 MHz thus encompassing the 23 cm band.

1. CIRCUIT DESCRIPTION

One of the most practical features of the plug-in units described so far, is surely the very large range of input voltages that they can accept without overload. They achieve this by means of a self-regulating PIN-diode network. An attempt to use this circuitry at higher input frequencies was, unfortunately, unsuccessful owing to the large minimum insertion loss of the PIN-diode network at these frequencies which reduced the counter sensitivity to an unacceptable level. Above all, the arrangement using an HF path, together with other components, on a printed circuit board had an enormous influence upon its frequency response. For this reason, a controllable attenuator network was effected by means of an integrated PIN-diode circuit (I 901) in a round plastic package complete with connecting pins.

The circuit diagram of **fig. 2** shows the preamplifier to comprise three cascaded amplifiers of identical design. The active element of each is the Avantek MSA 0404. This integrated circuit has now become favourably priced and does not

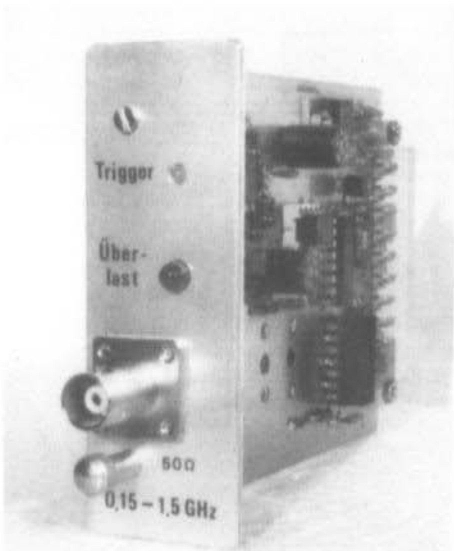

Fig. 1: The author's prototype

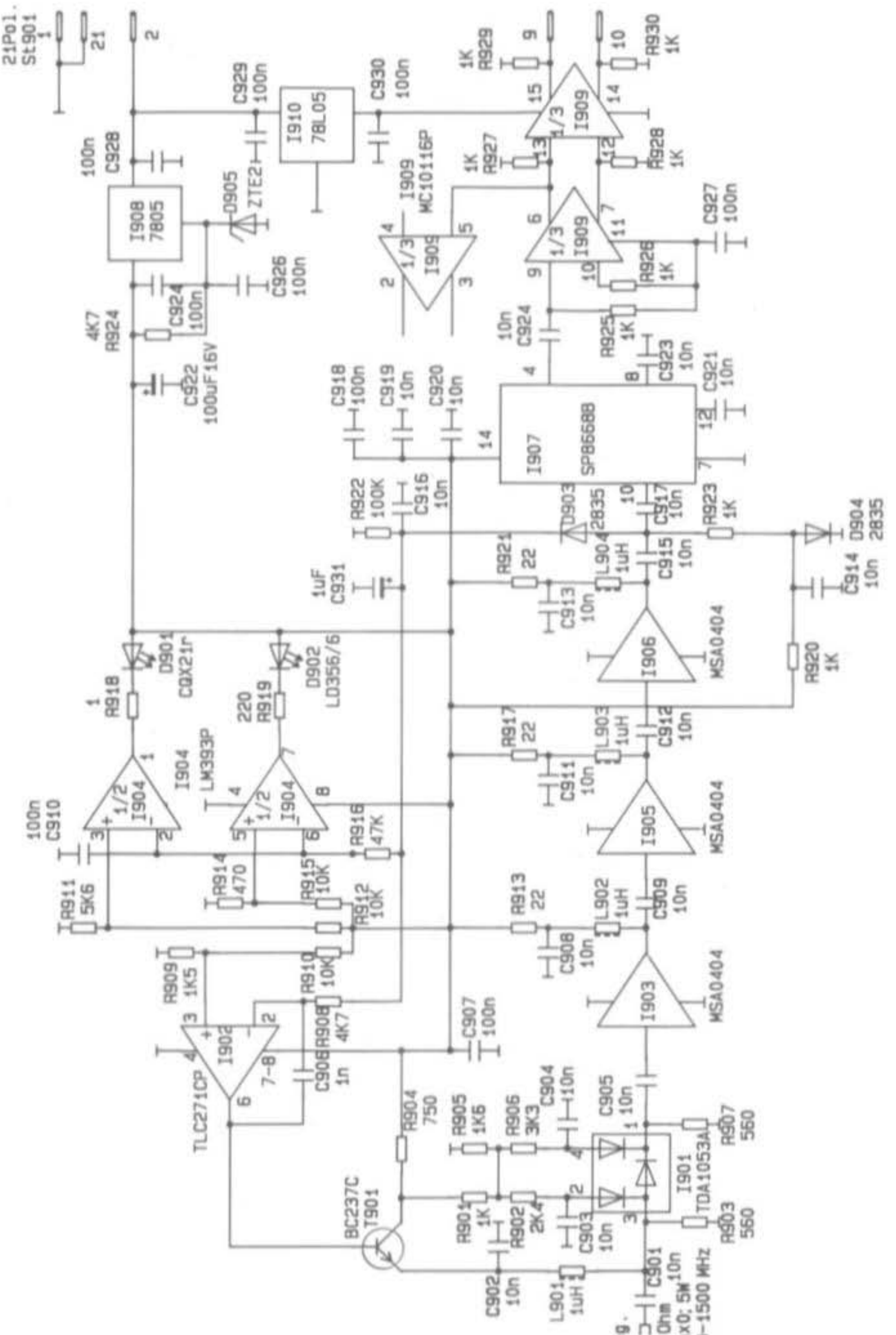

Fig. 2: The 1.5 GHz frequency counter plug-in comprising PIN-diode attenuator and three input pre-amplifiers

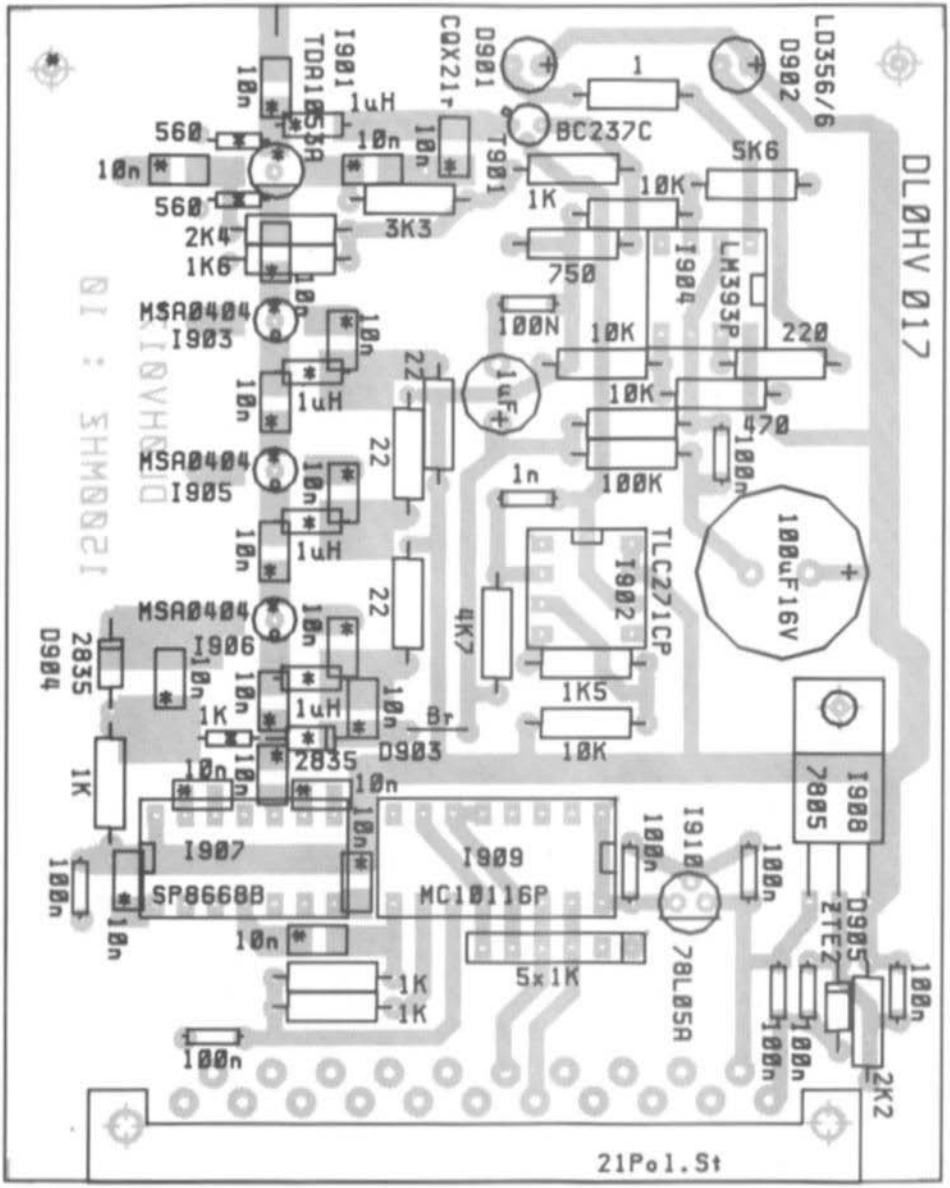

Fig. 3: The PCB is double-sided and is through-plated maually in certain places

require much in the way of external circuitry to achieve a constant gain of 8 dB from 10 MHz right up to 2 GHz.

At the output of the last amplifier, is a peak diode rectifier consisting of diode D 903 and an RC network. The latter comprises R 922 and C 916 in parallel with C 931. The diode is galvanically connected with a forward biased diode in the supply line which is of the same type. By this means, a degree of temperature compensation is achieved. The rectified HF voltage is taken to an operational amplifier I 902 and two comparators in I 904. The comparators control the display LEDs for "trigger" and "overload" front panel indications. The operational amplifier regulates, via a transistor T 901, the DC current through the PIN diodes and thereby the attenuation. The resistive current distribution network for the three PIN diodes was taken directly from (2).

The frequency scaler is an ECL integrated circuit by Plessey with the designation SP 8668 B. It requires a supply voltage of 6.8 V and is therefore driven together with the amplifiers and comparators from a 5 V voltage regulator I 908 with a 2 V Zener diode in its ground lead. The scaler contains four bi-stables which are internally set to divide by 10. The sensitivity of this chip is guaranteed to be less than 400 mV over the frequency range 200 MHz to 1300 MHz and is still under 600 mV at 1500 MHz. The output delivers an ECL level which, because of the enhanced supply voltage, does not match the I 909 power driver (MC 10116). For this reason the two ICs are coupled together by means of a capacitor C 924. The DC voltage is taken to pin 11 where it accesses the driver internal reference voltage. The supply to I 909 is effected by a separate 5 V regulator IC.

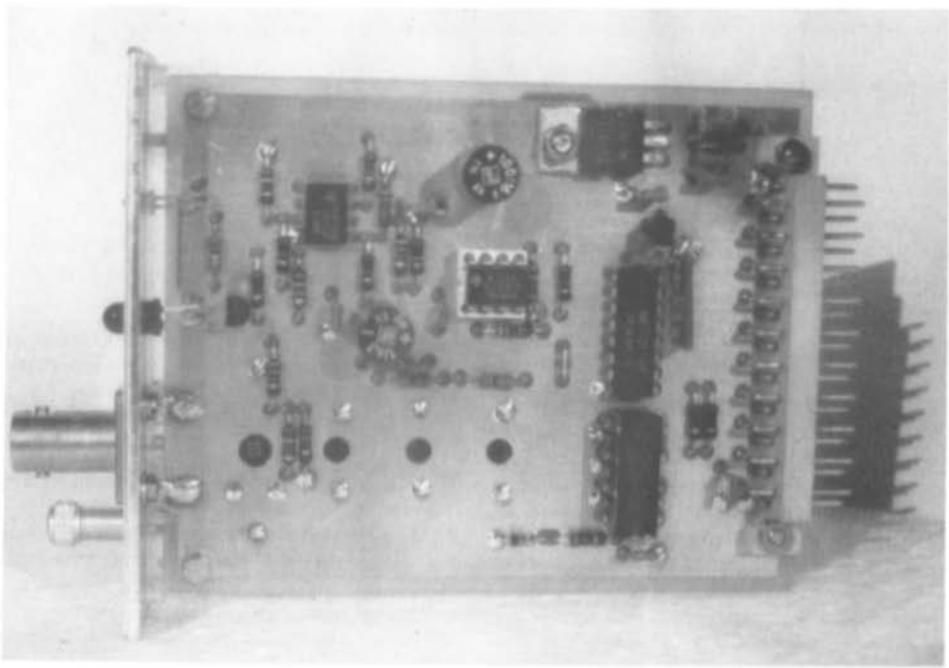

Fig. 4: Showing top-view of the prototype plug-in

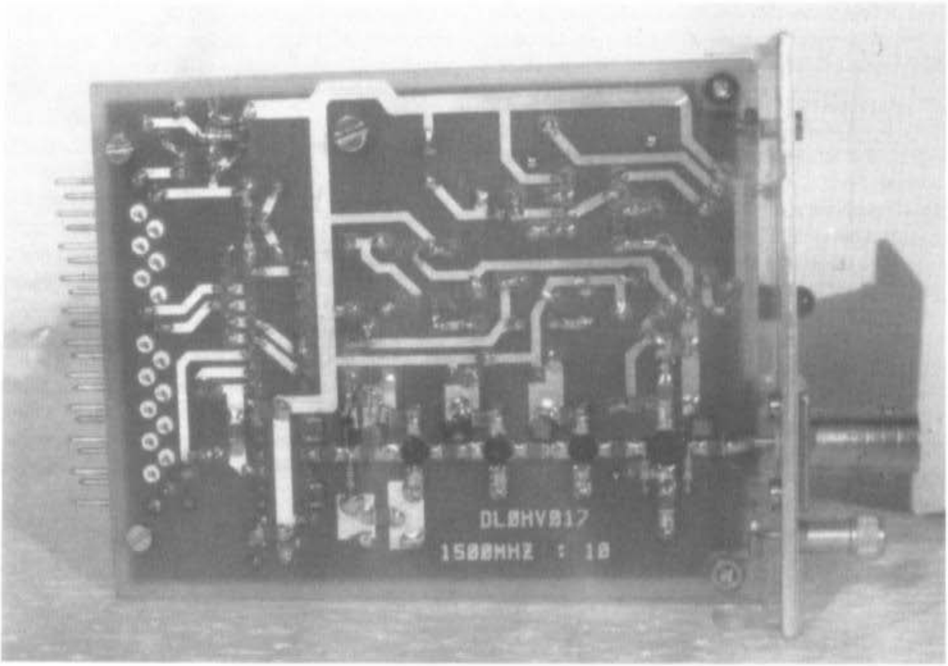

Fig. 5: Photograph of under-side of the plug-in

2. CONSTRUCTION

As already intimated, the dimensions of the components and the PCB tracks have a large influence upon the frequency response of the prescaler. The three HF amplifiers, therefore, follow each other in a direct line but in very close proximity with one another. In the interests of reducing the stray reactances still further, all the components in the signal path are soldered directly to the PCB track side, i.e. under the board. These components are marked with an asterisk on the lay-out plan of **fig. 3**. Chip capacitors only were used in the HF part of the circuit. The resistors are of a miniature type (5 mm lead spacing). The RF chokes consist of 2.5 turns of enamelled copper wire of 0.2 mm diameter, wound in a double-hole core.

During the construction, every effort should be made to conform exactly to that of the prototype. The photographs of **fig. 1** (general view), **fig. 4** (top view) and **fig. 5** (view from below) should help in this respect.

The rest of the construction is not so critical. The 5 V voltage regulator in a TO-220 housing (I 901) must be insulated from the groundplane layer of the PCB, otherwise the Zener diode will be shorted to earth. The prototype I 907 was fitted with a glue on heat-sink in order that the 500 mW of heat can be dissipated more efficiently. The dimensions of the front panel are identical with the other 50 Ω input plug-in units (1) page 73.

It was merely necessary to give it an inscription to indicate the frequency range. The BNC inner conductor pin lies directly upon the PCB pad, to which it is soldered. The front panel is bonded to the PCB by means of two solder pins.

No adjustments are necessary to put this plug-in into operation. The comparators' switching thresholds are set with the fixed resistors and are such that the "trigger" LED illuminates at input powers of over − 27 dBm and the "overload" LED at an input power greater than + 27 dBm.

2.1. Component List

Resistors:

R 901	:	1	kΩ	
R 902	:	2,4	kΩ	
R 903	:	560	Ω	*
R 904	:	750	Ω	
R 905	:	1,6	kΩ	
R 906	:	3,3	kΩ	
R 907	:	560	Ω	*
R 908	:	4,7	kΩ	
R 909	:	1,5	kΩ	
R 910	:	10	kΩ	
R 911	:	5,6	kΩ	
R 912	:	10	kΩ	
R 913	:	22	Ω	
R 914	:	470	Ω	
R 915	:	10	kΩ	
R 916	:	47	kΩ	
R 917	:	22	Ω	
R 918	:	1	Ω	
R 919	:	220	Ω	
R 920	:	1	kΩ	
R 921	:	22	Ω	
R 922	:	100	kΩ	
R 923	:	1	kΩ	*
R 924	:	4,7	kΩ	
R 925	:	1	kΩ	
R 926	:	1	kΩ	
R 927	:	1	kΩ	
R 928	:	1	kΩ	
R 929	:	1	kΩ	
R 930	:	1	kΩ	

Capacitors:

C 901	:	10	nF	Chip
C 902	:	10	nF	Chip
C 903	:	10	nF	Chip
C 904	:	10	nF	Chip
C 905	:	10	nF	Chip
C 906	:	1	nF	
C 907	:	100	nF	
C 908	:	10	nF	Chip
C 909	:	10	nF	Chip
C 910	:	100	nF	
C 911	:	10	nF	Chip
C 912	:	10	nF	Chip
C 913	:	10	nF	Chip
C 914	:	10	nF	Chip
C 915	:	10	nF	Chip
C 916	:	10	nF	Chip
C 917	:	10	nF	Chip
C 918	:	100	nF	
C 919	:	10	nF	Chip
C 920	:	10	nF	Chip
C 921	:	10	nF	Chip
C 922	:	100	µF/16 V	
C 923	:	10	nF	Chip
C 924	:	10	nF	Chip
C 926	:	100	nF	
C 927	:	100	nF	
C 928	:	100	nF	
C 929	:	100	nF	
C 930	:	100	nF	
C 931	:	1	µF/63 V	

Semi-Conductors:

D 901	:	CQX 21r
D 902	:	LD 365/6
D 903	:	HP 2835
D 904	:	HP 2835
D 905	:	ZTE 2
T 901	:	BC 237 C
I 901	:	TDA 1053 A
I 902	:	TLC 271 CP
I 903	:	MSA 0404
I 904	:	LM 393 P
I 905	:	MSA 0404
I 906	:	MSA 0404
I 907	:	SP 8668 B
I 908	:	MC 7805 CT
I 909	:	MC 10116 P
I 910	:	78L05 A

The resistors marked with an * have a lead spacing of 5 mm and together with the chip capacitors, are soldered to the underside (track side) of the board.

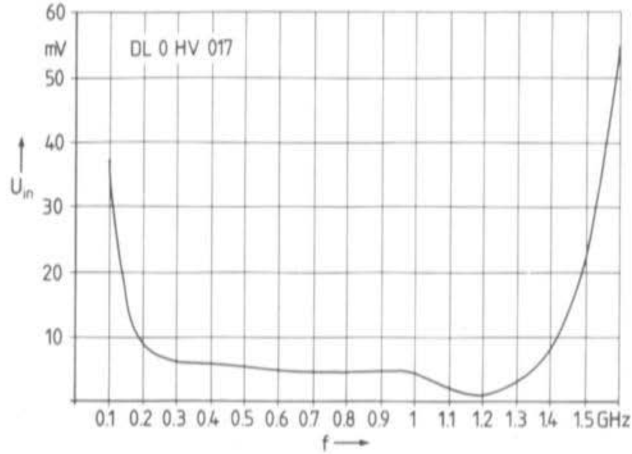

Fig. 6:
The specified input voltage lies under 10 mV over a wide frequency range

Miscellaneous

L 901 - L904:	Double-hole core B62152-A8-X17 (Siemens)
ST 901:	21 multi-way plug DIN 41617
BNC:	Panel socket
Front panel:	Aluminium 86.5 x 30.5 x 2
EPG PCB:	Double-sided 100 x 80 x 1.5 (DL Ø HV 017)
Solder pins:	2 x M3

Fixing brackets: BICC-Vero 31774
Mica insulation disc for TO 220
Heat-sink for 14 pin IC

3. PUTTING IT INTO OPERATION

Before putting the counter, with the new plug-in, into operation, the wire bridge for the counter control has to be installed correctly. This sets the gate time, thus the position of the decimal point on the counter display, to suit the new scaling factor. The correct position is shown in fig. 29 in (1).

The new plug-in offers, just as described, a high sensitivity together with a high overload capability. The sensitivity as a function of frequency, is shown for the prototype in the characteristic of **fig. 6**.

One not so good feature must be mentioned. In the absence of an input signal, the scaler IC tends to generate spurious, random signals even when the plug-in input is shorted. The measurement of input signals is, however, entirely unaffected as long as they are above the input threshold level as indicated by the trigger LED. The condition can be seen by the fact that the input "trigger" LED is not on but the random signals are displayed. The manufacturers of the chip suggest a 6 kΩ resistor be connected between pin 10 (input) and ground. This measure has the effect of drastically reducing the unit's sensitivity and was therefore not employed.

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Ralph Berres, DF 6 WU

Digital Storage Interface for the SWOB-2 Sweep Generator

The obsolete Rhode & Schwarz signal generator can be fitted with a digital storage interface, using very few components, which will allow the instrument to work with a proprietary digital memory. The Voltcraft 500 digital storage unit was purchased and it will now be described how the SWOB-2 can be provided with a trigger and a Y connection for it, thus enhancing this very convenient instrument.

It has been always a source of irritation for the author that the SWOB-2 trace could not be reproduced on paper. There exists, of course, the possibility of photographing the screen but one must wait so long for the whole film to be exposed, and then developed, that there is a danger of forgetting exactly what the trace is supposed to represent – unless, of course, the expensive Polaroid technique is employed.

There is also the possibility of sticking a piece of graph paper to the screen, and tracing the curve on it. This, however, is cumbersome and not particularly accurate.

Originally, the idea was considered to connect an XY-recorder to the SWOB, but owing to its very slow writing speed, the SWOB sweep time had to be very large – this means that the sweep cannot be derived from the mains. A separate sweep generator would have to be constructed and also another deflection amplifier. This was still not too much trouble to undertake. However, the SWOB-2 Y-amplifier is only AC-coupled with a limit frequency of 1 Hz and therefore a completely new, DC-coupled, Y-amplifier would also have to be constructed. That was too much!

The modern solution of using a digital memory was then considered as being the ideal answer. A Voltcraft 500 was obtained from the supplier Conrad (Hirschau) for DM 600. The expenditure was justified, because the memory unit is not only useful for this purpose, but it can also store information such as voltage, time, frequency and power into four given impedances. It also possesses a Centronics interface, to which a graphics printer may be connected.

The following description will now concentrate upon the interface electronics which match the digital memory to the SWOB-2.

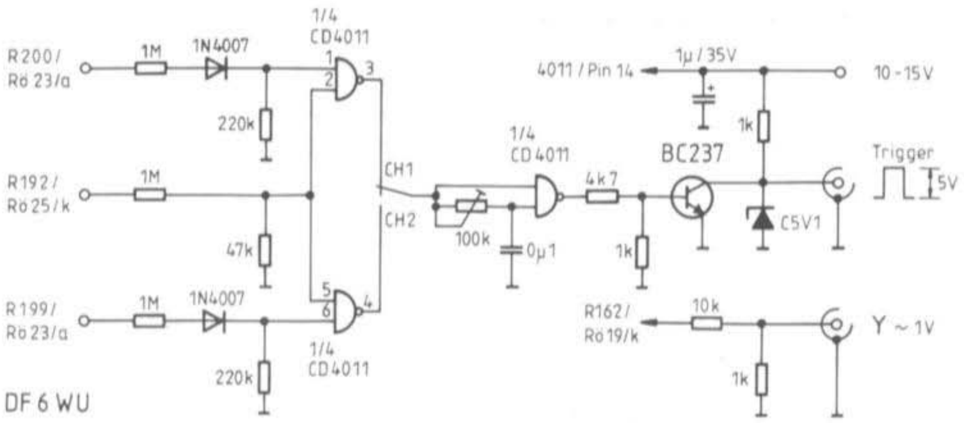


Fig. 1: The interface for the addition of a digital storage unit to the SWOB-2

1. INTERFACE CIRCUIT

As the Voltcraft 500 only works with one channel, the first thing to do is to direct the trigger signal from the channel in use on the SWOB-2. A toggle switch then serves to select the channels. The technicalities of the switching can be seen in **fig. 1**.

It is merely necessary to couple the anode of the double-triode bistable Rö 23 to provide an impulse to the deflection trigger. This may be found at the cathode of tube 25. As the voltage on the tube is too high for C-MOS gates, it must be attenuated by a voltage divider. The diode 1 N 4007 is required because the anode of tube 23 also accepts negative voltages. The RC-network delay, 100 kΩ and 0.1 µF, immediately following the channel selector, is made adjustable in order that the trigger signal appears right in the middle of the digital storage.

The Y-signal is simply taken from the cathode of the final tube in the Y-amplifier Rö 19, and divided by ten.

2. CONSTRUCTION

The circuit shown consists of so few components that the provision of a printed circuit board is hardly worth the trouble. It was therefore constructed on a piece of Veroboard. In order to gain access to the trigger and the Y-signal, the unit must be screwed to the right-hand side of the SWOB. Although this operation, in principle, presents no particular difficulty, the SWOB handbook should be studied in order to arrive at all the correct access points.

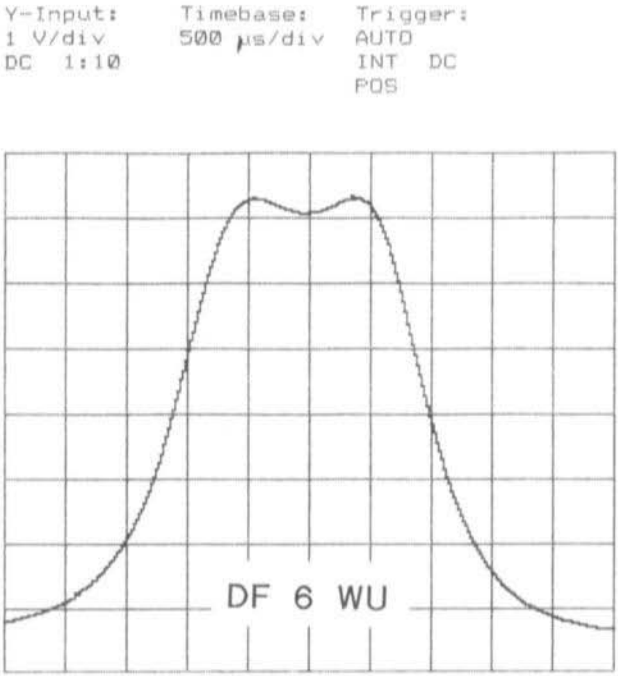


Fig. 2:
Band-pass filter curve taken by means of the digital storage unit.

3. COMMISSIONING

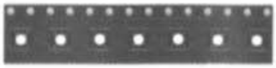
In order to adjust the Voltcraft 500 digital storage unit, an oscilloscope is necessary. The X and the Y outputs of the storage unit are connected to the corresponding oscilloscope inputs, the latter being set to "DC coupling" and "XY" working. Upon switching on the Voltcraft 500, a test picture appears which can be used to set the X and Y gains of the oscilloscope in accordance with the storage unit's handbook.

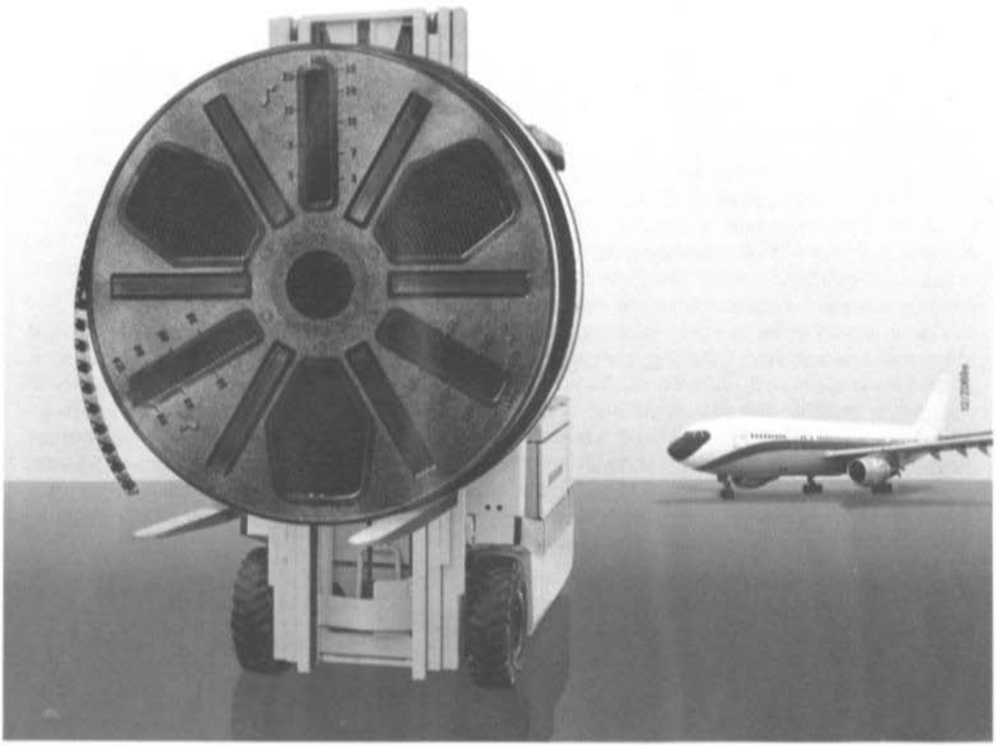
Following that, the storage unit can be connected with the new trigger and Y-outputs of the SWOB-2. Both inputs of the storage unit are switched to DC coupling, the trigger flank to 'positive' and a 1 : 1 test-probe employed.

The sweep speed is now set to 0.5 ms/div. and the Y-amplification to 100 mV/div. The Y-position on the storage unit is set in order that the zero line of the sweep is just visible but in as low a position as possible. The picture height on the SWOB-2 is set such that any part of the trace will not be overdriven. During this operation, the zero line should not be reset.

When now, the M/R button on the digital storage unit is depressed, the word "HALT" appears on the screen and the trace has then been stored. The print mode can then be selected and the trace printed out. During the process of printing, the SWOB-2 can be again put into operation.

By way of a printed example, the trace of **fig. 2** shows a bandpass filter characteristic.





Ralph Berres, DF 6 WU

Providing a Frequency Counter for the SWOB

The obsolete sweep generators SWOB-1 and -2 by Rhode & Schwarz are ubiquitous and many are used by radio amateurs. Its wide frequency range, 0.5 to 1200 MHz, its very linear frequency response and its rugged construction distinguish the POLYSKOP from the usual run-of-the-mill television-service wobbulators. In addition, the SWOB-1 and -2 are available from time to time on the second-hand market.

When working with this equipment for the first time, it will be disappointing to discover that because of the drum-type scale and its scale marking, it is very difficult to set any sweep limits in the range 800 MHz to 1200 MHz. The 50 MHz markers have to be counted from the 400 MHz marker in order that the correct frequency range of interest is interpolated. Following a succession of false calibrations and adjustments, the author decided to provide the instrument with a frequency counter. This "final solution" was considered to be much better than the provision of external markers because, since when has a suitable signal generator (with sufficient level) been at hand when it is required for this purpose?

The counter to be described displays the frequency of a superimposed marker signal in MHz and to four digits and is completely unaffected by the sweep width. The marker is able to be shifted, by means of a potentiometer, to any position on the cathode-ray tube (CRT) trace.

1. MEASUREMENT PROBLEMS

A problem occurs because the frequency of the sweep signal is constantly varying to the extent bounded by the sweep-width limits. The frequency change per unit of time is therefore proportional to the "sweep width" and the "sweep frequency". The latter is derived from the mains (50 Hz) and is 10 ms for the incident trace and 10 ms for the trace return – i.e. a total of 20 ms which corresponds to the mains frequency. The maximum sweep width, at 1200 MHz centre frequency, amounts to about 200 MHz.

If the gate time of the frequency counter is made small enough, and the resolution limited to a suitable value, the displayed error can be minimised to ± 1 digit. This counter, which has been developed with this concept in mind, has a 64 µs gate-time. Taking the values mentioned above for maximum sweep-width and sweep-time, the maximum frequency change delta f is given by: –

$$\text{Delta f} = \frac{\text{sweep-width x gate-time}}{\text{sweep-time}} =$$

$$\frac{200 \text{ MHz x } 64\ \mu\text{s}}{10 \text{ ms}} = 1.28 \text{ MHz}$$

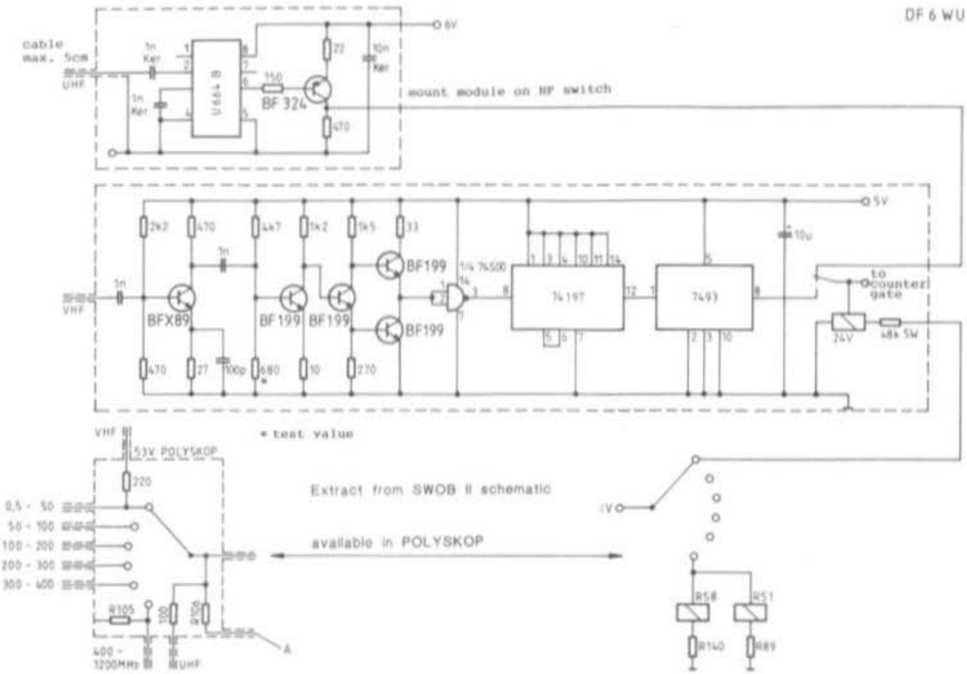


Fig. 1: The counter pre-amplifiers and dividers

The resolution has been fixed at 1 MHz so that the indicated frequency is varying within the 64 μs gate time at maximum sweep width at 1.28 MHz i.e. $\pm$ 1 digit. That is sufficient resolution for all practical requirements.

The counter gate must, of course, be synchronized with the sweep deflection voltage.

2. CIRCUIT DESCRIPTION

The three portions of this counter have been accommodated, following functional purposes, on three separate boards: A UHF and a VHF pre-amplifier/scaler together with a counter and control circuits. These three units are mounted at various places within the POLYSKOP.

2.1. Pre-amplifier and -scaler

Both the input amplifier and the dividers for the UHF (fig. 1 upper) and the VHF (fig. 1 lower) can be seen in the circuit diagram of **fig. 1** together with the relevant portions of the POLYSKOP schematic.

In order that obtainable, commercial components may be employed, it was decided to use the UHF pre-scaler U664B (Telefunken). This has a division factor of 64 and has an integrated pre-amplifier. It is specified to 1 GHz but many reports have indicated that it is perfectly capable of working at up to 1.2 GHz if the highest permissible supply voltage of 6 V is provided.

The VHF portion is used for the range 0.5 to 50 MHz and was built with discrete components. The circuit consists of a four-stage amplifier which brings the input signal up to TTL level, it is then

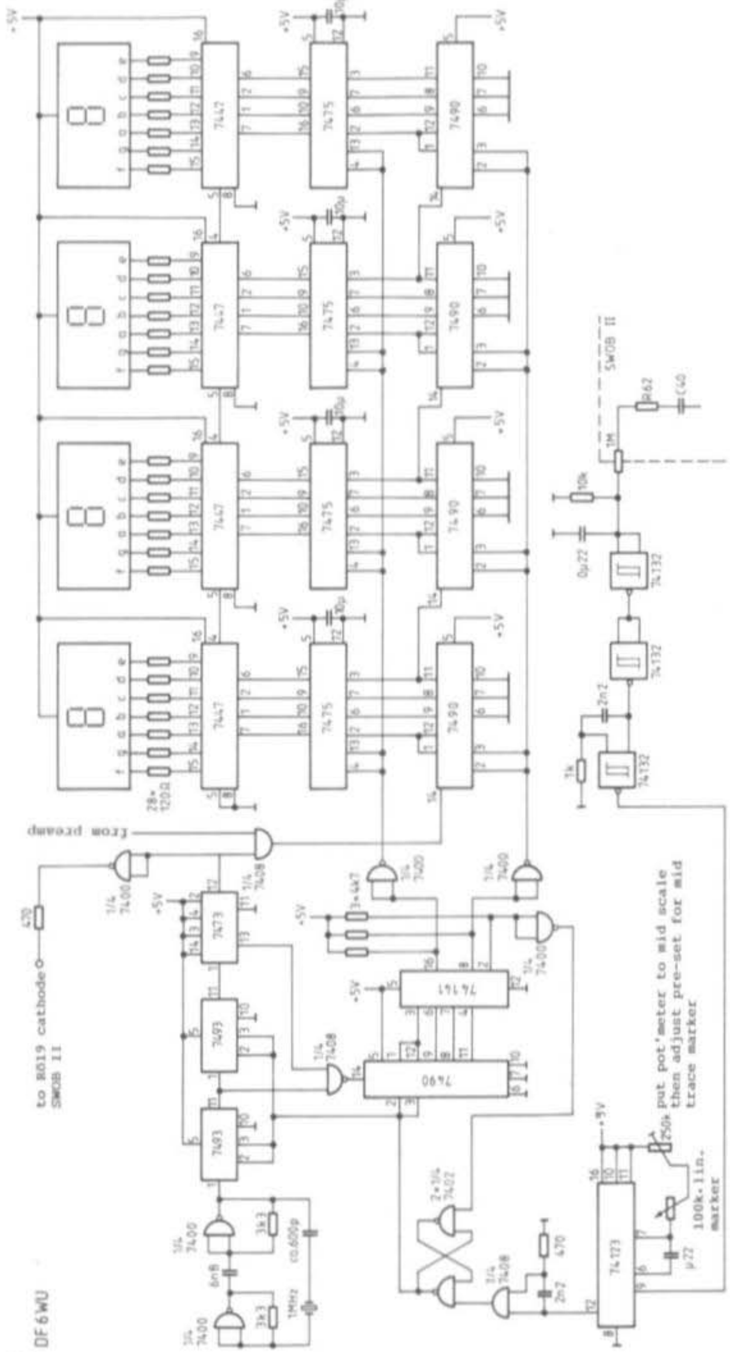


Fig. 2: The counter main board

formed into TTL pulses which are then divided by 64 by the two divider-ICs.

A small , screened relay switches either the UHF or the VHF circuits to the following gate circuit. The relay coil is provided with 250 V from the main valve supply line, tapped off a switch wafer in the SWOB. A 24 V relay would require a 47 kΩ/5 W dropper resistor.

2.2. The Counter and its Control

The counter portion is shown in the circuit schematic of **fig. 2**.

The time base is derived from a 1 MHz crystal which is included in a standard TTL oscillator circuit. The resolution is only 1 MHz for the whole counter; therefore, there is no need for concern about the ageing or accuracy of the crystal. Any available crystal that will oscillate at about 1 MHz will suffice. The 1 MHz oscillation is divided by a factor of 64 by means of two 7493 scalers.

This divider is reset to zero at the end of each sweep period by means of a bi-stable (two gates of a 7402). This bi-stable also resets the counter for the sequence control.

The single 7490 is used for the counter-time base. Its clock pulses are generated under the influence of the crystal frequency divided by 8, with the gate pulse. In this manner, the counter starts to function, following the closure of the counter gate until it counts 8. A following 74141 decodes this BCD word and gives the following pulses serially at its outputs: –

Display storage read-in
Main counter reset
Bi-stable reset

The bi-stable resets the event counter and, at the same time, inhibits the crystal-oscillator dividers and resets them.

The bi-stable is primed with the assistance of delayed pulse from a 74123 mono-stable which has been derived from the 50 Hz sweep signal via a 74132 Schmitt-trigger. The mono-stable's delay time determines the position of the frequency measurement on the X-axis of the cathode ray-tube. This can be adjusted from an externally accessible potentiometer.

By means of this trick of circuitry, the counter gate is opened only once for a time of 64 μs during each sweep period.

The gate pulse also controls the vertical amplifier of the POLYSKOP via a buffer formed from one of the gates of a 7400. The pulse is taken to tube 19's cathode which causes a 1 cm marker pip to appear on the trace.

The main counter circuit has nothing new in principle to offer. One thing though: owing to the high frequency to be counted (1200 MHz: 64), CMOS ICs from the 40 series could not be used. Instead, the standard TTL ICs were employed.

The four 7-segment display LEDs are followed by a memory which is driven by a four-stage BCD to 7-segment decoder. The 7-segment displays have common anodes.

3. CONSTRUCTION

The three modules were constructed on a Veroboard which is just as fast as the process of making a printed circuit board and cutting it up later. If there proves to be a great interest in this project, a PCB will be forthcoming.

As the teflon cable carrying the UHF between the frequency range switch and the U664B should be no longer than 5 cm, the UHF board is fixed by two pieces of wire, directly to the screening of the range switch as shown in **fig. 3**.

DF 6 WU

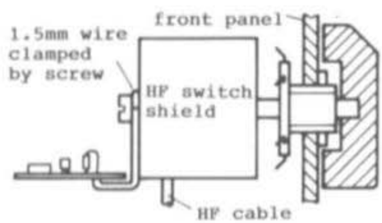


Fig. 3: Range selector switch

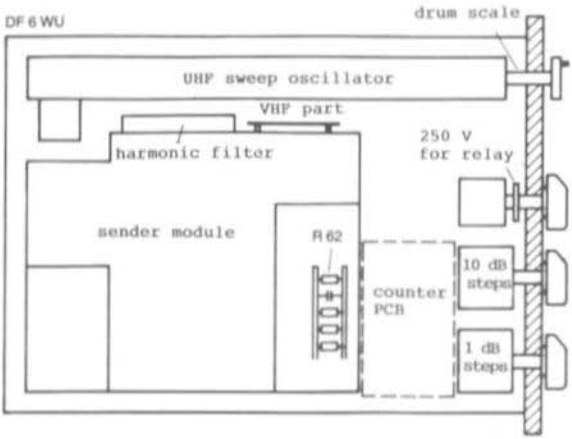


**Fig. 4:
SWOB side view**

The VHF amplifier/scaler is placed on the large output module on the top right near the UHF harmonic filter and underneath the UHF oscillator (**fig. 4**). It should be mentioned that a UHF type of construction should be employed which uses extremely short signal lines. In addition, it is important that supply lines to every IC should be cleanly de-coupled.

In the screened case of the HF switch at the range selector, two 3 mm holes are drilled for the teflon coaxial cable to pass through to the two input modules. The cable screen can be soldered to the switch housing and the inner via a metal-film resistor (VHF 220 Ω, UHF 100 Ω), using the very shortest path to the appropriate switch contact (fig. 1).

The voltage for the relay which switches the counter input to either the UHF or the VHF path, is taken via a switch which is mounted immediately behind the front escutcheon (fig. 4). As mentioned earlier, the voltage is 250 V.

The trigger signal for the counter must be taken from R 62 (fig. 4) because the sine wave is only here, delayed by 90° in the SWOB circuitry (see SWOB handbook).

The counter marker-signal for the sweeper must be taken to the vertical final amplifiers. The Y-amplifier final can be found in the receive compartment on the top right-hand. The compartment must be completely unscrewed in order to access the socket of tube 19. The marker signal is taken to the cathode.

The power supply unit is of conventional construction and is really not worth describing. The two voltage regulators, 7805 and 7806, were screwed on to the sender-module wall. It is important that both the orientation of, and the wiring to the mains transformer should be tested with longer lead wires, to ensure that its field does not distort the trace on the CRT. It is the best policy before making any alterations, to make oneself thoroughly acquainted with the handbook's contents.

The 7-segment display is mounted over the cathode ray tube where the inscription "POLYSKOP" has been placed. It is the only where there is space behind the front panel. Moreover, in order to install the display, the whole SWOB front panel has to be completely removed, together with the CRT. An aperture is then cut in the 4 mm thick front panel using both hack-saw and file. All this, of course, could be avoided by mounting the display part in a small box which is then placed either on, or beside the POLYSKOP.

The details in this article refer to the POLYSKOP model SWOB-2 but the counter can be installed without modification into the SWOB-1 instrument.

Klaus Gottwald/Editorial Staff

Timer / Zoom Unit for the YU 3 UMV / DL 6 NAD Image Storage

The weather image storage of YU 3 UMV (1) and its extension to 5 or 10-fold storage capacity, by DL 6 NAD (2), has been duplicated practically world-wide, literally thousands have been built and are now in operation. The almost uncountable improvements and modifications will not be gone into here but an extension unit will be described, which will enhance the basic equipment in two ways: –

Firstly, the weather images from METEOSAT may be read out in one-hourly cycles. In this manner, and in the context of the single-image memory of YU 3 UMV 001/002, images containing little of interest may be suppressed and those extracts (CO2, CO3 or D2) which have been selected may be hourly updated. Together with the multiple-image memory YU 3 UMV/DL 6 NAD, a slow-motion presentation or "film" may be obtained of the most interesting sections.

Secondly, this unit contains a circuit to chose a desired strip and enlarge it as it is read-in. In other words, a three-position switch allows the choice of either left, right or centre of the transmitted image to be zoomed by a factor of two.

1. CIRCUIT DESCRIPTION

The circuits for both these independent functions will now be described.

1.1. Timer Operation

The circuit of this part is shown in **fig. 1**. This circuit operates a relay when 56 minutes and 9.6 seconds after triggering has taken place. The trigger is operated by a two-pole switch which connects pins 8 with 9 and 10 with 11. This sets the divider I 4 to zero and the timer is enabled, and begins to run.

A crystal frequency of 5242.88 kHz is divided by a total factor of 4096 in I 6 to give 1280 Hz. The integrated circuits I 7, I 8 and I 5 further divide the signal by 2106 to give 0.6078 Hz i.e. 607.8 mHz. Finally, I 4 provides a division by 2048 to 0.29677 mHz. This corresponds to the time period required, of 3396.6 seconds, i.e. 56 minutes and 9.6 seconds. An H-signal from I 4/ Q12 is then taken via the closed switch between pins 10

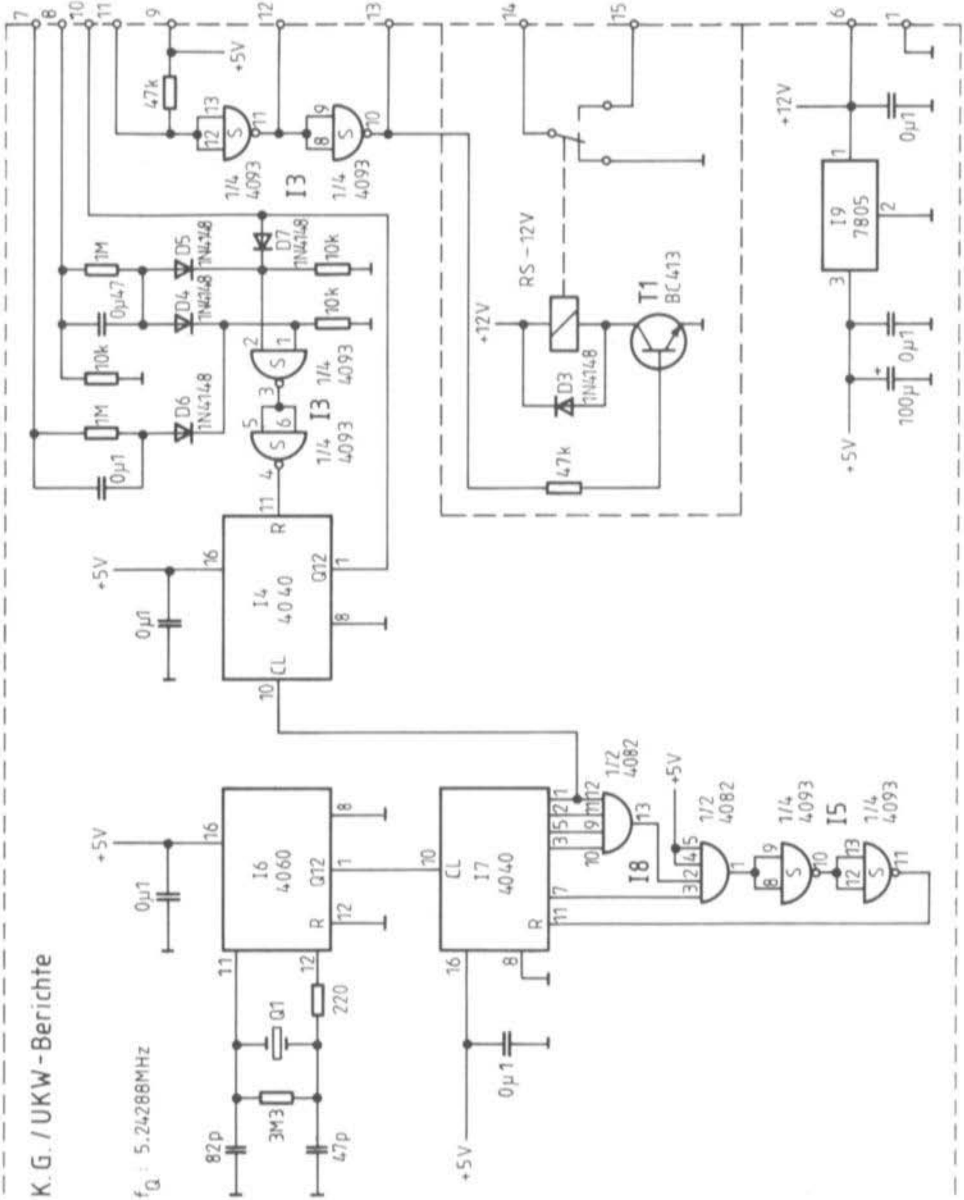


Fig. 1: Timer schematic

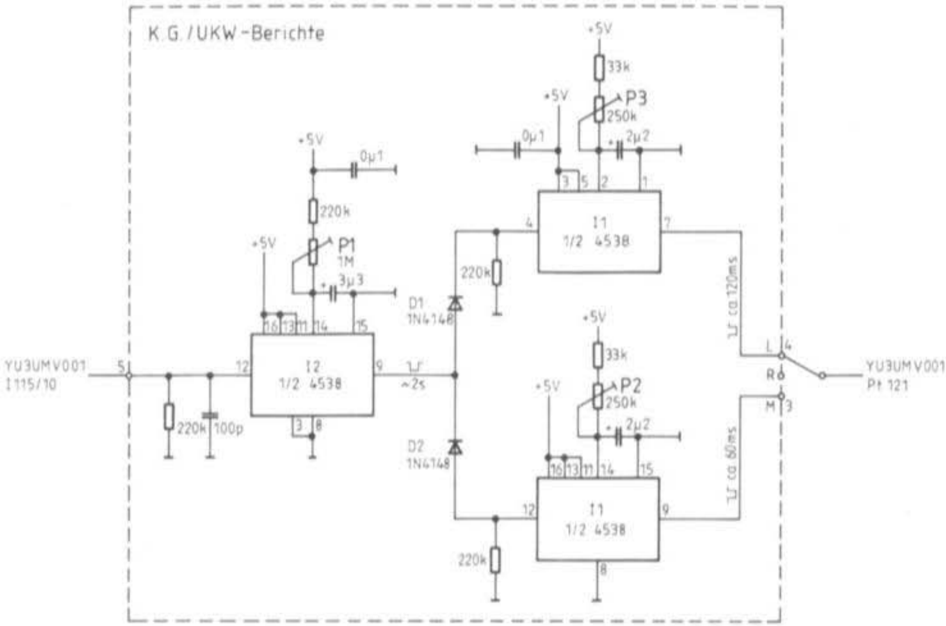


Fig. 2: Zoom-sector control

and 11 on the multi-way connector, via two Schmidt-triggers to transistor T1 – the transistor that operates the relay.

This relay now switches the line frequency from the YU 3 UMV 001/Pt 124 to the YU 3 UMV 002/ Pt 205 in order that a image may be written in.

If the DL 6 NAD multiple-image storage option is incorporated, the part contained within the dotted lines, i.e. the relay and its driver, need not be equipped. If this is the case, it is merely necessary to connect the timer input of the DL 6 NAD 001 (multi-way connector Al/pin 4) with the output 13 of the timer circuit.

The timer circuit will then be reset by the stop tone of the same image and the line frequency and timer input will again be inhibited for 56 minutes and 9.6 seconds. For this, the input 7 of this circuit is to be connected with I 115/pin 3 on YU 3 UMV 001. An H-signal appears there when the stop tone is detected.

The operation, consequent on the above circuit description, is merely the making of switch S1 immediately after the stop tone of the desired format. Everything else follows automatically.

No adjustment procedure is necessary.

1.2. The Zoom Control

This circuit eliminates the weakness of the original circuit (1) in that using the zoom factor of 2 (higher magnifications have been found to be meaningless), the required sector is difficult to select and has to be placed in position by operating the right/left switch. This procedure must be followed upon every image change except, if only the right-hand part of the image is wanted as the circuit selects this automatically.

The circuit of **fig. 2** allows the right-hand, centre, or left-hand part of the magnified image, by the

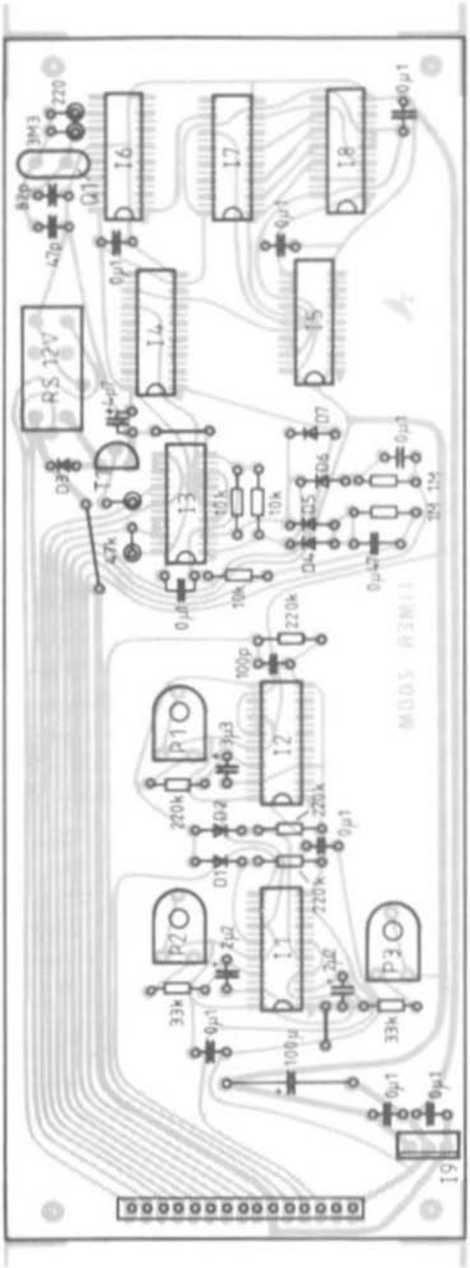


Fig. 3:
Timer/Zoomer component layout plan

operation of a three-position switch, to be selected.

After sychronization on the image right-hand side, the original circuit requires two delay circuits of differing times. The bi-stables, used for this application, are set to 60 ms (approx.) for the centre part of the image and 120 ms (approx.) for the left-hand part. A third bi-stable ensures primarily, that the synchronizing pulse, derived from the YU 3 UMV 001-I115/pin 10 is sufficiently delayed in order that the basic setting is restored.

The following approximate times are to be set by the bi-stable adjustment presets:

P1: for 2 s
P2: for 60 ms
P3: for 120 ms

If an oscilloscope is not available, it is sufficient to turn P1 to mid-travel and the other two pre-sets for a satisfactory image sector.

2. CONSTRUCTIONAL NOTES

For both the circuits described in this article, a common printed circuit board was developed which has the same length as the YU 3 UMV/ DL 6 NAD version, namely 190 mm. The width is 72 mm. It is single-sided and therefore it was necessary to employ two wire bridges as may be seen from the component plan of **fig. 3** and the photograph of **fig. 4**.

The single-row multiple plug with 2.5 mm spaced pins has the following pin-out allocations:

Pin 1	from/to
1	ground (0 V)
2	free
3	Zoom switch (centre)
4	Zoom switch (left)
5	YU 3 UMV 001 (IC 115/pin 10)
6	+ 12 V
7	YU 3 UMV 001 (IC 115/pin 3)

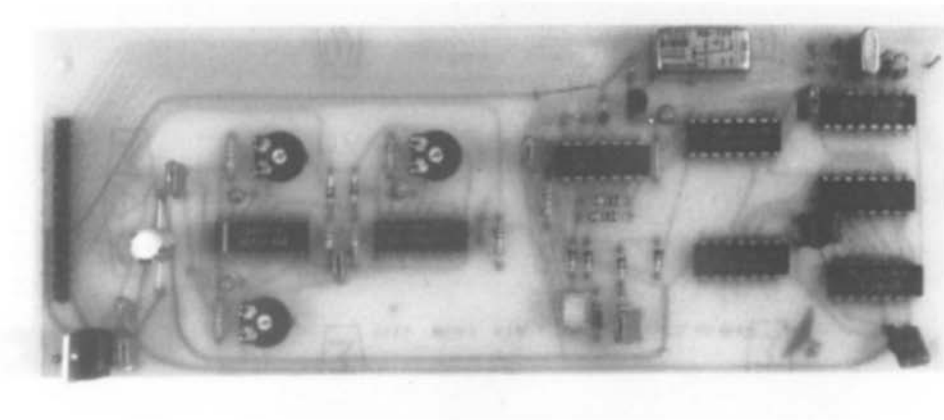


Fig. 4: Timer/Zoom prototype board

8	Timer switch 1
9	Timer switch 1
10	Timer switch 2
11	Timer switch 2
12	Timer out/inverse
13	Timer out to DL 6 NAD 001 (AI-4)
14	YU 3 UMV 002/pt 5
15	YU 3 UMV 001/pt 124

2.1. Special Components

Crystal: 5242.88 kHz fundamental, 30 pF, HC-18/U or similar
Relay: RS-12 V or similar
Preset: horizontal, RM 10/5
M/P plug: 15 pole, RM 2.5
Transistor: LF, NPN e.g. BC 413
Diodes: Switching e.g. 1 N 4148, 1 N 4151
ICs: C-MOS
Capacitors 47 pF, 82 pF: 100 pF ceramic disc RM 2.5 or 5
Capacitors 0.1 μF, 0.47 μF: ceramic multi-layer or foil
Capacitors 2.2 μF, 3.3 μF and 4.7 μF: tantalum pearl

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(2) H. Hufenbecher, DL 6 NAD:
A Digital Multiple-Image Storage for Weather Satellite Images
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Harald Hufenbecher, DL 6 NAD

A Digital Multi-Image Storage for WEFAX Images Part 2

As was mentioned in edition 1/85 (2), the YU 3 UMV 002 has become so modified that is no great effort to incorporate it into a common board with the DL 6 NAD 001 and 002. This article will describe such a board, the DL 6 NAD 003. This board has incorporated all the experience of the many replicas of the other boards as well as a few design improvements. This has not only resulted in an improved reproducibility, but also more operating convenience.

1. INTRODUCTION

With reference to the YU 3 UMV board described in edition 1/83 (1), the new board exhibits the following four important changes: –

* The board has now a 40-pole multi-way connector allowing it to be directly connected to the bus of the board described in part 1. This obviates the critical work involved in splaying out the ribbon cable and soldering each conductor separately.
* Modifications necessary for part 1 have been incorporated.
* All connection points have been brought out to multi-way plug pins which makes for a clean and service-friendly construction.
* The original LC oscillator on the YU 3 UMV 001 board has been replaced with a crystal oscillator.

2. CIRCUIT NOTES

The circuit of **fig. 1** is, in the main, identical with that of the combined part-circuits of figs. 13, 14 and 15 of edition 1/83. In addition, the alterations from part 1 are indicated here and the interfaces annotated. This makes a repeat of the complete circuit description superfluous. The proposed modification by D. Gratz is, however, new to this part. This replaces I 213 and I 214 with SN 74LS169Ns and connects them to the scroll direction (N-S/S-N) change-over. This enables the direction to be changed – with orbiting satellites – when the picture content shows that

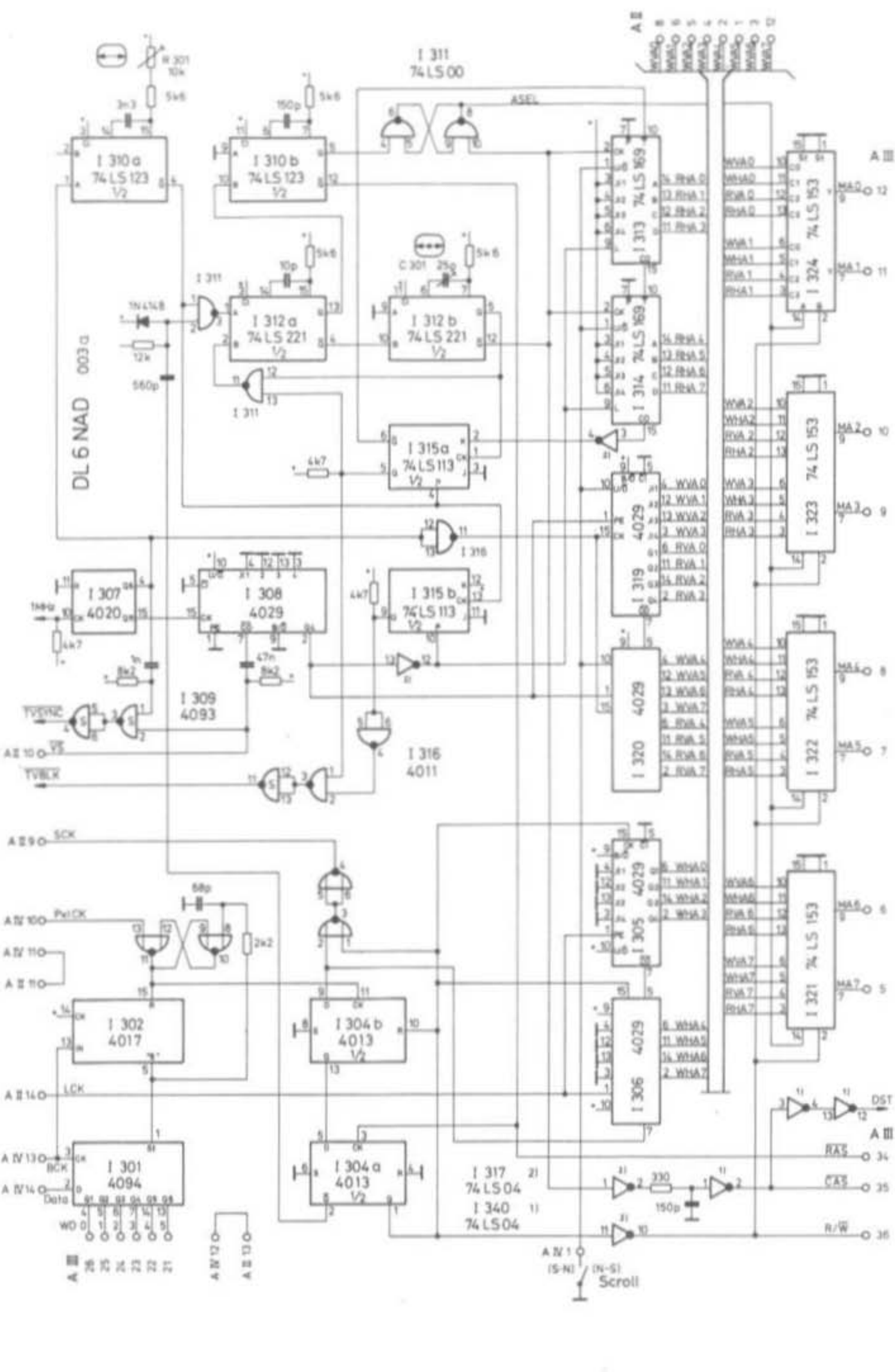

Fig. 1: The circuit as modified by DL 6 NAD 003

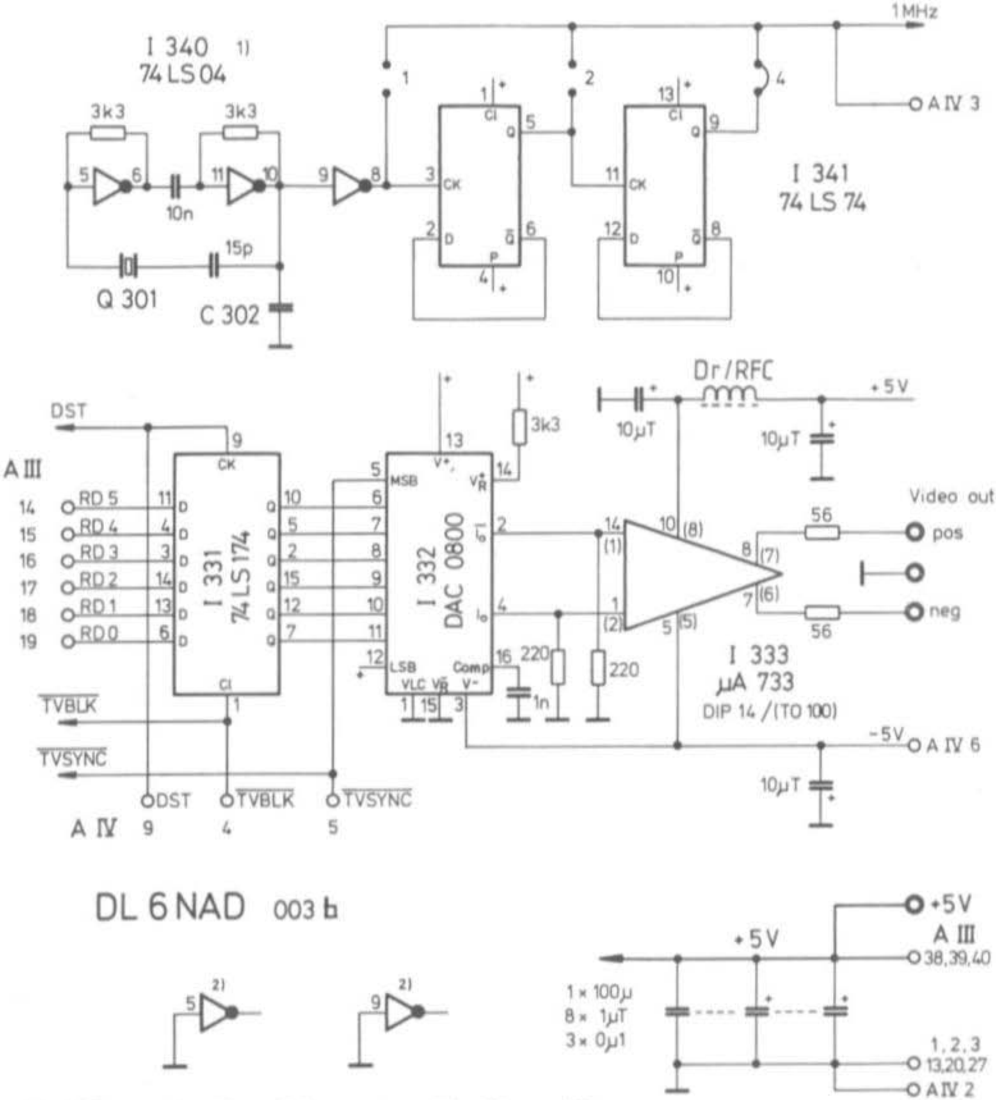

Fig. 2: The crystal oscillator, D-A converter and the video amplifier

it's being read-in upside down. After the change-over, the picture is normal and not a mirror-image.

The crystal oscillator, as already mentioned, has been newly introduced and is located near the digital/analog converter complete with video amplifier (1/83, fig. 16). It replaces the original LC oscillator whose temperature drift caused some problems with the monitors or TV screens. If no problem has been experienced, then there is no need to equip I 341 and the crystal Q 301 and just feed 1 MHz to pin 3 of the multi-way plug A IV as normal. The board is designed for a 4 MHz

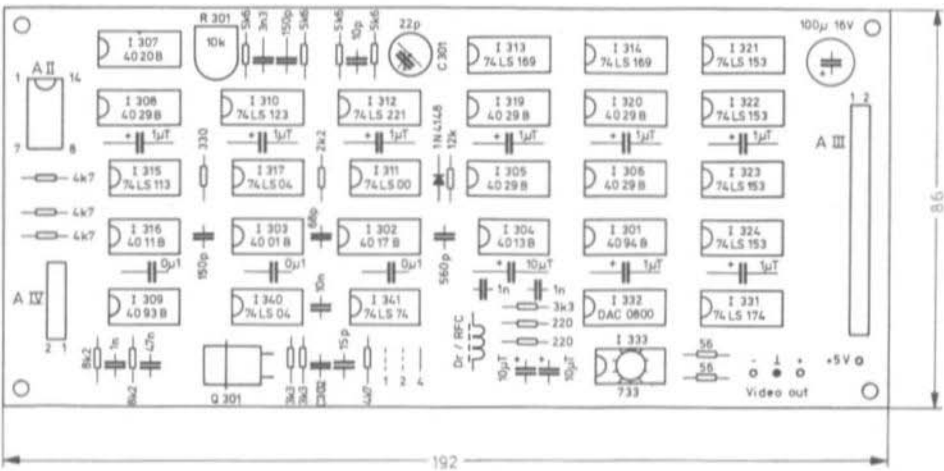

Fig. 3: The new board's component layout plan

crystal, but a 2 or a 1 MHz crystal can be used. For this, it is only necessary to cut the wire bridge at "4" and wire in the appropriate one at "1" or "2". In addition, C 302 is also to be added in accordance with **table 1**.

Crystal Freq.	C 302	Bridge
1 MHz	220 pF	1
2 MHz	100 pF	2
4 MHz	47 pF	(4)
LC Oscillator	– –	–

Table 1: Various possible crystal frequencies

3. CONSTRUCTION

The component layout plan is shown in **fig. 3** and indicates that both the external dimensions and also fixing holes are compatible with the 'old' YU 3 UMV board. As the components on the new board are very tightly packed, when loading the discrete components ensure that no connecting wires are pushed into holes meant for through-contacting.

No.	Function	Connects to
1	Scroll	S-N/N-S switch
2	Ground	Ground
3	1 MHz	see text
4	TVBLK	(option)
5	TVSYNC	(option)
6	– 5 V	Pt 128
7	– – – – – –	(free)
8	– – – – – –	(free)
9	DST (Data Strobe)	(option)
10	PxICK	Pt 115
11	(to A II 11)	
12	(to A II 13)	
13	BitCK	Pt 114
14	Data	Pt 113

Table 2: Wiring of A IV

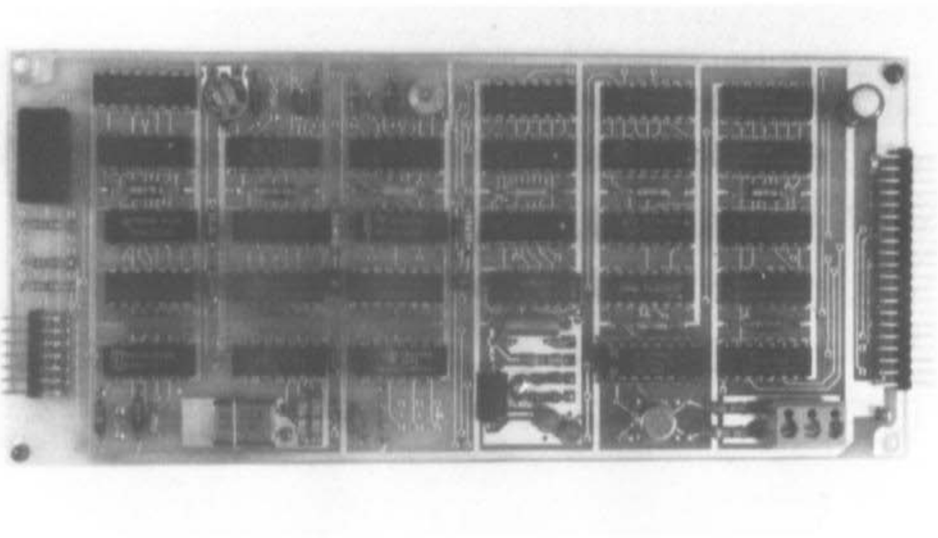

Fig. 4: The completed DL 6 NAD 003 board

Three multi-pin plugs are to be seen on the narrow sides of the board which, again, are prefixed with an A. The pin-outs for these connectors A II and A III may be obtained from part 1 and should not be changed – particularly when flat ribbon cable has been used. **Table 2** indicates the wiring of connector A IV.

Finally, a word about the solder pins near connector A III, this is an additional + 5 V supply connection. The outputs for the video signal can be either solder pins or solderable screw clips. The ground connections should be effected, again, via the fixing bolts but care must be exercised that the boards are connected galvanically together via the (metallic) stand-off bolts which should be mounted on a common **conducting** plane (an aluminium mounting plate or the equipment housing etc.)

3.1. Component Notes

In principle, the same notes that were given in part 1 are valid here. This applies particularly to the capacitors, the multi-way connectors and the C-MOS ICs.

As the video amplifier IC μA 733 is not everywhere obtainable, the possibility is offered on the board to accept the version in the metal housing (TO 100) or the DIL package (DIP-14), whichever comes to hand.

The inductor marked Dr/RFC is a proprietary six-hole choke coil. An example of the completed board **DL 6 NAD 003** can be seen in the photograph of **fig. 4**.

4. COMMISSIONING

Following the usual visual checks for correct placement of parts, dry joints etc. the connections to the board and the board fixations to the equipment (ground bonding!), the installation can be put into operation. The following operations are essentially the same as those described by YU 3 UMV in sub-para 2.4.

If any problems do occur when the board is tested (in isolation from the main equipment if this is at all possible), check the DC supplies and in particular the presence of both the + 5 V as well as the − 5 V! The presence of one voltage without the other can lead to the destruction, due to large unbalanced currents, of I 332 or I 333. When only a part equipping is contemplated, ensure that no C-MOS IC input terminals are left open-circuited.

R 301 sets the picture horizontal centering and **C 301** the horizontal picture width.

5. REFERENCES

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Part 1: VHF COMMUNICATIONS Vol. 17, Ed. 1/1985, P. 17 - 30

Dragoslav Dobričić, YU 1 AW

A Super Power Amplifier for 144 MHz EME

Thanks to the steady advance of technology, an increasing number of radio amateurs are able to construct their own power amplifiers for 144 MHz and higher bands, achieving powers which, a little while ago, they could only dream about. Most radio amateurs neither feel the need for high power nor to work at VHF, but serious constructors cannot really resist the challenge of building their own monster power amplifier. Many of these are ardent EME operators and in this propagation mode, the employment of high power plays an all important role for fruitful results to be obtained. Power is also not to be denied in meteor-scatter work or in the pursuit of DX, but that, of course, does not imply that either the illegal, or the unnecessary and inconsiderate use of power is hereby sanctioned.

This project should not be attempted by amateurs who are not acquainted with high-voltage techniques. The treatment of the power supply should be handled carefully and the following description be used only as a guide. Particular attention should be given to cabinet interlocking, the provision of a automatic ground to the HV line when the amplifier is shut down and the refinement of the HV metering arrangement.

(Editor)

1. THE CHOICE OF DESIGN CONCEPT

Any high-power amplifier project involves careful consideration of many factors. Among these are as follows: –

* High efficiency
* High output power
* Reliable operation
* Stable, intermodulation-free operation
* Simplicity
* (Above all, **operational safety** – G3ISB)

The author has chosen the Siemens valve **YL 1056**, a tetrode with an anode dissipation of 2 kW up to a frequency of 1000 MHz. It must be pointed out at this stage, that this valve is easily capable of exceeding the licenced power stipulations of most countries. Therefore, it might be a very good idea to check the regulations in your country before the project is commenced! As the YL 1056 is a co-axial tetrode, the choice of a co-axial anode resonator was entirely logical. This configuration ensures an extremely high unloaded resonator Q as well as an inherently good cooling of the anode circuit due to heat conduction.

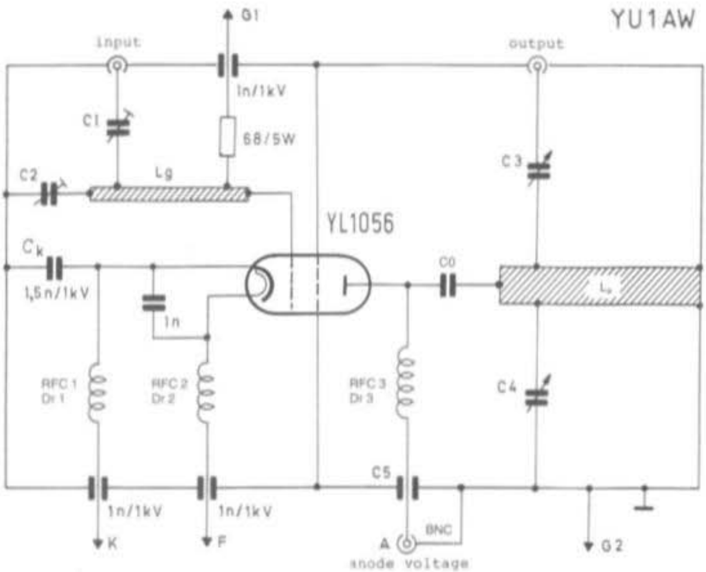

Fig. 1: Circuit schematic of the high-power, 2 metre-band amplifier

As this tube has an output capacitance of only 8.5 pF, it can readily be incorporated into the tuning of a quarter-wave co-axial resonator. The manufacturer's data sheets, especially those relating to the constant current characteristics of the tube, are invaluable for the optimisation of the working conditions for 144 MHz. The author uses a special program written in BASIC to assist in the process of design optimisation. This program is capable of calculating design details for all kinds of HF, VHF and SHF amplifiers, using either tubes or transistors. It can also deal with low-noise preamplifiers for VHF to SHF with FETs or bi-polar transistors, antenna preamplifiers as well as other radio frequency circuits.

All the electrical values which have been derived from the use of this program have been listed in **table 1**. Following the determination of these values, it was a simple matter to design and construct the discrete components required. The whole amplifier has been conceived with an utmost regard for simplicity. Anyone with an average ability in the use of tools will be able to construct this amplifier. The project was completed by the author in spite of his utter aversion to mechanical work, this being absolutely unavoidable in a project of this kind – unfortunately! **Figure 1** shows the simple circuit diagram of this high-power amplifier.

Table 1: Test Results

Capacitors		Currents:	
C 1:	4.8 pF	I_a:	1.3 A max.
C 2:	20 pF	I_{g2}:	20 mA max.
C 3:	4.6 pF	I_{g1}:	0 mA (AB1)
C 4:	5 pF	I_f:	20.5 ± 2 A
C 0:	1400 pF		
Voltages:		**Powers:**	
U_a:	3.5 kV	$P_{a\,(DC)}$:	4.5 kW max.
U_{g2}:	650 V	$P_{a\,(diss)}$:	1.7 kW max.
U_{g1}:	− 100 V max.	P_{out}:	2.9 kW max.
U_f:	3.8 V ± 5 %	P_{drive}:	60 W max.
		$P_{g2\,(diss)}$:	13.1 W max.

Power gain: 15 - 18 dB
Anode efficiency: 64 % max.

2. ANODE CIRCUIT

Values given by the computer indicated that for the 144 MHz band it would be relatively easy to obtain optimum characteristics without involving compromises. The anode circuit was designed for the greatest possible efficiency and at a minimum loaded Q (Q_L = 15) an almost ideal value. The antenna coupling is provided by a simple home-constructed variable capacitor (C3) which has certain advantages.

The low Q_L of the anode circuit effectively masks any detuning effects caused by capacitance variations and heat induced dimensional changes. The anode circuit resonator is a 165 mm copper tube of wall thickness 4 mm and outer diameter of 105 mm which is drawn over the valve. The other extremity of the anode resonator is tightly affixed to the chassis side wall by means of screws.

Tuning for resonance is provided for by C4 – a movable plate fixed to the cabinet wall. The coupling capacitor C3 is fabricated in a similar fashion but it is not, of course, grounded and is taken to the antenna output connector by a 50 Ω strip-line L0.

The anode line coaxial circuit has a characteristic impedance of 77 Ω. DC insulation is provided by C0 sandwich capacitor, one plate of which is formed by the resonator itself, and the other is a piece of 0.5 mm copper sheet rolled in order to fit the YL 1056 radiator. Teflon (PTFE) foil 0.6 mm thick serves as the dielectric which is perfectly capable of withstanding the high anode voltage without breakdown. The anode voltage is introduced to the inner plate of C0 by means of a length of 1 mm dia. enamelled copper wire. This capacitor assembly is shown in fig. 6 but its construction will be detailed later. C5 is the anode by-pass capacitor (**see fig. 8**).

As may be observed from the circuit diagram, the amplifier tube YL 1056 is connected in a grounded-screen configuration. Referring to fig. 4, the valve's base-plate "D" has a 46 mm diameter hole, through which the YL 1056 can be passed as far as its screen ring connector. The valve, resting on the base-plate, is secured by means of four metal strips 35 x 15 mm in the manner indicated in figures 5 and 8. Strong fishing line is used to move the plates of both the tuning and the output coupling capacitors.

3. THE GRID CIRCUIT

The drive power is applied to the grid circuit L_g which is a half-wave strip-line with a Z_O of 90 Ω. Since the YL 1056 has a high input capacitance, namely 102 pF, it was obligatory to base the calculations upon a high value for Q. The loaded Q worked out, for this case, to Q_L = 25. This imposes a somewhat sharper tuning characteristic on the grid circuit than that of the anode. An alternative solution would have been to drive the cathode circuit thereby lowering the Q_L to some 15 - 20 and improving the bandpass of the amplifier over the whole of the 2 metre band, but this would have inflicted a reduction-of-gain penalty because of the increased drive requirement. Driving the grid results in quite an acceptable bandpass characteristic providing only moderate drive frequency changes are made. By careful design and construction, it is still possible to achieve low losses, despite the higher loaded Q value, and, at the same time, to preserve all the advantages of applying the drive to the grid.

The grid stripline L_g consists of a 125 mm long, 1 mm thick copper strip. One end of it is suitably rounded in order to fit the grid electrode contact of the YL 1056. A single screw holds it in position. The grid bias is applied via a 68 Ω/5 W non-inductive resistor. C1 and C2 are air trimmers used for tuning purposes. All feed-through capacitors in this area should have a working voltage of at least 1 kV.

A very high-quality device should be employed for the 1 nF capacitor C_K and it must have a working voltage of at least 1600 volts. The filament heating power is de-coupled by two high-frequency chokes, RFC 1 and RFC 2. Each consists of 8 turns of 2 mm enamelled copper wire wound bifilar fashion on a 15 mm common core.

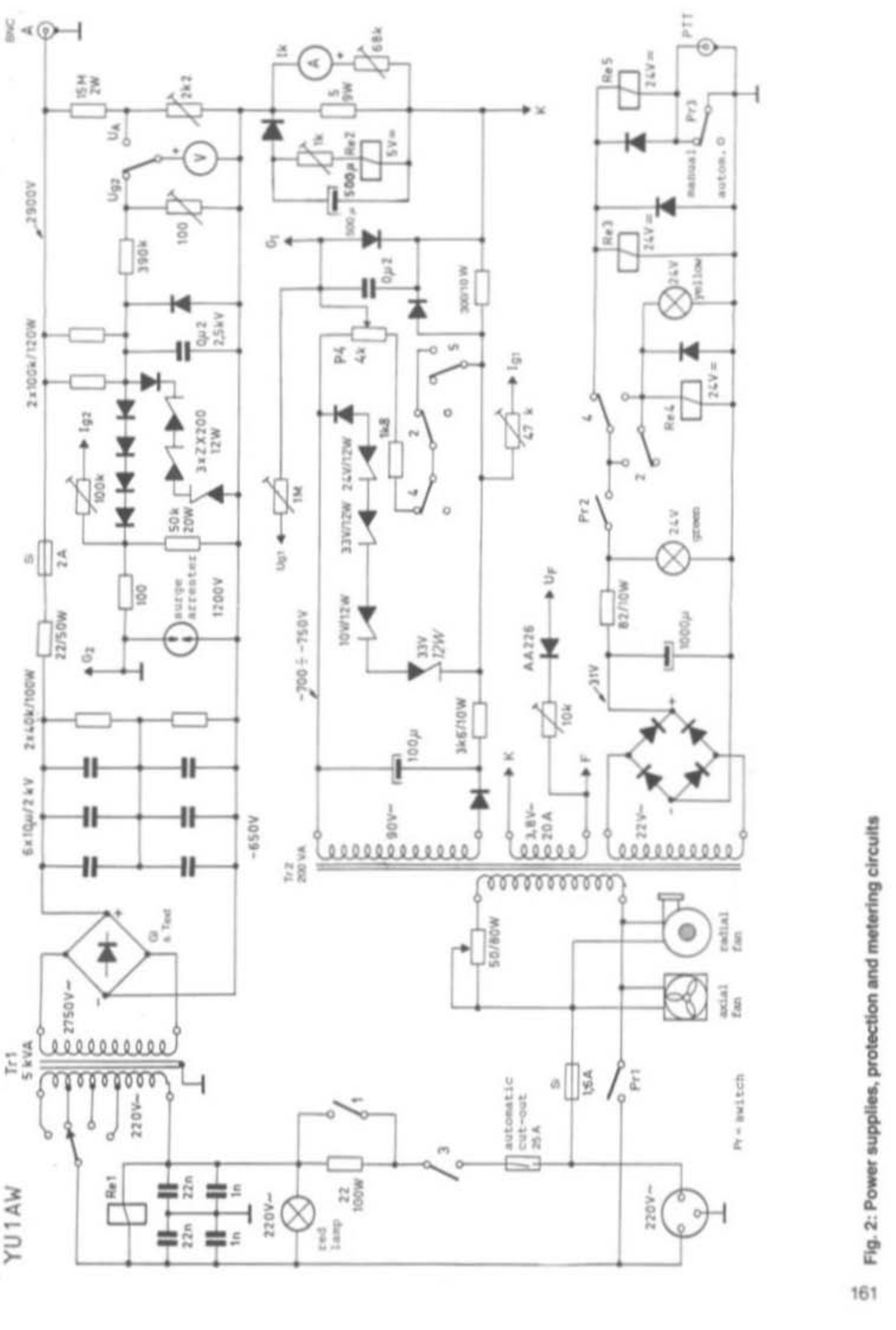

Fig. 2: Power supplies, protection and metering circuits

The three feed-through capacitors and ferrite beads serve to complete the filament filtering.

4. THE POWER SUPPLY

The use of a grounded screen-grid configuration results in a greatly simplified power supply. The screen supply itself is fed via a dropper resistor thus obviating the need for a screen protection circuit. The power supply is divided physically into two compartments, one contains just the high-voltage transformer Tr 1 and the other contains the rest of the power supply circuit. Electrically, the circuit may be seen as three distinct entities, they are as follows:–

1. Anode and screen-grid supply
2. Bias supply
3. Control circuit supply (24 V)

A 5 kVA transformer is used for Tr 1 with a secondary voltage of 2700 V rated at 1.6 A (**fig. 2**). It is provided with primary taps at 10 V intervals between 200 and 230 V in order that the actual mains voltage can be closely matched. This is especially necessary in areas prone to a fluctuating incoming mains supply in order to preserve the integrity of the output power. The tap switch used for this purpose must, of course, be of a robust construction.

Two relays in the primary circuit are employed to provide a "soft start" and an overcurrent protection is in the form of a 25 Amp automatic overload trip.

High-voltage rectification is provided by a standard Graetz bridge using five **1N 5408** diodes in each leg. Each of these diodes has a 390 kΩ/2 W resistor and a 10 nF/1.6 kV capacitor connected across it in order to ensure the highest reliability. The six 10 μF/2 kV filter capacitors also have resistors (2 x 40 kΩ/100 W) across them to equalize the PD across each individual capacitor. These resistors also serve as supply bleeders (a safety requirement – G3ISB) and they also improve the high-voltage supply regulation in the presence of large dynamic range amplifier input signals. Several smaller format resistors may be used here, instead of the two specified, as long as the overall resistance and ratings are maintained.

Damage to the costly YL 1056 tube, due to interelectrode flash-over, is limited by the inclusion of a 22 Ω/50 W resistor in the HV supply line. This is effective until the following 2 A fuse has time to blow.

WARNING: on no account should this 2 A fuse in the HV line be mounted either on the front, or the back panel of the enclosure unless a very special holder is available. In any case, it is safer to mount the fuse within the properly interlocked cabinet.

The screen-grid bias supply is a parallel stabilizer consisting of a chain of zener diodes and a 50 kΩ/250 W dropper resistor connected across the HV line. Ensure that these zeners are provided with appropriate heat sinks. An alternative to zener diodes is the use of stabilizer tubes such as the OA 2, OB 2, STV 150/130 etc.

The negative lead of the high-voltage supply is connected to the YL 1056's cathode via a 5 Ω/10 W resistor. Between cathode and ground (screen-grid potential), a surge-arrester has been connected in order to limit the screen voltage to some 1200 V in the event of a voltage breakdown from anode to ground.

The power supply has been provided with two moving-coil meters, one to measure the anode voltage/current and the other for the screen voltage/current.

A separate transformer Tr 2 has a rating of some 200 VA and the secondary has windings of 3.8 V/22 A, 22 V/0.3 A and 90 V/0.2 A. They supply the heater power, the control circuit voltage and the grid-bias voltage respectively.

The grid-bias supply is a very simple affair consisting of a chain of zener diodes in a parallel stabilizer delivering 100 V. A wire-wound 4 kΩ potentiometer is provided for the adjustment of the bias for SSB and for telegraph conditions. The tube is biased off both during 'receive' and when the over-current protection circuitry has been activated. Diodes protect against internal tube flash-over, or in the event that drive has been inadvertently applied in the absence of anode and screen voltage. The control circuit power supply is also simple, providing a rather "soft" voltage for the relays.

The primary circuit of Tr 2 has been provided with a 50 Ω/80 W variable resistor in order that the heater voltage may be finely adjusted to nominal. It also reduces the surge current upon switch-on. There are indicators for the filament voltage, the grid current and for the bias voltage included in this circuit.

The circuit diagram shows two air blowers, an axial blower for general power supply enclosure ventilation and an radial high-speed blower for the tube cooling.

The complete metering consists of three meters, two of which have already been mentioned. The third one has a multi-purpose role of measuring grid voltage and current, screen current and filament voltage, each selected by a double-pole, four-way switch (see **fig. 3** for the instrument connections and **fig. 2** for the metering points in the supplies). Each instrument has two paralleled, back-to-back diodes and also a 10 nF ceramic disc capacitor connected across it for protection against overload and HF currents respectively. All unspecified diodes are 1N 4007s (1 kV/1 A).

The voltages shown in the circuit diagrams are referenced to ground.

4.1. Power Supply Operation

In order to start the power supply, the mains switch Pr 1 in the primary circuit of transformer Tr 2 must operated. This applies power to the filament, the blowers and the control circuit relays. The – 100 V of grid bias appears at the grid and this is signalled by the green indicator lamp.

After about three minutes warm-up time, Pr 2 may be operated in order to the apply anode voltage. Relay Re 3 operates via Pr 2 and the idle contact of Re 4 thereby switching on the primary circuit. The switch-on surge is reduced by the 22 Ω/100 W resistor (stops the house fuses blowing!). As the capacitors in the HV circuits are being charged up, the primary current is steadily diminishing thus increasing the voltage across Re 1. At about 180 V, this relay operates and applies a shorting contact across the 22 Ω anti-

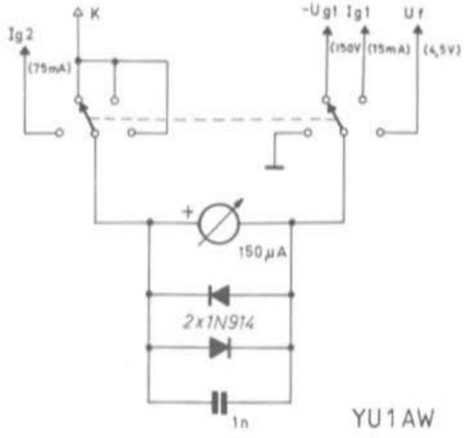

Fig. 3: Meter switching for screen current, grid current and bias as well as the heater voltage

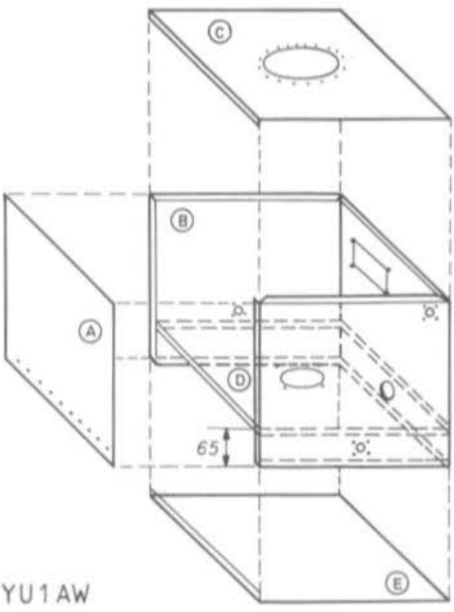

Fig. 4: Mechanical construction of the PA cabinet

surge resistor thereby applying the full 220 V mains to the transformer. A red indicator lamp illuminates at the same time.

Protection for the power supply components from mains-borne, voltage surges (spikes) is provided by 22 nF styroflex and 1 nF disc capacitors – both rated at 1600 V working.

All the essential potentials, necessary for the operation of the tube, are now present but the tube is still biased off with the – 100 V applied to the grid. Depressing the "press-to-talk" switch, or manually operating Pr 3, will operate Re 5 thus reducing the bias voltage to that set by the 4 kΩ wire-wound potentiometer P4. The amplifier is now ready for operation. The quiescent anode current is adjusted to some 200 mA for SSB working and 50 mA, or less, for telegraphy.

4.2. Protection Circuitry

In the event that some irregularity occurs which results in an anode current of more than 2 A, the fuse in the HV line will blow. If the cathode current rises above 1.6 A (adjustable via 1 kΩ preset), relay 2 operates, and then relay 4 thereby applying a – 100 V bias to the tube. Relay 4 continues to operate via a holding contact thus keeping the – 100 V bias applied. A yellow indicator lamp signals this condition to the operator. At the moment of operation of Re 4, the holding voltage of Re 3 falls to zero and the relay drops

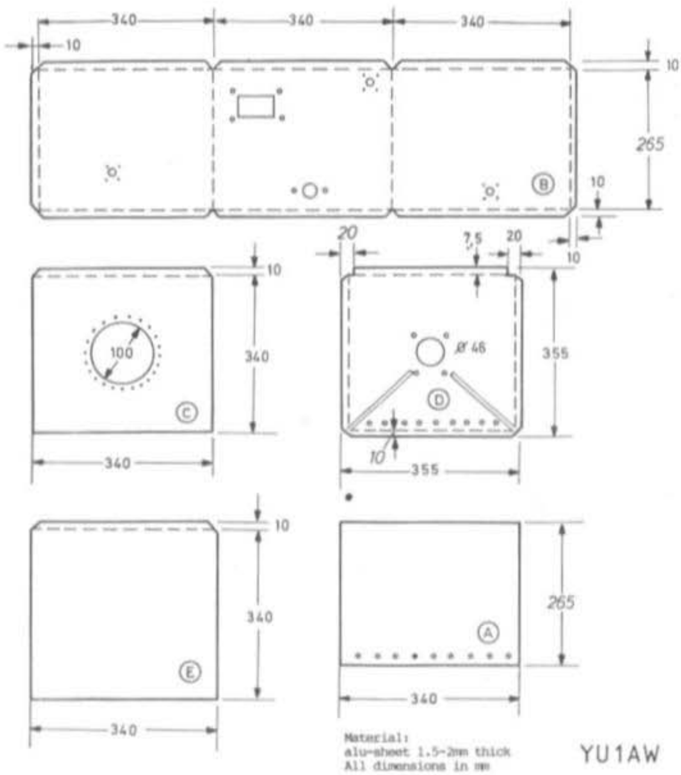

Fig. 5: Dimensions of PA cabinet

out switching the primary of Tr 1 off, thus ensuring a complete protection. To reset the system, Pr 2 must be switched off, and then on again. In order to increase the current switching capacity – and therefore the reliability – of certain of the relays, any free contacts are wired in parallel. This applies particularly to Re 1 and Re 3.

5. MECHANICAL CONSTRUCTION

The amplifier is housed in the cabinet shown in **fig. 4** made of 1.5/2 mm thick aluminium. A piece part diagram is shown in **fig. 5**. The overall dimensions of the cabinet are 340 x 340 x 265 mm and it is divided into two compartments, the upper one, the larger, contains the anode tank circuit. The tube itself, rests by the whole circumference of the sreen-grid ring on a base plate which also serves to divide and isolate the cabinet completely. The cabinet is so constructed such that (**fig. 4**) cover C, the lower panel E and the side wall A may easily be removed for ease of construction and also for easy access to components, including the tube, for trouble-shooting and replacement. These plates are secured with screws whereas all the other cabinet securing elements can be poprivets or screws. In any case, as many as possible should be employed in order to keep the cabinet and its internal compartments RF-tight.

The panel D is provided with a 46 mm dia. hole for the tube to pass through and engage the screen ring and four 5 mm holes to secure the tube. A dozen 8 mm holes have also been drilled to provide ventilation for the cathode area.

The cover panel C has a large 100 mm hole as well as several 6 mm holes which are used in securing the anode tuned circuit line.

The rear panel is cut and drilled to accommodate the blower. The air inlet is covered by a fine metal mesh or grid. This plate also carries the BNC connectors for the high-voltage and the RF input as well as the N panel socket RF output connector. The various other supply potentials required are accessed via a multi-way connector.

The front panel A has a row of holes which are provide as an access vent for the cathode air

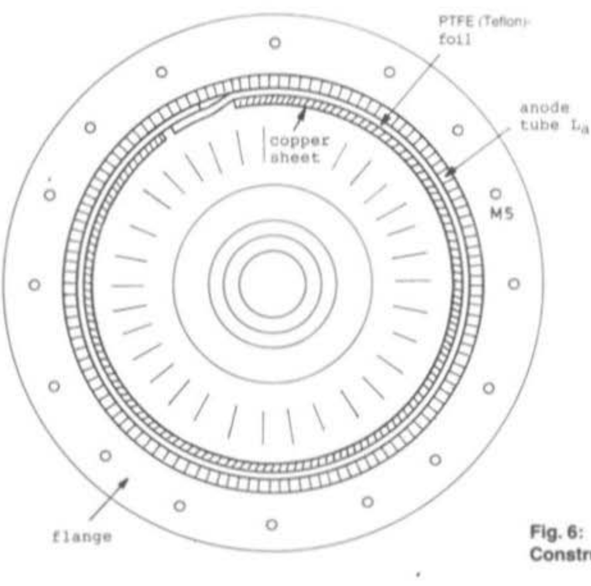

Fig. 6:
Construction of anode capacitor C0

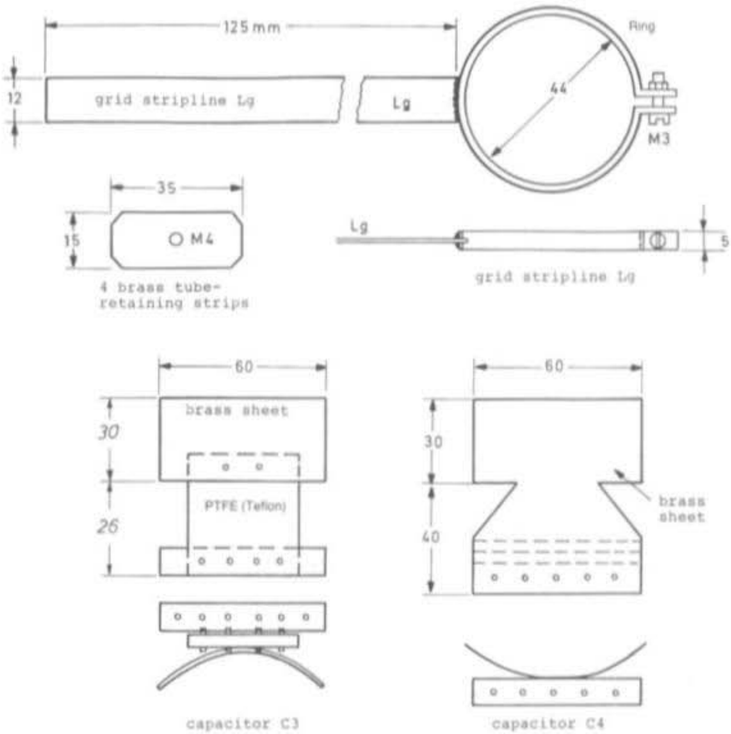

Fig. 7: Dimensions of L_g, C3, C4 and the tube retaining strips

coolant. Two plastic angle stock, mounted on panel D, are used to direct the air-blast efficiently and accurately to the cathode area.

The anode capacitor C0 is an integral part of the anode resonator tube L_a, the latter being 165 mm long and forms one plate of the capacitor with a 150 mm long cylinder of 0.6 mm teflon (PTFE) foil as the dielectric. Thin (0.5 mm) copper sheeting is used as the other (inner) plate of the capacitor C0. This copper cylinder is cut to a length of 125 mm, some 20 mm shorter than the teflon dielectric tube, and also it does not need to form a complete inner cylinder. The teflon strip, however, is cut so that it has an overlap of 10 mm, the form of assembly being as shown in **fig. 6**. This dielectric is fitted such that it protrudes 10 mm further than the inner and outer plates of C0 at the anode end and some 15 mm above the inner cylinder at the other end. This sandwich construction is held in place by the YL 1056's anode which is jammed very thightly inside it. The whole high-voltage capacitor assembly is shown in the cross-sectional diagram of **fig. 8**.

A hole is drilled near the earthed end of the anode cylinder which accommodates a feed-through capacitor to admit the HV line to the anode. The adjacent RFC 3 together with feed-thro' C5 ensure that the HV line is decoupled from the RF voltages at the anode.

The anode resonator is fitted with a mounting flange consisting of a copper ring of 105 mm inner, and 140 mm outer diameter. This is fitted

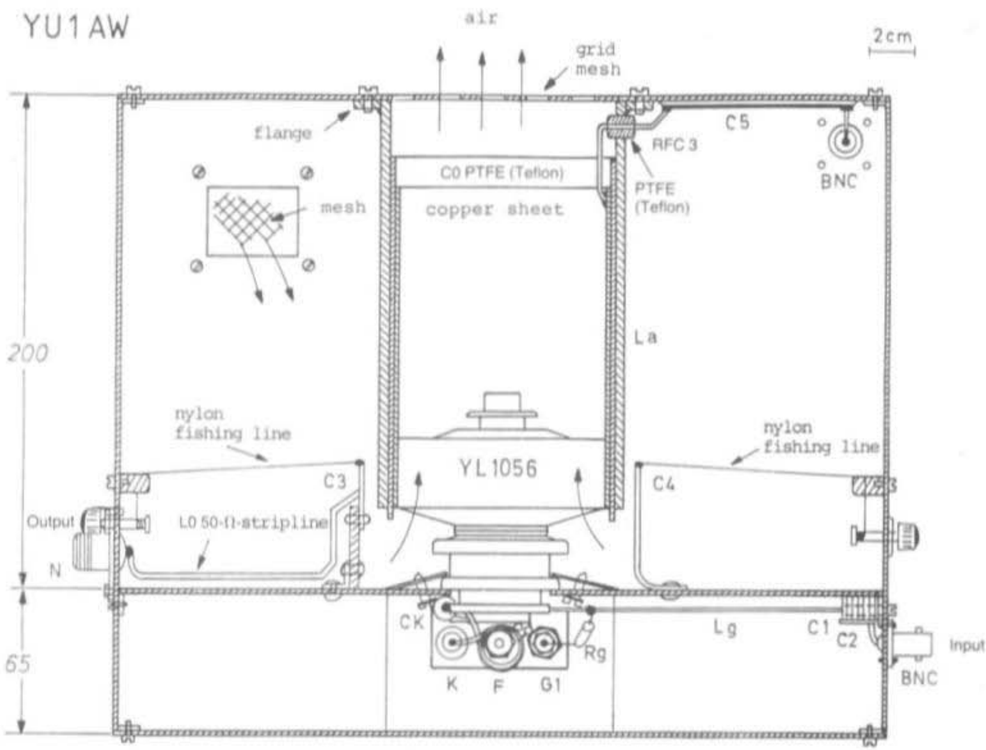

Fig. 8: Cross-section through the high-power PA

closely to the anode resonator's extremity and hard soldered into position. It is then silver-plated in order to reduce the corrosion that would exist between the copper and aluminium junction. The output coupling capacitor C3 consists of a piece of brass sheet which is pop-riveted to a 2.5 mm piece of teflon. This, in turn is fixed to a piece of aluminium angle stock by the same means. See **fig. 7** for the details. A length of 50 Ω stripline connects C3 to the N output connector.

The anode tuning capacitor C4 (**fig. 7**) is of similar construction to C3 but is directly grounded as shown in **fig. 8**.

The HV filtering capacitor is accomplished by C5. This comprises a piece of single-sided (1.5 mm) epoxy PCB material bonded to the upper panel. The copper should be chamfered from the edges of the board in order to inhibit RF breakdown. The choke RFC 3 is a length of 1 mm diameter enameled copper wire which takes the HV line to C5 and the inner plate of C0.

The grid stripline L_g is made from 1 to 1.5 mm copper sheet having a connection ring soldered at one end for fitting to the tube's grid connection. Similar rings are used for the cathode and heater contacts in order to facilitate disconnection if and when required. The tube is held in place by means of four pieces of brass plate which are drilled and then tapped to 4 mm (**fig. 7**). The ends are rounded so that the plates can be simply turned through 90°, pivoting on the screw, when

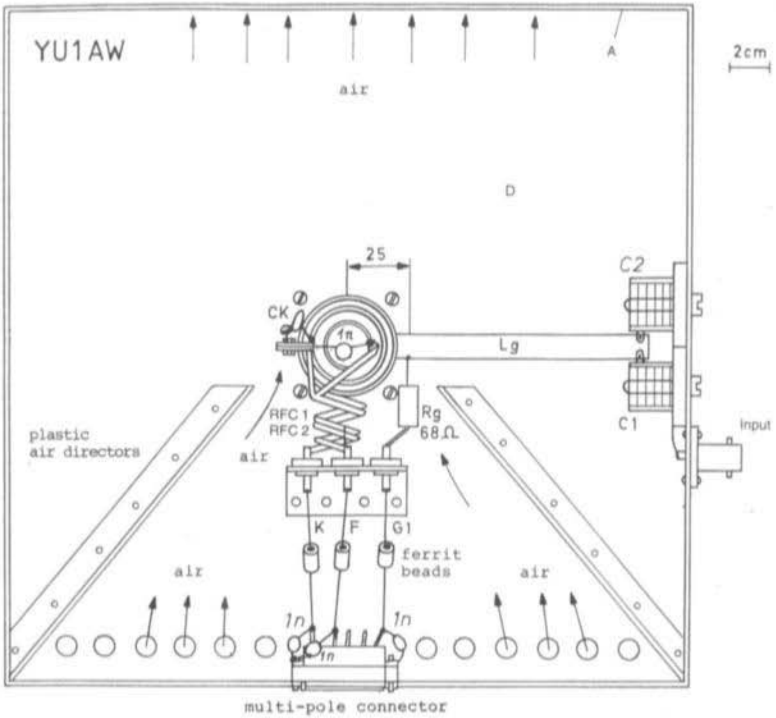

Fig. 9: Looking up into the grid compartment

dismounting the tube. A suitable length of aluminium angle stock is riveted to the tube base plate and carries three feed-through capacitors as in **figure 9**.

With the exception of the anode HV, all other supplies are taken to the tube via this arrangement from a common connector. Each lead is bypassed by a 1 nF/1600 V disc capacitor. The heater leads must be of at least 16 mm^2 cross-sectional area. **Separate leads are used for the amplifier's HV line and for the screen-grid earth return leads.** RF ground leads are effected by the screening mantle of coaxial cable.

Always bear in mind that the cathode is always at a potential of 650 V with respect to the ground, and 750 V to the grid! **The potentials used in this amplifier can easily kill, and are unforgiving if one disregards this fact.**

5.1. Cooling

The cooling must always be adequately carried out when a tube with such a large anode dissipation (2 kW) is employed. At least 2000 litres/minute should be used with an air pressure drop across the anode radiator of 2.2 mB. An outlet temperature of 100° should never be exceeded.

6. TUNING AND ALIGNMENT

The careful constructor will be pleasantly surprised by the ease with which this power amplifier may be adjusted and commissioned. Following a thorough inspection of the power supply, a through-power wattmeter, or a VHF/UHF SWR

Fig. 10:
Anode resonator with tuning and output coupling

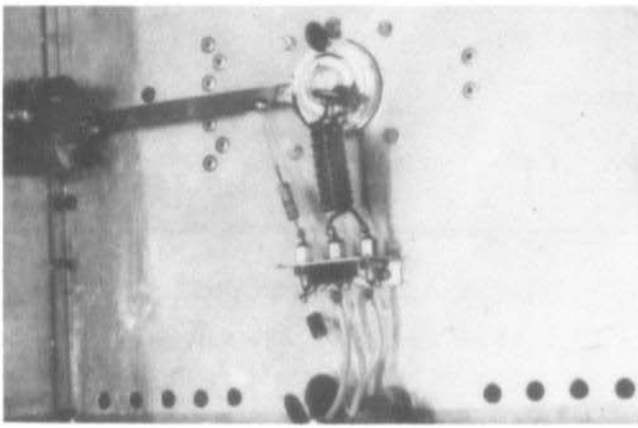

Fig. 11:
Cathode showing grid line and heater chokes

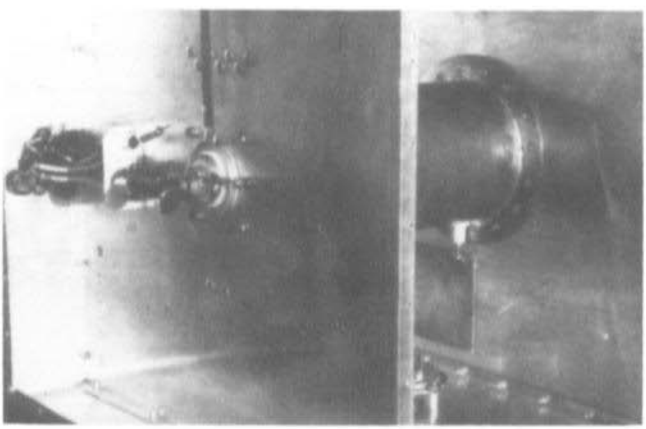

Fig. 12:
The "cold" end of the anode capacitor

meter which is capable of handling the power, is connected to the output.

Using a low grid drive power, the grid is tuned for maximal anode current. The anode circuit is then tuned for a maximal screen-grid current. This procedure is repeated for every increasing small increments in the drive power, tuning C4 for maximal screen current. Capacitor C3 is adjusted for a screen current of 10 to 15 mA.

The final adjustment for maximum output is made in the presence of full drive, tuning C1 and C2 for maximum anode current and C4 for maximum screen current. C3 is then adjusted for a screen current not exceeding 20 mA as given in **table 1**. The tuning is finished when all the quantities specified in this table have been attained. The power amplifier has then been tuned to its maximum output power consistent with an optimum anode efficiency.

Table 2: Further Component Information

Tube:
YL 1056 (YL 1055, YL 1057, YL 1050, YL 1052)

L_a:
Copper tube, 105 mm outer, 97 mm inner diameter. Length: 165 mm

L_g:
Copper strip 1 mm thick, 12 mm wide, 125 mm long. Suspended 6 mm above the base-plate (figs. 7, 8, 9)

L0:
50 Ω stripline, 0.6 mm thick, 20 mm wide, 4 mm above base-plate (fig. 8).

RFC 1/RFC 2:
8 turns 2 mm enamelled copper wire bifilar wound on a 15 mm coil former (fig. 9).

RFC 3:
1 mm enamelled copper wire (fig. 8)

C5:
Epoxy glass 1.5 mm thick PCB material; as large as possible, bonded to the cover (fig. 8).

C0:
PTFE sandwich capacitor (see text and figs. 6 and 8)

Klaus Eichel, DC 6 HY and Hans-L. Rath, DL 6 KG

GrafTrak and Mirage Tracking Interface (MTI) – Something Really Good for the Radio Amateur! Second (concluding) Part

2. ANTENNA CONTROL (MTI)

The MIRAGE/KLM (MTI) interface is required for controlling the antenna in azimuth and elevation with the programs from Silicon Solutions. An 8-conductor cable connects the RS-232C-input of the computer (cable with 2 x 25-pin sockets DB-25 on the one hand, and on the other hand a connection with the combined control unit for the satellite rotor system KR-5400 or KR-5600 using an 8-pole DIN plug (*). The external dimensions of the MTI Interface are so small that it fits nicely on top of the combi-control unit.

The MTI (**figs. 13 and 14**) contains a microprocessor and carries on a dialogue with the GrafTrak program at 2400 baud (switchable to 300, 600, 1200 baud) when a satellite is being tracked. The version being supplied at the moment, carries a guaranteed implementation accuracy of 4 degrees. In practice, however, it is mostly better, and short-term inaccuracies of more than 5 degrees were seldom encountered (see chapt. 4).

The following interface modes are, among others, selectable by means of a mini-switch:

- Elevation from 0 to 90 degrees or 0 to 180 degrees.
- Mechanical antenna stops, both for north and for south (whereas the combi-control unit has an azimuth scale with a stop at south).

When the elevation limit of 90 degrees has been reached, the MTI carries out a swing in the azimuth of about 180 degrees in order that the departing satellite is able to be followed. The MTI assisted antenna control becomes an almost indispensable facility under contact conditions

* The combined control unit is provided for the horizontal rotors KR 400 or KR 600X. The older KR 500, or the later KR 500A or KR 500B, can be used for the vertical rotor. When using existing horizontal rotors, it should be noted that the KR 600RC cannot readily be used in its original condition. This is because it does not have a potentiometer for the azimuth display, but only a resistance with 2 connections. The rotor diagram should therefore be studied very carefully.

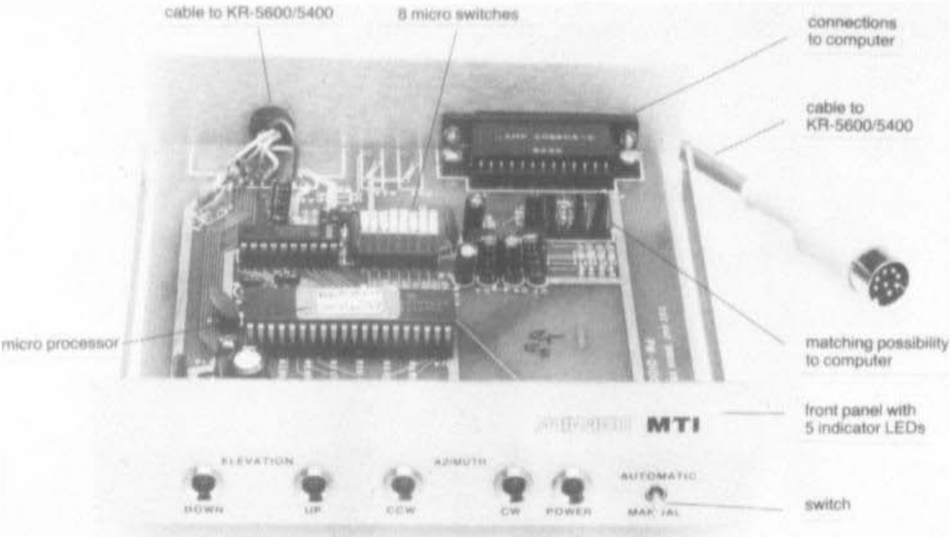

Fig. 13: MTI Interface

Fig. 14: Showing printed board in the MTI

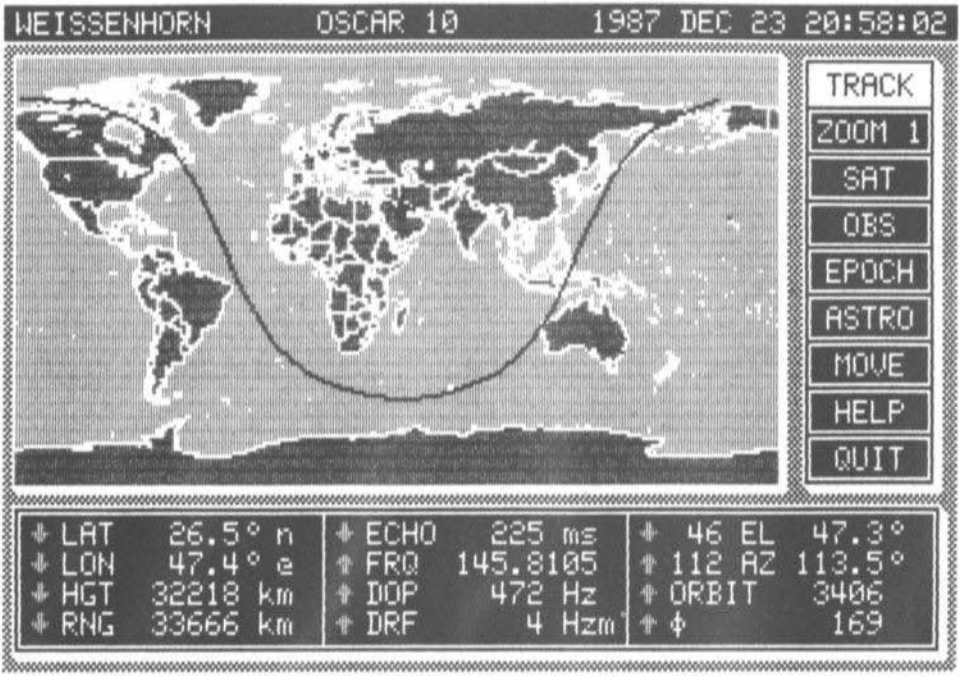

Fig. 15: GrafTrak display of OSCAR 10 over Saudi-Arabia. The automatic antenna control is switched on. In the display field, EL and AZ are, as always, displayed on the right of the computed reference data and left of that is the MTI with the actual antenna headings from the rotor.

via FO 12, where the operator would normally have to track the satellite with the antenna manually, as well as to follow frequency deviations caused by the Doppler effect.

Right at the start of the GrafTrak program, it must be decided whether, or not, the antenna control will be employed. If automatic control for the antenna is selected, the combi-control unit (supplied with operating potential from MTI) must also be switched on, right from the start. The software is so arranged that negative elevation angles cannot be followed.

The display of **figure 15** shows automatic operation in both EL and AZ in the data insert columns – as well as manual operation – the reference line from the computer being always shown in the right-hand column. The actual position of the rotor has recently been added to the left of the EL and AZ data.

A very handy switch on the front panel of the MTI enables "manual" to be selected when in the automatic mode. The scale of both the azimuth and the elevation meters are not very big, physically, but both indications are duplicated by digital displays on the monitor, showing the antenna heading with a good readability. Moreover, there is no difference between the display at the monitor in comparison with automatic operation (fig. 15). Manually operated antenna EL and AZ directions, are again, indicated on the left.

Before the MTI installation is brought into initial operation, two potentiometers on the combi-control unit must be adjusted in order to set the digital elevation and azimuth limits to 90 and 180 degrees respectively ("out voltage adjust").

The manual recommends that **before** the initial switch-on of the antenna control, the whole system should be checked by means of special software to verify the co-ordination of the computer and the MTI. If, however, the satellite antenna installation is known to be functioning well, and the GrafTrak is working satisfactorily with the computer, then this system check may be dispensed with.

It should be borne in mind that a computer working in the shack, in close proximity to the radio equipment, could cause reception interference. Methods of countering this will not be gone into here, but it is worth noting that screened cable, used on the connections from the MTI to the computer and interface, was sufficient to clear any interference from both the two-meter and 70-centimeters bands. Even without using MTI there was some disturbing interference in evidence at 29 MHz. This was reduced to such a low level that even working the RS satellite with the computer in operation, presented no difficulties. The situation was unaffected by the use of MTI.

Satellite enthusiasts who are already users of Silicon Solutions programs are advised that the interface for MTI must be obtained if automatic antenna tracking is required. Additional software is not required.

For an introduction into automatic tracking techniques, the reader is referred to references 5 to 10.

3. OPERATING CONDITIONS

A whole list of programs is now available to radio amateurs interested in satellite communications especially if he has access to the resources of the various AMSAT organizations (*). Programs such as those from G3RUH in England, from N4HY and WØSL in USA, and the C 64, Atari computer (11, 12), the Schneider computer (Amstrad, 13), from DK1TB (1), are already widely established. W5SXD and WB5CCJ have developed, in conjunction with GrafTrak and Silicon Ephemeris, a software which fulfills practically **all** possible requirements in this field.

Nevertheless, two improvements should be incorporated into the forthcoming versions:–

- For the Phase-3C satellites (DL-SAT), information about the satellite's orientation from the perspective of the observer would be of interest, such as: Attitude ALONG/ALAT, OFF-Pointing ANGLE and SQUINT.
- All programs contain the MA-data (Φ) but in GrafTrak, unfortunately, this information is unable to be extracted at the time which it is presented, although in DL-SAT (phase 3C) operation the various modes, such as mode B, L or S, can be switched off and on according to the mode-data.

When the antenna control MTI is in use, setting up and maintaining a contact with an orbiting satellite is as simple as using a conventional radio propagation mode. All the important tasks are presented on the monitor screen in two colours at an astoundingly high update rate. Its always impressive!

For satellites having an elliptical orbit, automatic antenna control is not so absolutely necessary, particularly when the satellite is located in the vicinity of its apogee. In the perigee area, however, the automatic antenna control is just as useful as for the case of the circular orbit.

4. TRACKING ACCURACY CONSIDERATIONS

As in all automatic systems, an antenna control using the MTI system has a residual error i.e.

* In DL: AMSAT-DL Software Borse, DL 9 SAD, Liegnitzer Strasse 70, 7141 Schwieberdingen
For UK and USA: Addresses, see (3).

a departure of the actual from the computerized and desired position of the antenna. The following discourse will indicate who, or what, is responsible for these errors, as well as their effect.

Of course, it cannot be expected that the same accuracy should be available to the radio amateur as that necessary for a radio telescope. Nevertheless, the limits of the system must be defined in order that great expectations are not disappointingly shattered when high-gain antenna systems are initially brought into operation.

The tracking error in any plane of the antenna (azimuth or elevation) may be considered, as a first approximation, as the sum of the following partial errors: –

1) Faulty alignment of the rotor.
   This zero deviation is a setting error and is constant, that is, it is manifest over the entire range of movement. Typical values for this error are ± 1° to ± 2°.

2) Movement of antenna installation by storms.
   Typical errors caused by the mast swaying and play in the rotor bearings: up to ± 3 degrees.

3) Angle monitor-potentiometer linearity error in the rotor. According to the specification of the KR 400/500/600 rotor, the displayed error is no more than ± 4 degrees. The potentiometer itself accounts for about half of this, i.e. ± 2 degrees. This error is mainly manifest in the middle of the antenna swing and not at its limits.

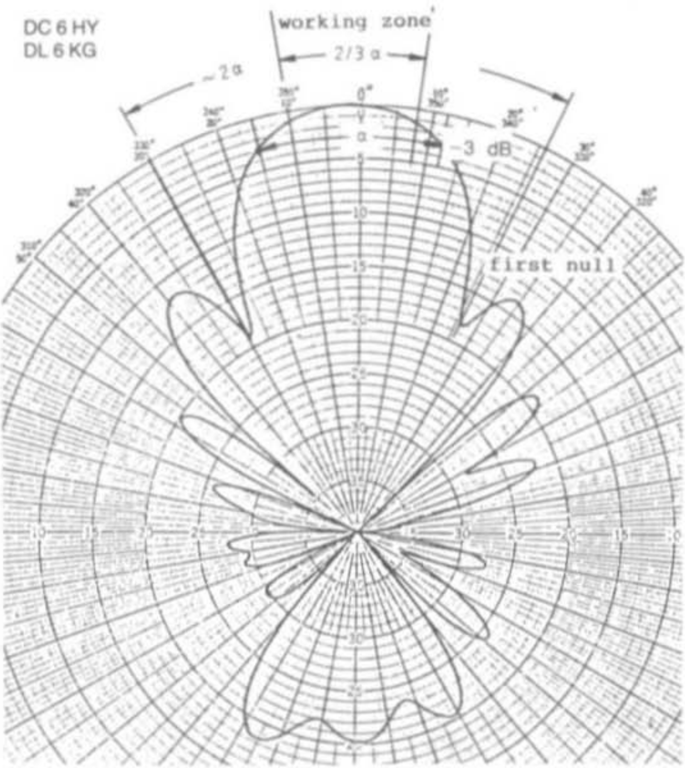

Fig. 16: Typical antenna diagram; α = beamwidth

4) Quantization errors in the MTI analogue/digital converter.
   The D/A converter can be taken as 2 degrees resolution with an attendant quantization error of up to ± 1 degree.

5) Tracking errors – the difference between the indicated position and the actual position of the antenna.
   Indicated tracking errors up to 5 degrees have been observed but typical are errors of 3 and 4 degrees. These values can be considered as being perfectly normal, as the control system is not a linear one but only a simple three-point system.

In general, the effect of all these error sources is not cumulative in one particular direction nor do any errors necessarily assume their greatest potential value – that, of course would be unacceptable!

2° Set-up error + 8° control error = 10° between the actual setting and the optimal setting. With half this value, i.e. 5° error, in azimuth as well as in elevation (simultaneously), must be reckoned with.

In this error figure of any real consequence, and if so, for what size of antenna?

To simplify the matter, consider one plane of an antenna diagram (**fig. 16**): If the antenna were to be directed at the satellite without any tracking error, then the maximum gain of the antenna would be available. The beamwidth of the antenna (expressed in degrees) by defination, means that if there were to be a heading error amounting to exactly half that of the main lobe, then the path loss would be increased by 3 dB. A further doubling of the loss will occur with the most antennas if the heading error falls at the first null-point. In practice, for most radio contacts, a heading error of ± 1/3rd of the beamwidth giving a 1.0 to 1.5 dB path-loss penalty, has proved sufficient.

The above considerations are based upon the assumption that the ground station has only one antenna possessing a narrow polar diagram, and the second antenna a considerably broader diagram. For the case of both up- and down-link antennas having about equal gains, and therefore the same polar-plots, the demands upon the tracking system are somewhat increased.

It is well known, that the beamwidth and the gain of an antenna are very closely dependent upon each other (15), that is, the tracking ability of the system is ultimately limited by the effective antenna gain.

Typical values for antennas or antenna arrays are shown in **table 1**.

Using MTI for radio communication via satellite, it can be assumed, that for most of the time, the tracking error will amount to no more than 5 degrees. In order that this error does not cause a path loss of more than 1 dB, the antennas must have a beamwidth of at least 3 times 5°, i.e. 15° (see fig. 16). This, according to the tables, is equivalent to an antenna gain of some 20 dB_i (18 dB_d).

Gain rel. dipole	Gain rel. isotropic antenna	Beamwidth α
dB_d	dB_i	degrees
7.5	9.5	60
10	12	45
13	15	30
15	17	22
18	20	15

Table 1

The MTI system does not have the tracking capability, at the moment, to cope with antennas having smaller beamwidths than 15 degrees.

What can be expected in the way of antenna dimensions?

Until now, this beamwidth for single Yagi antennas, has only been attained in the 23 cm band (i.e. measured, not merely published) with a boomlength of some 12 wavelengths (3 m). Yagi antenna arrays are required for 2 m and 70 cm working. The recommended configuration is four Yagis, each possessing similar polar diagrams in both the vertical and horizontal plane. The dimensions of these arrays are (approx.):–

Length of individual Yagi antenna: 3 λ approx.
Stacking spacing: 1.8 λ (hor.) and 1.7 λ (vert.) approx.

These dimensions are easily attainable in the 70 cm band (13-element Yagis with 2.25 m boom, stacking 1.3 m/1.2 m). This, in the two-metre band would represent the absolute limit of feasibility (16-element Yagis with 6.3 m boom, stacking 3.8 m/3.5 m). The two-metre antennas would moreover severely overload the rotor series KR-400/500/600 in the event of a storm, unless additional measures were taken.

Reflector antennas have a beamwidth of about 70°/D where D is expressed in wavelengths. That means, that for a 15° beamwidth, a parabolic antenna should not have a diameter of more than 5 λ (1.2 m at 1269 MHz).

It is evident from this, that it is easily possible for the radio amateur to construct an antenna system for the band 430 MHz and higher, which has a higher gain than the trackability of the MTI can cope with. These higher gains can lead to tracking error losses of greater than 1/3 of the beamwidth. This means that, in certain circumstances, these large antennas under automatic control are not as effective as smaller antennas with beamwidths ≥ 15°.

The MTI antenna tracking system can be easily checked by the amateur by using the noise emitted by the Sun (16, 17). The GrafTrak program allows the antenna to be aimed at the Sun for just this purpose. Using a 20 dB$_i$ antenna (e.g. 4 stacked DL 6 WU Yagis each of 13 elements) in the 70-cm band, the Sun's noise should be heard (measured) some 5 to 6 dB above the receiver's basic noise. This, of course, assumes the use of a pre-amplifier located directly at the antenna terminals – unless the cable loss between antenna and receiver is less than 2 dB.

The tracking capability should be deemed to be functioning perfectly if the Sun's noise cannot be increased by more than 1 dB manually, after it has been tracked in the automatic mode.

By using this method of testing, sources of alignment errors in maual operation may be detected and subsequently corrected. This is facilitated by the fact that both the calculated reference heading and the actual heading are both presented together on the display (fig. 15).

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- AMSAT-DL Journal, 6 editions yearly.
Publisher AMSAT-DL e.V.
Holderstrauch 10, D-3550 Marburg 2.
DM 50.00 p. year.
- OSCAR NEWS, AMSAT-UK journal, 6 editions yearly.
Obtainable from G 3 AAJ,
94 Herongate Road, Wanstead Park,
London E12 5EQ, England.
Costs 12.75 pounds stirling p. year.
- AMATEUR SATELLITE REPORT, AMSAT-NA newsletter, published 2 times a month.
Publisher: AMSAT-NA, P.O.Box 27,
Washington, DC 20014, USA.
Costs p. year $ 24.00

- OSCAR 11 transmits the latest Kepler orbital data on weekends.
- W1AW transmits the Kepler orbital data in RTTY on 3.625/7.095/14.095 MHz on Tuesday and Saturday at 23.30 UTC (in summer different times!)

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Hans Oppermann, Quickborn

More on the PC Interface for the YU 3 UMV Weather Picture Store

As a supplement to the VHF Communications 3/87 article on the interface circuit, an improvement possibility is offered in this article. In addition, answers to both spoken and written questions will be given an airing.

1. INCREASING THE READ-OUT SPEED

The read-out time may be reduced by 50 % if, instead of a 2651 being used for I 101, a **2661B** is used. The suffix "B" is important in the designation. The 2651 only allows a 19200 baud speed but this is increased to 38400 (max.) by using the 2661B. This enables a 156 line picture to be read-out in only 13.65 seconds.

As far as the circuit diagram is concerned, there is no alteration necessary as the replacement IC is pin-compatible with the original. The output loop of the software, however, should have the number of its commands reduced to a minimum, otherwise the full 38400 baud-rate capability will not be realised.

2. EXPLANATIONS

2.1. Crystal frequency: This is 5.0688 MHz and determines the accuracy of the programmed baud rate. It is otherwise not critical. It does however, affect the output speed. According to the data-sheet, the frequency can be anywhere between 1.0 and 5.0738 MHz.

2.2 The 8251 integrated circuit: This is by Intel and is not compatible to the 2651. Besides this, it will only support a baud rate of 9600.

2.3. The supply voltage: All ICs are supplied with 5.0 volts.

2.4. The prototype card: This must be equipped with the specified IC types.

2.5. The connection "Reset DRV": This refers to the PC bus on the card's multi-way plug.

2.6. The connection "U3/11": This refers to the IC U3/Pin 11 on the prototype card.

2.7. The enable-line from I 111 on YU 3 UMV 001 must be manually switched to a definate potential. If the output from the PC to the YU3-

memory is required, it must be switched to + 5 V (disabled). When inputting the PC from the YU3-memory, the line must be at 0 V (enabled).

3. EVALUATION OF START AND STOP SIGNALS

By means of a simple modification of the interface, it is possible to evaluate the start and stop signals from METEOSAT. This makes it possible to automatically read-in pictures over a longer period.

The modification is carried out as follows:–

Make connections from I 101/16 with I 105/6 and also I 105/5 to YU 3 UMV 001 Pt. 123. This inverts the start/stop signal at the "carrier detect" on I 101. The log level of the signal is determined by reading the Status Register by I 101. Note! Log. 1 at CD (stop) blocks the receiver from I 101.

4. TELECOPIER

Finally, a word about the new possibility of copying the weather picture information out via the PC into a remote copier. I have developed a program which enables the digitalized pictures to be displayed on a 3M 2346 telecopier. As a precaution this was implemented, using galvanic isolation, by means of an AF transformer wired across the PC's loudspeaker. That was all in the way of an interface which was required. No modification was required at the copier, as the speed from the PC is suitable for the copier.

The telecopier must, however, be set-up in the FM mode, but this is no problem as the greatest resolution is achieved in this mode anyway.

The pictures have a good dot resolution but the grey-level steps have been reduced to some 25. The pictures from the polar-orbiting weather satellite NOAA, METEOR appear now in their full length and are particularly impressive.

Wolfgang Guenther, DF 4 UW

Short-Wave Pre-Selector / Amplifier

A versatile selective HF module for the frequency range 20 to 40 MHz is described which is particularly well-suited for the input stage of insensitive receivers, or as an IF stage following a UHF/VHF down-converter. Its salient features are, an adjustable gain from 16 dB to − 24 dB and a tuned three-circuit filter having a bandwidth of only ± 150 kHz. The main components comprise a 3-gang variable capacitor, 3 coil-formers, 3 mica capacitors and a dual-gate MOSFET, all mounted upon a small printed circuit board (fig. 1).

1. SELECTION AND AMPLIFICATION

The above mentioned variable amplification, or attenuation, serves to enable the level to be adjusted in order to suit the input of the following mixer stage to avoid undesirable overloading. An over-driven mixer stage produces intermodulation distortion and cross-modulation and is the main source of distortion in a receiver. This is made evident when the receiver is tuned to a weak signal, by a high, obscuring carpet of unintelligible signals which disappear very sharply when the pre-amplifier gain is reduced to the optimum level. The mixer stage input, at this point, is then just under the "crash-point". In nearly all cases, this takes place at an attenuation which is well above the maximum capability of the module (24 dB). See reference (1).

The gain of the amplifier actually remains fixed at 16 dB but the overall attenuation is made variable by a ceramic potentiometer at the input. When the slider is set to the hot end of the potentiometer, the amplification of the module is effectively 16 dB. When the slider is tuned to the bottom end of the potentiometer, a loss of 40 dB is incurred thus making the overall gain − 24 dB − i.e. a loss. This ensures that practically all incoming signal levels can be accomodated, and that the FET amplifier is always working at its optimum point as far as the minimization of intermodulation-products is concerned.

The three-circuit filter before the amplifier is, however, responsible for the attenuation of out-band, high-level signals which could overload the amplifier and following mixer. Its 3 dB bandwidth is only ± 150 kHz. This must be compared with the 2 to 3 MHz bandwidth of UHF converters or indeed, that of wideband diode ringmixers. The out-band attenuation (50 dB) of the three-circuit

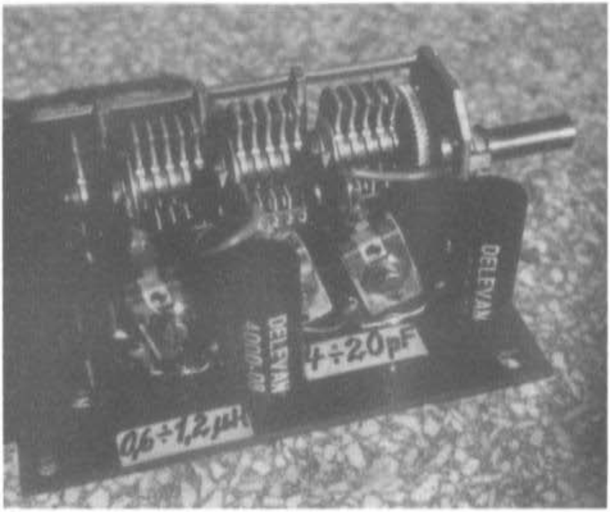

Fig. 1: Prototype of the selective HF pre-amplifier without housing

pre-selector filter, also makes its agreeable presence felt. This latter specification is, however, dependent heavily upon the method of construction employed. One only has to consider the level at which short-wave propaganda stations are received at. A long-wire antenna in Europe can present input voltages of 100,000 µV to the receiver input, i.e. 0.1 volt! The out-band attenuation of the pre-selector reduces this by 50 dB to some 300 µV, and this may be further reduced by the potentiometer, if necessary.

At this time it should be mentioned, that the ceramic potentiometer (1 kΩ or 470 Ω) is mounted directly in the vicinity of the antenna input socket in an RF-tight enclosure (2). **Figure 1** does not show this point.

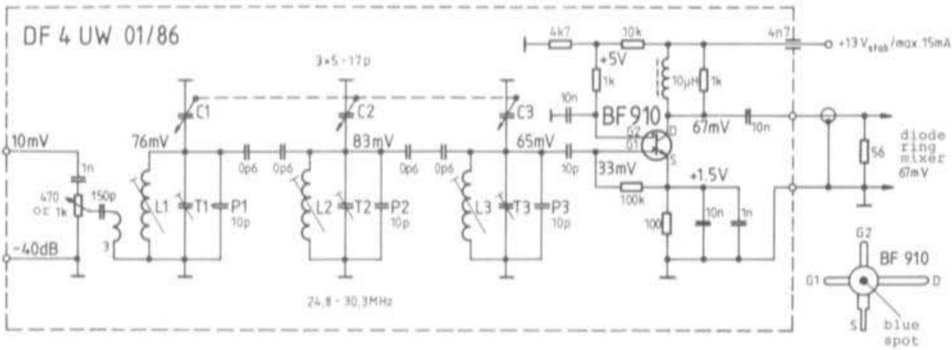

Fig. 2: 10 m-Band pre-selector DF 4 UW 01/86. For tuning 28 MHz, G = 6.7 ≙ 16 dB/50 Ω (input and output). Input potentiometer at 0 dB. 3 dB Bandwidth = ± 150 kHz. Hi-Z probe with − 20 dB/0.75 pF cap. used with URV voltmeter for testing.

2. THE CIRCUIT

The circuit diagram of **fig. 2** is shown complete with measurement values at various points. The attenuation has been set so that the input impedance to L1 is 50 Ω - 75 Ω. The voltage gain of this selective circuit is determined by the transformation ratio from the low input to the high-impedance tuned circuit, i.e. from 50 Ω - 20 kΩ. This corresponds to a voltage transformation of 7.5. The gate 1 of the DG-MOSFET is effectively, at 28 MHz, a parallel combination of about 30 kΩ resistance and 6 pF capacitance. This, in combination with the 10 pF coupling capacitor, reduces the input voltage to the device by a factor of 2. Increasing the value of the coupling capacitor, to say 100 pF, would increase the available voltage but it would also load the tuned circuit and deteriorate its selective properties. The remaining x3.3 antenna level, together with a transistor noise-figure of 1.8 dB, ensures, nevertheless, that a higher than ordinary sensitivity is achieved.

The characteristics of the TI BF 910 are largely responsible for the high sensitivity. With a drain voltage of 15 V at 10 - 15 mA, and a G2 voltage of 4 to 5 V, a slope of 25 mA/V is achieved. Most probably, the same sort of performance can be obtained from the Siemens BF 961 (or the BF 965, but suitably damped!).

As previously mentioned, the dual-gate MOSFET with the above working conditions is employed at its best condition for linearity and therefore large-signal working. A (supplementary) gain control using the voltage at G2, as used frequently in IF stages and in RF stages as well, unfortunately, is absolutely not to be recommended. This is because the working point can be driven into the non-linear region thus causing large-signal handling problems. Classical receiver circuits are in this respect somewhat problematical. The gain-control potentiometer used here can only be replaced by a PIN diode variable attenuator (3).

The transistor amplifies the HF voltage by (only) a factor of 2 this being controlled by the low external impedance of 56 Ω. This not only ensures an extremely good intercept-point (IP) but it presents also the correct output impedance to the following coaxial cable and diode ring mixer (SRA-1 H, RAY-3, IE-500 etc.). It is also suitable for various high and low-impedance receiver inputs of all kinds.

The voltage overall amplification amounts to some 6.6, i.e. 16 dB. The HF voltage was measured with a Rhode & Schwarz UHF millivoltmeter "URV" and a high-impedance, low-capacitance probe (– 20 dB/0.75 pF).

The Q of the tuned circuit depends heavily, of course, upon the quality of the tuned circuit components, i.e. inductor, trimmer and tuning capacitor. A Q of 60 to 180 can be expected, giving dynamic resistances of 11 to 33 kΩ. The corresponding bandwidth is then ± 250 kHz to ± 80 kHz. The quality of the components used by the author lay in the middle of these extremes so that the bandwidth was measured at ± 150 kHz.

The total bandwidth can be readily reduced to ± 50 kHz if screening walls are used between the filter coils and so minimizing the inductive coupling between them. The price to be paid for the reduced bandwidth is a noticeable increase in the filter's insertion loss. This leads to a direct loss of sensitivity as well as introducing tracking difficulties with the tuned circuits. The advantage

Frequency range:	**20 - 25 MHz**	**25 - 30 MHz**	**30 - 40 MHz**
Coils L1...L3:	2.0 - 2.4 μH	1.0 - 1.2 μH	1.0 - 1.2 μH
Mica trimmer:	4 - 20 pF	4 - 20 pF	3 - 10 pF
Parallel cap.:	none	10 pF	none
Total-ΔC:	18 - 30 pF	28 - 40 pF	15 - 27 pF
3-Gang variable cap.:	each 5 - 17 pF; ΔC = 12 pF		

Table 1

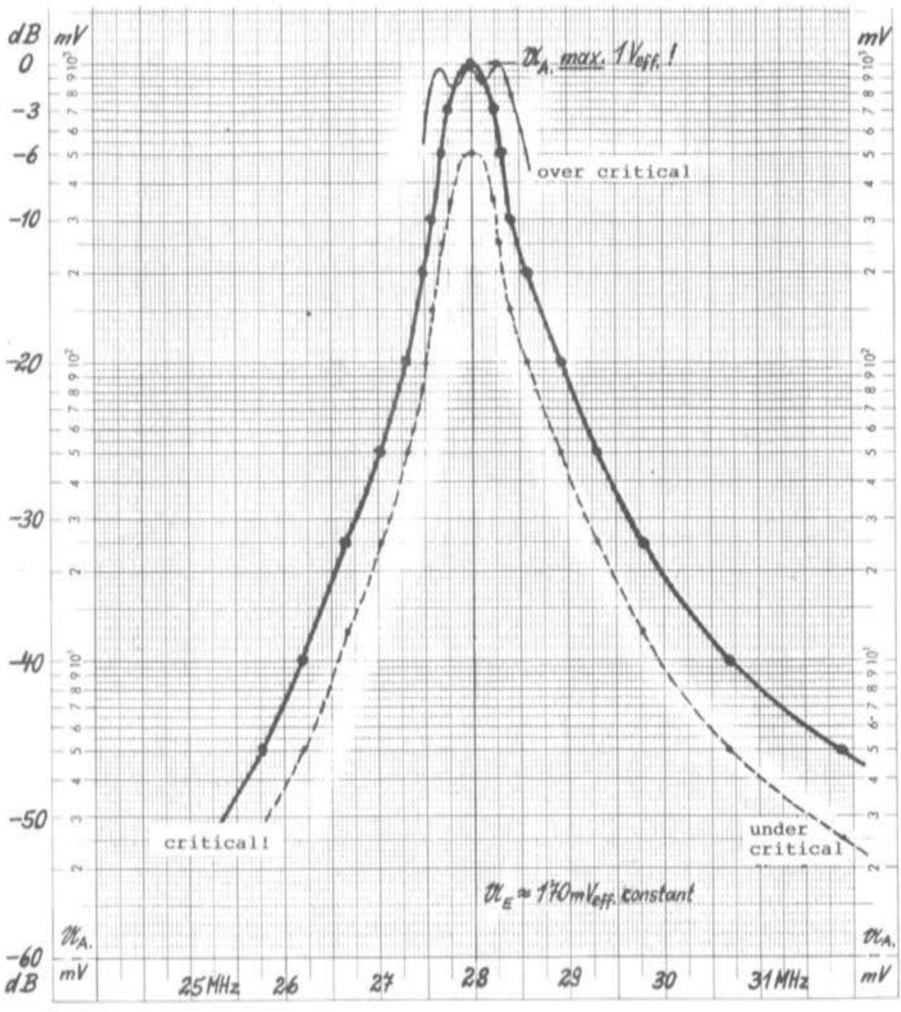

Fig. 3: The selectivity curve of the tunable 3 circuit pre-selector.

——•—— At critical coupling i.e. max. power transfer

- - - -•- - - - At under-critical coupling and 6 dB more insertion loss

lies in an improvement of the slope of 6 dB at ± 150 kHz but the out-band selection between ± 1.5 and ± 15 MHz remains the same.

The components, shown in the diagram, are valid for a frequency range from 25 to 30 MHz. If the 3-circuit filter is only required to be tunable between 20 and 25 MHz, the 10 pF capacitor is dispensed with and the three inductors should have an inductance of 2.0 to 2.4 μH. The total effective capacitance (i.e. variable C, trimmer, switch C) must lie between 18 and 30 pF.

In a similar fashion, the components may be dimensioned for the frequency range 30 to 40 MHz. Next to the variable capacitor (5 - 17 pF), a small trimmer (3 - 10 pF) is inserted. The inductors use the same value as for the middle frequency range (1.0 to 1.2 μH). The total capacitance should, in this case, lie between 15 pF and 27 pF. This information is listed in **table 1**.

If only a two-gang variable capacitor is available, the filter may be readily reduced to a 2-circuit type. This, of course, reduces the filter flank steepness from that depicted in **fig. 3**.

Varicap diodes are not recommended for this circuit owing to the deterioration in the overall Q and the non-linearity which they introduce (poor IP characteristic).

3. CONSTRUCTION

The circuit can be built very nicely on a small piece of circuit board material using small solder pins as component supports. It can also be built on a specially etched printed circuit board in the normal manner. The results will be similar in both cases but the perfectionist will no doubt find more satisfaction with a PCB and, in any case, it is easier to duplicate it if required.

It is absolutely necessary, however, to place the module in an RF-tight enclosure. The supply voltage is fed in via a feed-through capacitor and shafts of 4.1 mm to 4.4 mm are fabricated to clamp the 50 Ω RG-223 coax cable input (2).

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BRIEFLY SPEAKING...

10 GHz Contest at 3200 m in OE8

For the second sub-regional contest week-end (7/8 May) **OE 6 TH, OE 6 AP, OE 8 TPK** and **OE 8 MI** were QRV on the top of Scharek summit (Austria) with two 10 GHz SSB stations. The equipment details were: A DL 1 RQ transverter with 1 W output, a 70 cm diameter parabolic antenna and a 2 m transceiver.

The weather on Saturday was very nice with an inversion layer clearly visible on the horizon. In spite of this, not one 10 GHz DX contact could be made. Even 2 metre contacts, made with HB 9 RG and HB 9 MIN, were very weak. The only good contact was achieved by splitting the party into two groups and conducting a QSO over a distance of 200 metres!

The next day, Sunday, brought very bad weather and a premature return home by OE 6 AP and OE 6 TH but the transverter of OE 8 TPK and OE 8 MI remained to stay it out. Their tenacity was rewarded with a 2 ½ hour burst of activity, during which they worked 8 DX stations in DL and I at distances between 223 and 386 km! The average path distance was 327 km and the best report came from the GHz fraternity in Ancona, 5/9!

The new addage must surely be: that fine weather is no guarantee for success and bad weather doesn't necessarily mean no 10 GHz contacts will be made.

A sked arranged between Italy and Germany fell through owing to the differing contact frequency used by both parties. The Italiens used frequencies in the transponder band around 144.950 MHz, owing to the large amount of contest QRM, whilst the Germans were using 144.3 or 144.450 MHz and other frequencies.

The overwhelming priority is therefore, to urgently arrange a common frequency in the 2 m band during contest times to be used as a schedule fixer for 10 GHz band contacts. But please, do not use the 70 cm band because then, all other 70 cm stations would have to be hauled up 3000 m peaks!

Information from OE 6 AP

Veteran Short-Wave Receivers (only in German)

36 equipments in Words and Pictures

DM 21.–, 136 pages
Format: 16.4 x 23 cm
approx. 92 illustrations
Verlag fuer Technik und Handwerk, Baden-Baden.

This book presents 36 short-wave receivers, of mainly professional construction, which may be obtained nowadays at a fraction of the price at which they were originally sold.

Through countless articles, author Nils Schiffhauer has made himself a well-known expert in this field and over the years has comprehensively tested those receivers which are still in current use with radio amateurs and short-wave listeners.

Each receiver is described with its own individual characteristics in signal processing and mechanical solutions as well as an appraisal of its actual reception capabilities.

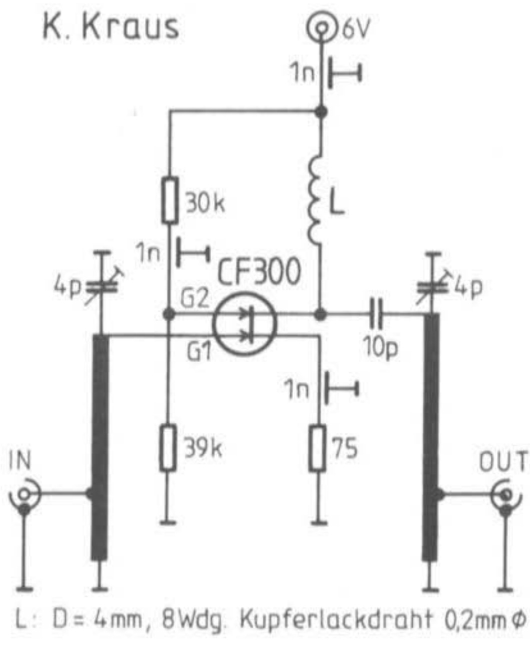
The book therefore represents an aid for radio amateurs and listeners to choose an equipment for the station which is both nostalgic and functional. It is only obtainable in the German language.

Pre-Amplifier using a CF 300

The accompanying circuit diagram shows a pre-amplifier built with a single CF 300 dual-gate MOSFET. The tuned circuit lines were fabricated from ball-point refills cut to L = 30 mm and of 3.1 mm diameter. The pre-amplifier is housed in a brass container constructed of 0.5 mm brass sheet. A hole is drilled in the dividing wall through which gate 1 of the DG MOSFET protrudes. The amplifier has been constructed and evaluated many times and the following data can be considered typical: A = 30 dB, NF = 1.1 dB, mid-band frequency = 750 MHz, BW = 32 MHz.

The author would like to thank Herrn H. D. Kipnich of Muenster for his valuable assistance with this project.

K. Kraus, Rokycany



MOS-Tetrodes BF 988, BF 998 used as pre-amplifiers up to 1000 MHz

Siemens are now offering semi-conductors tetrodes BF 988 and BF 998 for the first time with gate lengths of 1 μm. In comparison with the established BF 966 S and BF 996 S, these newcomers offer a higher transconductance and smaller capacity. They are intended for employment in gain-controlled pre-amplifiers of high-grade TV-tuners (e.g. CATV), tuning from 50 to 1000 MHz.

Modern TV tuners must exhibit optimal noise and large-signal handling properties in order to be effective in the latest technologies e.g. cable TV (CATV), TV receivers etc. Key elements are UHF tetrodes, the use of which enables the necessary pre-amplification to be realized.

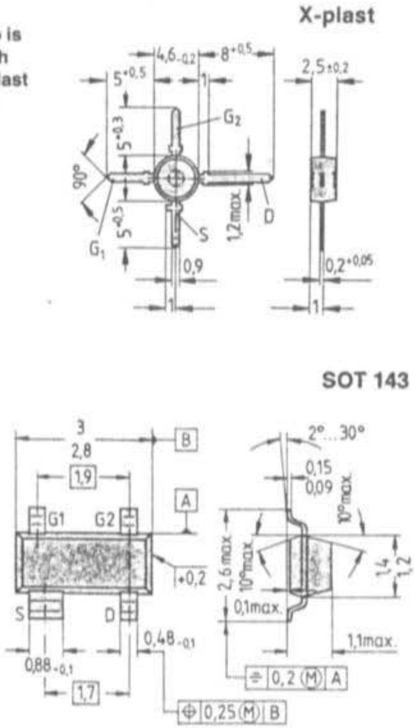
Their low price, as opposed to GaAs-tetrodes, makes the new MOS-tetrodes BF 988 (X-plastic package) and BF 998 (SOT 143 housing) very interesting from an economical point of view. Both forms use the same silicon-planar MOS technology (**fig. 1**).

The new MOS tetrodes are based upon the specifications of the established UHF devices BF 966 S and BF 996 S but have only a 1 µm gate 1 channel length instead of 2 µm, owing to the use of more advanced manufacturing technology (**fig. 2**). This reduction in length improves the high-frequency characteristics of the UHF tetrodes: With smaller gate-lengths, the ratio, transconductance to input capacity increases and the noise figure sinks at the higher frequencies.

The data shown in the **table** show the difference between the salient characteristics of the newly introduced tetrodes BF 988, BF 998 and the established BF 966 S and BF 996 S.

Siemens Components 26 (1988), Edition 1

Fig. 1:
The same tetrode chip is encapsulated into both package variants, X-plast (BF 998) and SOT 143 (BF 988)



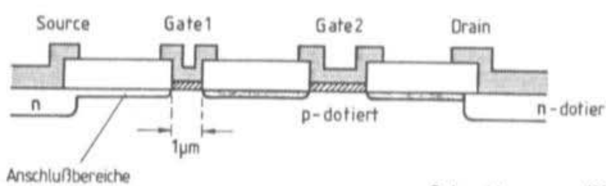


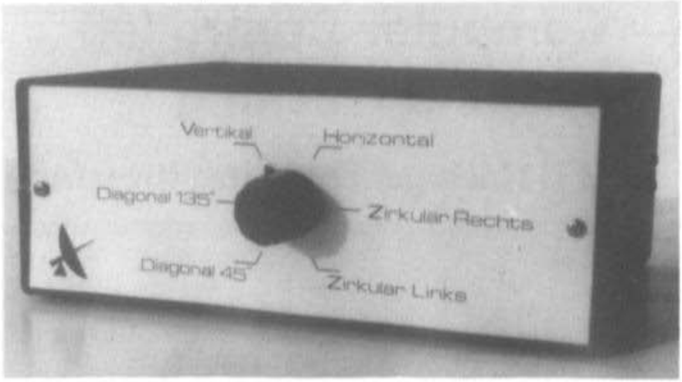
Fig. 2:
Cross-section of the BF 988 and BF 998 tetrode chip

Salient characteristics	BF 966 S, BF 996 S	BF 988, BF 998
Gate length	2 µm	1 µm
Transconductance	18 mS	24 mS
Gate-source capacity	2.3 pF	2.1 pF
Noise figure (f = 800 MHz)	1.8 dB	1.0 dB

MATERIAL PRICE LIST OF EQUIPMENT

described in edition 3/1988 of VHF COMMUNICATIONS

DL0HV 017	**1.5 GHz Plug-in for the Frequency Counter**		**Art.No.**	**Ed. 3/1988**
PCB	DL0HV 017	two-sided, drilled		upon request
Kit	DL0HV 017			upon request
Timer/Zoom	**for YU3UMV/DL6NAD Image Storage**			**Ed. 3/1988**
PCB	KG 001	single-sided, drilled	6580	DM 25.–
Kit	KG 001	1 crystal, 1 transistor, 7 diodes, 1 volt.reg., 8 CMOS ICs, 5 elkos, 1 foil-, 12 cer. caps., 15 carbon film-, 3 preset resistors, 1 relay, 1 15-pole connector	6581	DM 100.–
Kit	**KG 001**	**with the above parts**	**6582**	**DM 120.–**
Timer/Zoom	**KG 001**	**ready-for-use**	**6583**	**DM 220.–**
DL6NAD WEFAX Digital Multi-Image Storage				**Ed. 3/1988**
PCB	DL6NAD 003	thro'-contacted	6577	DM 68.–
Kit	DL6NAD 003	12 CMOS ICs, 1 DAC, 1 video IC, 15 TTL ICs, 1 diode, 20 carbon film-, 1 preset resistors, 12 elkos, 10 foil-, 6 cer.-, 1 trimmer caps. 1 RFC, 2 pin strips, 1 flat bus-cable with plugs, 4 solder pins, 1 crystal (1 MHz)	6578	DM 280.–
Kit	**DL6NAD 003**	**with the above parts**	**6579**	**DM 340.–**
Module	**DL6NAD 003**	**ready-for-use**	**6584**	**DM 450.–**



Polarizer Data	Ordering Information		
Freq. range: 144 - 146 MHz	**HF sockets**	**Art.No.**	**Price**
Impedance: 50 Ω	BNC	0320	DM 193.–
SWR (at 145 MHz): 1.2 max	SO 239	0321	DM 199.–
Insertion loss: 0.1 - 0.3 dB	N	0322	DM 217.–
Rated continuous pwr: 100 W max.			
Phase error: 0.1° typ.			

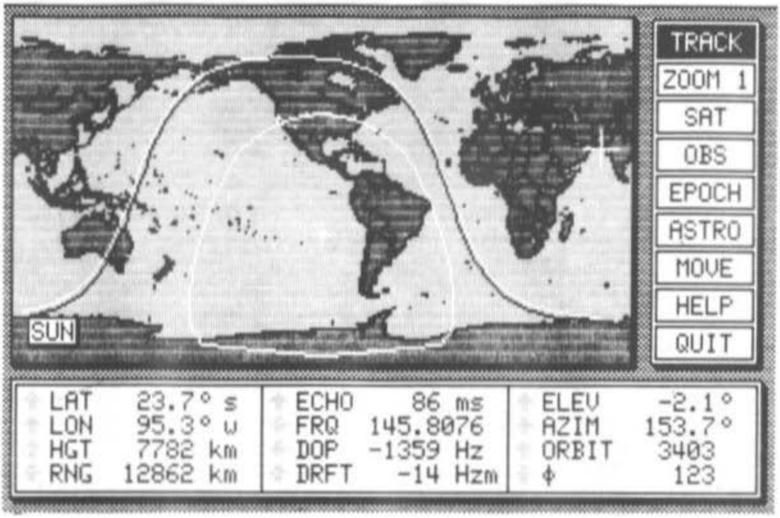
Mode L offer: Transmit-Transverter MMX 1268/144

Output frequency range:	1268 - 1270 MHz
Input frequency range:	144 - 146 MHz
Output power:	2 W (continuous)
Input drive power:	5 - 500 mW, or 10 W via (enclosed) 15 dB pad
Modulation modes:	SSB, FM, AM, CW
Spurious emissions:	less than − 40 dBc
Supply:	13.8 V at 0.5 A
Sockets (50 Ω):	input: SO-239; output: N
Dimensions (mm):	187 x 120 x 106
Art.Nr.: 3215	**Preis: DM 775.–**

The ideal solution for the most discriminating satellite operator:

Computer-Controlled Satellite Tracking

MTI (Mirage Tracking Interface)



- Automatic tracking of any orbiting body
- Antennas stay aimed correctly at all times
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PC / XT / AT or compatible

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MTI consists of:
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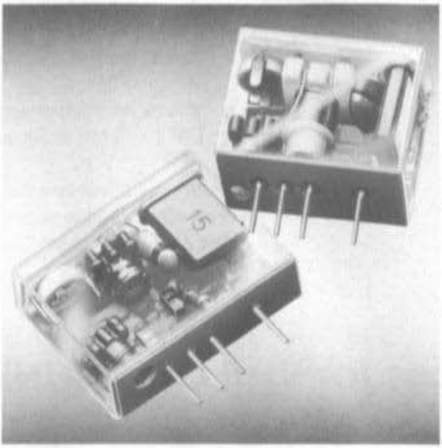

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Freq. range	10 – 80 MHz			6.4 – 25 MHz			10 – 80 MHz		
stability vs temp. range	–30 to +60°C			–30 to +60°C			–30 to +60°C		
Current consumption	max. 3 mA at UB = +5 V			max. 10 mA at UB = +5 V			max. 10 mA at UB = +5 V		
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same size as CCO 102 A + B

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