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VHF COMMUNICATIONS

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ESPECIALLY COVERING VHF, UHF AND MICROWAVES

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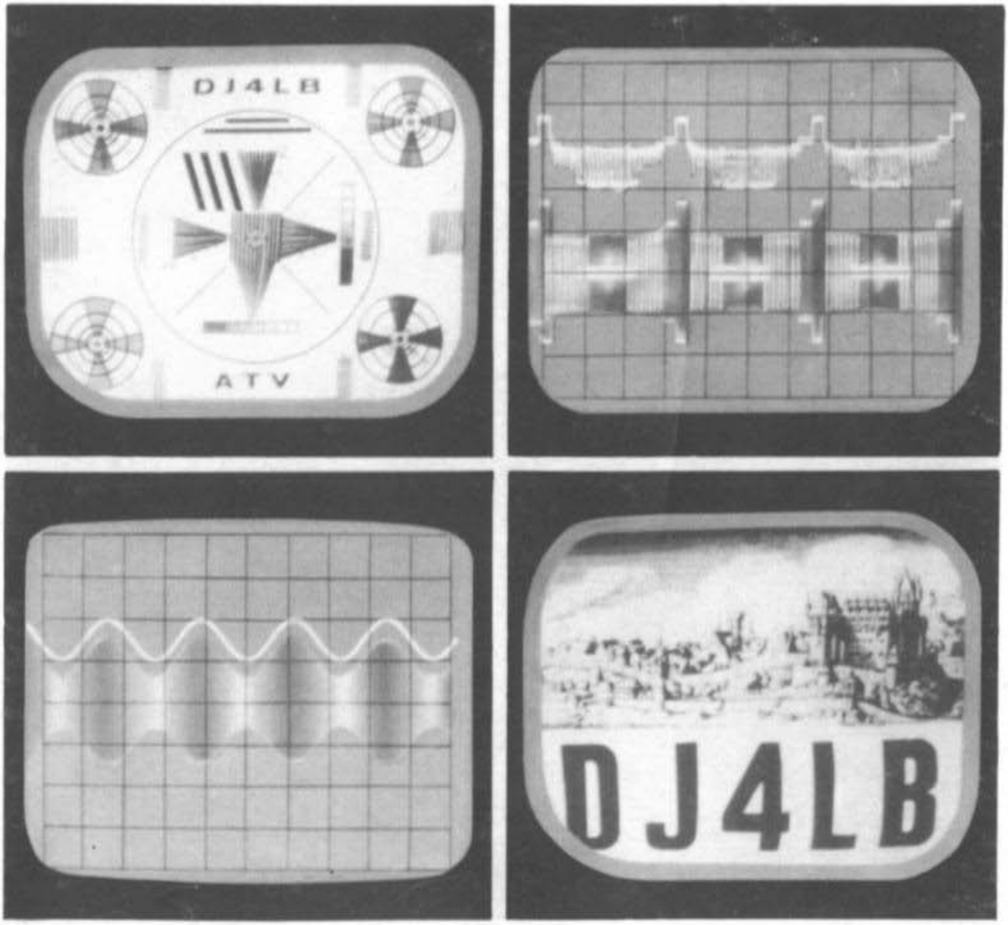

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Amateur television is becoming an increasingly interesting mode of operation for radio amateurs. Up till now, this type of transmission has been limited to a few "specialists" who have designed and constructed their own equipment. There are, of course, some very active groups of ATV amateurs, but little has been described that has allowed other interested amateurs to construct equipment for this communications mode. VHF COMMUNICATIONS commenced describing the fundamentals of ATV last year and are now to publish a number of ATV-designs that will allow sophisticated equipment to be constructed easily. This edition commences a description of a complete video and sound transmitter for 70 cm, with IF-injection of the sound carrier, as well as the first part of a ATV-pulse center/pattern generator. The modules of the ATV-transmitter also allow other modes to be operated on 70 cm and the description gives details how a 28 MHz - 432 MHz converter as well as a 70 cm transmitter can be constructed.

As may have been noticed in the last edition of VHF COMMUNICATIONS, the publishers are now cooperating closely with the manufacturers of the high performance J-Beam antennas. This means that virtually all requirements for the VHF/UHF amateur are now available from a single source. J-Beam Eng. Ltd. have also taken over our British agency.

A MODULAR ATV TRANSMITTER

by G. Sattler, DJ 4 LB

The following article is to describe the low-power modules of an amateur television transmitter for the 70 cm band. The transmitter is of modular construction and the modules can also be used for other purposes such as a converter or voice transmitter. Since the linearity and the bandwidth of the 70 cm module has been designed for television (A 5) modulation, it will also be suitable for use with any other operating mode permissible on the 70 cm amateur band. Details are to be given on how the modules can be used as an SSB-converter, FM-transmitter and how the frequency plan can be modified for use on the inactive frequencies on the whole 70 cm band, which is 10 MHz and not just 2 MHz in bandwidth.

1. CONCEPT

As was mentioned in (1), it is advantageous to inject the sound carrier at IF-level. In this case the video and sound signals are modulated onto intermediate frequency carriers that are then converted in a common mixer to the required frequency on the 70 cm band. It is also possible for the signal to be converted further so that transmissions are possible on the 24 cm band.

1.1. SELECTION OF THE INTERMEDIATE FREQUENCY

The intermediate frequencies used in television receivers operating according to the CCIR standard of 38.9 MHz (video) and 33.4 MHz (sound) are also favourable for transmission if the selectivity at the intermediate frequency level and the image rejection on converting this signal to the 70 cm band are taken into consideration.

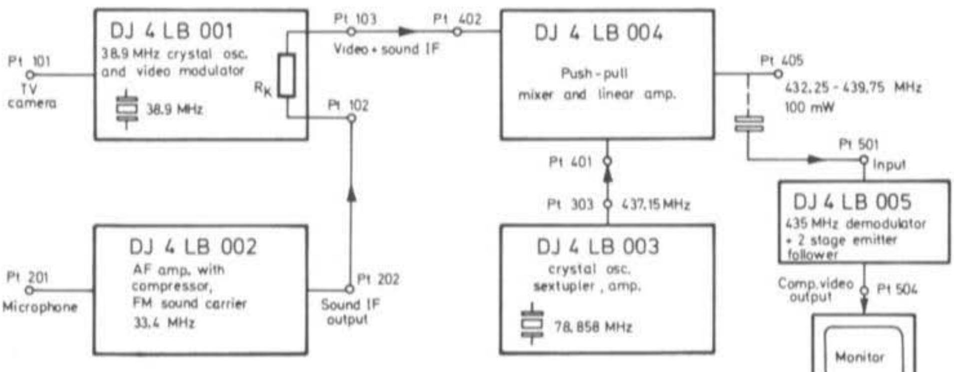


Fig. 1: ATV transmitter with IF injection

This also allows several modules, such as the UHF local oscillator and the IF chain to be used both for transmit and receive, which means that it would be possible to construct a ATV-transceiver.

Of course, this ATV-transmitter is not only suitable for transmissions according to the CCIR standard since it is easily possible to change the spacing between video and sound carriers and since the video signal is dependent on the composite video signal fed into the transmitter from the camera. This means that the transmitter can be used for virtually all television standards.

1.2. LIST OF MODULES, FREQUENCY PLAN

The individual modules of the low-power ATV transmitter are given in Fig. 1 in the form of a block diagram:

Module DJ 4 LB 001 provides the video IF signal at 38.9 MHz as well as the 33.4 MHz signal injected from DJ 4 LB 002. These signals are converted to the 70 cm band in module DJ 4 LB 004 with the aid of the local oscillator frequency of 473.15 MHz generated in module DJ 4 LB 003. The video carrier will then be available at 434.25 MHz, and the sound carrier at 439.75 MHz.

The monitor circuit DJ 4 LB 005 is used to demodulate the UHF signal to obtain the composite video signal for monitoring purposes, since this allows the actual transmitted UHF signal to be monitored and not just the input video signal.

1.3. SIDEBAND SUPPRESSION

A residual sideband filter can be connected between the video IF output and the input of the mixer. The sound IF bypasses the filter and is added in the output stage.

It is recommended that a residual sideband filter with switchable bandpass characteristics be used that is combined with the receive portion. Due to the adjustable bandwidth, which is reduced with respect to that given in the CCIR television standard and by use of separate traps, it is possible for a 70 cm FM repeater to be used simultaneously.

The transmit frequencies of the active and planned 70 cm repeaters in the range of 438.6 MHz and 439.1 MHz results in video frequencies in the range of 4.35 MHz to 4.85 MHz after beating with the TV video carrier. However, they can be suppressed by decreasing the bandwidth without noticeable loss of resolution (1).

It is also possible for TV transmissions to be made without residual sideband filter since the frequency plan used for the sound carrier frequency does not cause a second sound carrier to be transmitted outside of the 70 cm amateur band, e.g. at 428.75 MHz. This image frequency will only appear when a sound subcarrier of 5.5 MHz is modulated to the video IF frequency.

In addition to this, the frequency conversion and amplifier circuits of module DJ 4 LB 004 and the subsequent amplifier stages (e.g. with tubes EC 8020, 2 C 39) will noticeably suppress the lower sidebands when tuned to a frequency between the video and sound carrier due to the limited bandwidth. Experiments at the receive end has shown that only a very low portion of the radiated frequency spectrum is transmitted in the voice portion of the 70 cm band (432.1 MHz to 433.5 MHz).

1.4. OPERATING VOLTAGE, OUTPUT POWER

All modules are designed for an operating voltage of 12 V (11 V to 13 V). An output power of approximately 100 mW composite video and sound signal is available for feeding a 70 cm antenna or for driving a linear amplifier.

1.5. MECHANICAL CONSTRUCTION

All modules are built up on single-coated PC boards. The dimensions of modules DJ 4 LB 001 to 004 are 135 mm x 50 mm, and are suitable for installation into a TEKO box size 4B. Printed circuit board DJ 4 LB 005 is only 60 mm x 50 mm and fits into a TEKO-2B box.

The modular construction in individual metal boxes ensures correct operation and avoids RF injection from the transmitter.

2. VIDEO IF MODULE DJ 4 LB 001

As can be seen in the block diagram of module DJ 4 LB 001 given in Figure 2, the video intermediate frequency is generated in a crystal-controlled oscillator. This ensures a high frequency stability and ensures that the video carrier fre-

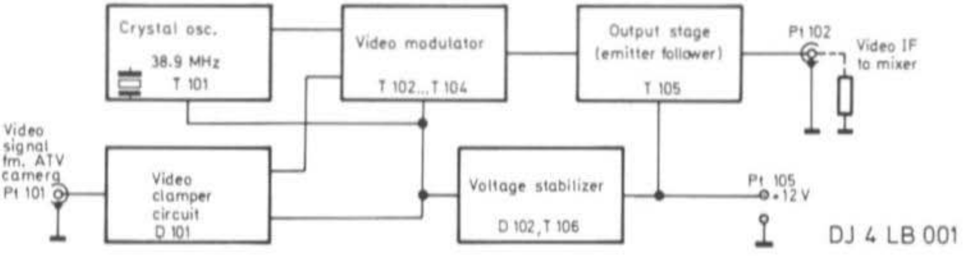


Fig. 2: Block diagram of the video-IF module DJ 4 LB 001

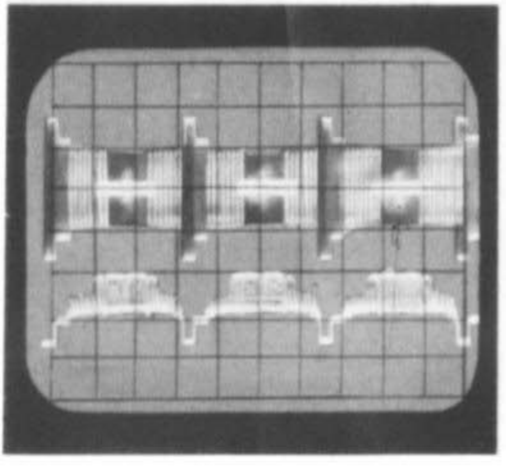


Fig. 3: IF envelope (above) and composite video signal (below)

quency is not affected by the modulation. The amplitude modulator circuit has been especially designed for composite video signals. It differs from conventional AF modulators in that its frequency bandwidth is from approximately 20 Hz to 6 MHz and that the negative modulation is made with the aid of a clamping circuit. The reasons for using negative amplitude modulation were mentioned in (1). With negative modulation, the lower the modulation level, the greater will be the output carrier level, and vice versa. The peak output power

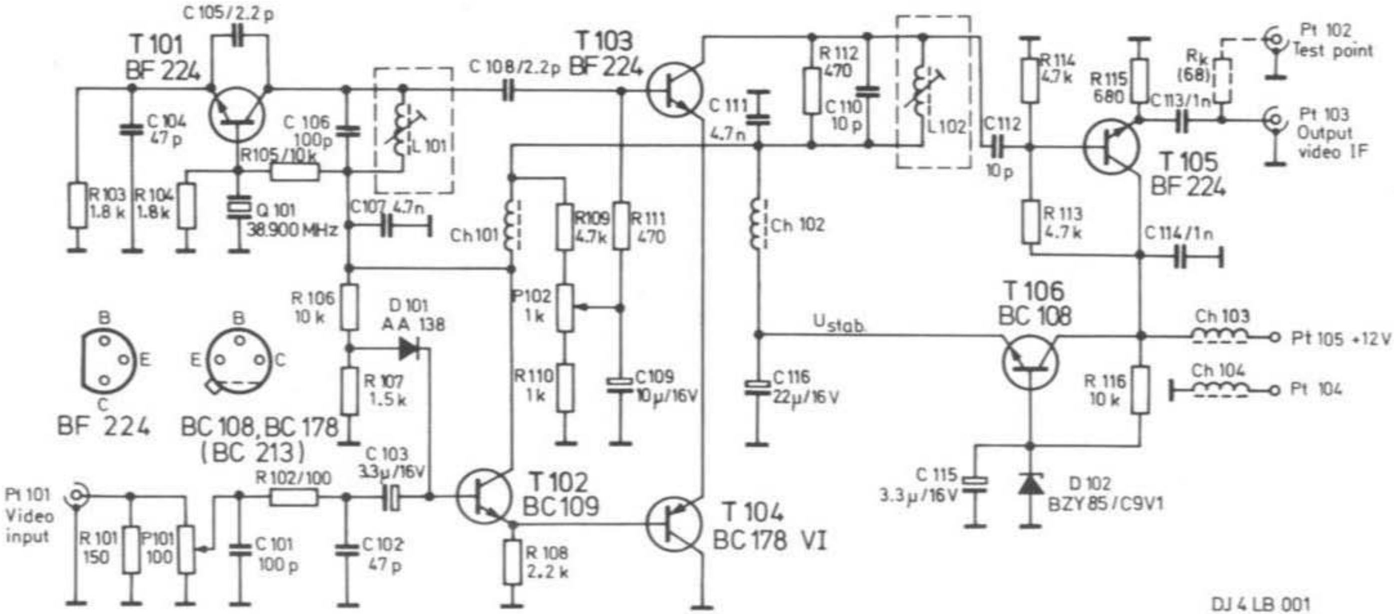


Fig. 4: Circuit diagram of the video IF module DJ 4 LB 001

of the video carrier signal is present when no video modulation is fed to the transmitter, and not the mean value as would be the case during voice transmissions. Figure 3 shows a photograph of the IF-envelope (38.9 MHz) as well as the composite video signal (below).

2.1. CIRCUIT DETAILS

The circuit diagram of module DJ 4 LB 001 is given in Figure 4. The overtone crystal oscillator (T 101) operates at 38.9 MHz. The oscillator is loosely coupled to the amplifier stage (T 103) via the low capacitance of C 108. The emitter of the amplifier stage T 103 is modulated with the video signal. Trimmer potentiometer P 102 adjusts the operating point of the amplifier stage by varying the base bias voltage and can therefore be used for adjusting the IF output voltage. The subsequent IF resonant circuit comprising L 102/C 110 is dampened by resistor R 112 in order to achieve the required bandwidth.

2.1.1. OUTPUT STAGE

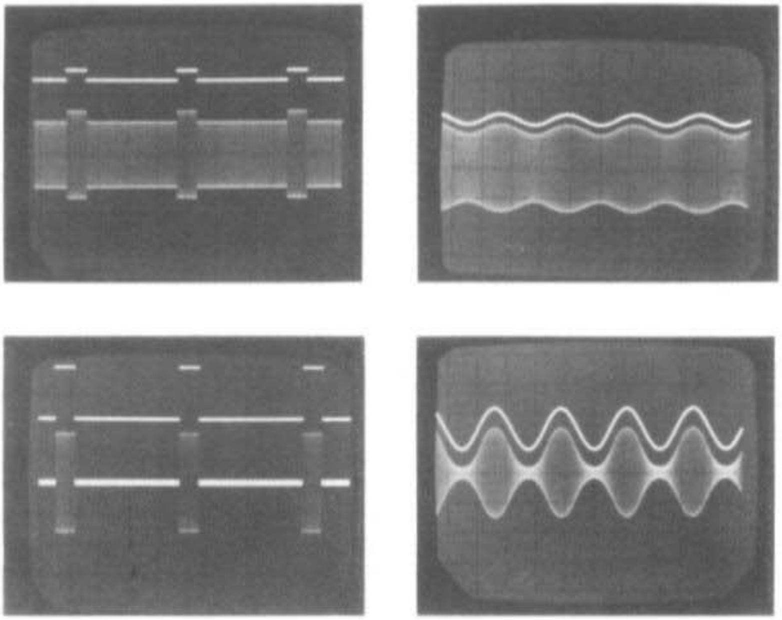
The modulated IF voltage is fed via coupling capacitor C 112 to the impedance converter transistor T 105. The selected dimensioning allows RF signals of up to approximately 0.9 V (peak-to-peak) to be fed to a 60 Ω load without flat-topping. An IF voltage of between 0.3 V and 0.6 V (peak-to-peak) should be available at the output connection Pt 103 which is fed to the mixer module DJ 4 LB 004 with the aid of a coaxial cable. The injection or extraction of IF signals is possible over resistor R_c. When no residual sideband filter is to be used, the sound IF voltage from module DJ 4 LB 002 can be injected at test point Pt 102.

2.1.2. INPUT CIRCUIT FOR THE COMPOSITE VIDEO SIGNAL

The composite video signal from the television camera or a pattern generator (2) is fed to the input connection Pt 101. The parallel connection of P 101 and R 101 forms an input impedance of 60 Ω. Potentiometer P 101 allows the input voltage of the modulator to be adjusted and thus the depth of modulation. A lowpass filter comprising components C 101, R 102 and C 102 suppress any RF signals picked up between the composite video input and the modulator.

2.1.3. CLAMPER CIRCUIT

A constant, positive bias voltage is fed from the voltage divider R 106/R 107 to the base of transistor T 102. The clamper diode D 101 ensures, in conjunction with C 103, that the base voltage of T 102 is only driven into the positive voltage range. Diode D 101 will conduct when any negative modulation pulses are present and the forward current will charge C 103 until the original, positive bias voltage is obtained. The negative-going synchronizing pulses of the composite video signal are therefore based on this bias voltage and are clamped to a constant value. The base voltage of transistor T 102 has a direct relation to the IF level due to the DC coupling to transistor T 103. This means that the clamper circuit ensures that the synchronizing pulses always possess the same peak-to-peak value in the IF-envelope independent of whether the total composite video signal has a value of 0.5 V (black image) or 1.4 V (white image). The oscilloscope traces given in Fig. 5a/b and Fig. 6a/b show the operation of the clamping circuit in the presence of squarewave, and sinusoidal modulating signals. This means that the ATV transmitter radiates synchronizing pulses of the same power level which are virtually independent of the level of the video signal.



Figs. 5 and 6: Operation of the clamping circuit

2.1.4. NEGATIVE MODULATION

The series connection of transistors T 103 and T 104 is fed from the impedance converter T 102 with the clamped modulation signal. A high base voltage at T 104 will have the effect of a low current in the series circuit and thus a low IF output level, and vice versa. This circuit provides the negative modulation so that the IF envelope signal is obtained from the composite video signal.

The interconnection of the emitters of T 103 and T 104 is at IF voltage, since no bypass capacitors are provided. The differential resistance of transistor T 104 (RF feedback) is thus operative during the modulation process and linearizes the modulation characteristic.

2.1.5. VOLTAGE STABILIZATION

Due to the high value of the base bias resistor T 116, the simple voltage stabilizer circuit (T 106, D 102) is capable of being short-circuited. Capacitor C 115 suppresses any noise voltage generated by the zener diode which can occur, especially, at low currents. The stabilized voltage is used for feeding the crystal oscillator and modulator stages. The adjusted value will remain even when connecting to different operating voltages.

2.2. CONSTRUCTION

As has been previously mentioned, this module is accommodated on a single-coated PC-board whose dimensions are 135 mm by 50 mm. The PC-board for the video IF module is designated DJ 4 LB 001; it can be accommodated in a

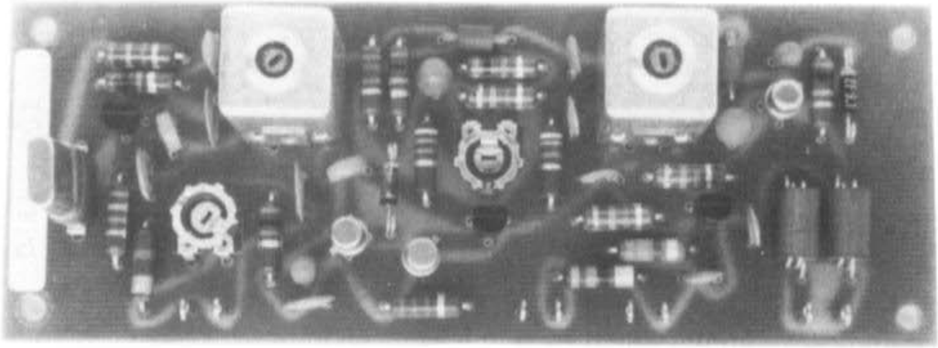


Fig. 7: Prototype module DJ 4 LB 001

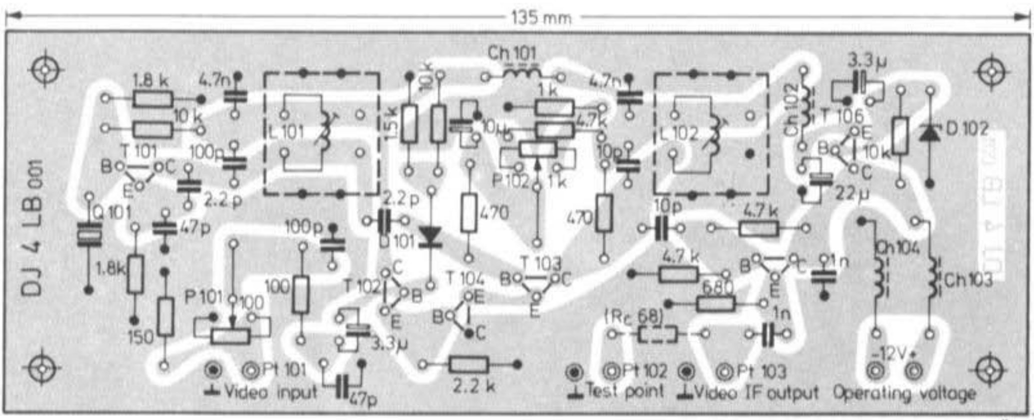


Fig. 8: PC-board and component locations of DJ 4 LB 001

TEKO-box size 4B. It has been necessary to use the higher boxes due to the height of the screening cans. The PC-board can be mounted with the aid of screws using spacing bushings or nuts in order to obtain a spacing of approx. 5 mm to the base of the box. As can be seen from the photograph of the prototype given in Figure 7, all connection pins are located on the long side of the printed circuit board. After installation into the TEKO-box, sufficient room is provided on this side for plug-in connections and/or coaxial connectors and feedthrough capacitors. The PC-board and the component locations are shown in Figure 8. Sufficient room is given on the PC-board so that even older, larger capacitors and resistors can be used.

2.2.1. SPECIAL COMPONENTS

T 101: BF 224, BF 173
T 102: BC 109, BC 184 or similar
T 103: BF 224, BF 173
T 104: BC 178 VI, BC 213 (PNP)

T 105: BF 224, BF 173
T 106: BC 108 or similar
D 101: AA 138, AA 112, AA 116 germanium diode
D 102: BZY 85/C9V1 (9.1 V zener diode)

L 101: 5.75 turns of 0.8 mm dia. (20 AWG) silver-plated copper wire wound on a 5 mm dia. coilformer, coil length 8 mm, facing the collector side of the PC-board. Special coil kit.

L 102: 13.75 turns of 0.3 mm dia. (29 AWG) enamelled copper wire close-wound, otherwise as L 101.

Ch 101, Ch 102: Ferrite bead on insulated wire.
Ch 103, Ch 104: Ferrite choke Z = 800 Ω (6-hole ferrite core, 6 mm dia., 10 mm long, Philips 4321 020 36700)

Crystal: 38.900 MHz HC-25/U with holder (vertical) or HC-6/U without holder.

Trimmer potentiometer: For horizontal mounting, spacing 5 mm/10 mm.

A spacing of 12.5 mm is available for all resistors.

All electrolytic capacitors: Tantalium drop types for 2.5 mm spacing.

All other capacitors: Ceramic disc types for 5 mm spacing.

2.3. ALIGNMENT OF MODULE DJ 4 LB 001

The coarse alignment is made without composite video signal. Potentiometer P 102 should now be adjusted to its fully right stop in order to obtain the highest base bias voltage for transistor T 103. The crystal oscillator is designed so that it is not able to oscillate at any other frequency than the resonant frequency of the crystal. The core of L 101 is now slowly rotated from its fully inserted position until the oscillator commences oscillation and the IF-voltage can be measured at connection Pt 103. After the point of maximum IF-voltage has been found, the core should be rotated slightly more out of the coil for reasons of stability until the IF output falls to 70% to 50% of the maximum value. After this, L 102 should be aligned for maximum IF-voltage output. Due to the damping of the circuit, the resonance will not be very sharp. Potentiometer P 102 should now be adjusted to a range by which the IF output voltage is reduced when the potentiometer is rotated in an anticlockwise direction (towards a lower base voltage). The fine alignment is made with the aid of a composite video signal from a TV-camera. Potentiometer P 101 is firstly placed in its centre position. The IF output voltage can be injected into the last IF amplifier of a TV-receiver if a test demodulator is not available. If the image is distorted, this will probably be caused by compressed or clipped synchronizing pulses. The operating point of the modulator is adjusted with potentiometer P 102 until no distortion of the image is noticeable. Since good TV-receivers will provide perfect images even when the synchronizing pulses are distorted, attention should be paid to the reproduction of the various grey tones of the test signal. If the various monochrome values cannot be differentiated as far as the brightness is concerned, this will mean that the modulation signal (which can be adjusted with potentiometer P 101) is still too great.

3. SOUND IF MODULE DJ 4 LB 002

As can be seen in the block diagram given in Figure 9, module DJ 4 LB 002 consists of the IF sound carrier oscillator and the preamplifier/dynamic compressor for frequency modulation of this oscillator. The combining of these two units to form one module avoids any difficulties that could occur when using an external preamplifier whose behaviour, for instance, with respect to the frequency response or rejection of UHF signals may not be known. A dynamic compressor is provided in the preamplifier in order to compensate for audio voltage fluctuations so that a virtually constant frequency deviation of the sound signal is obtained.

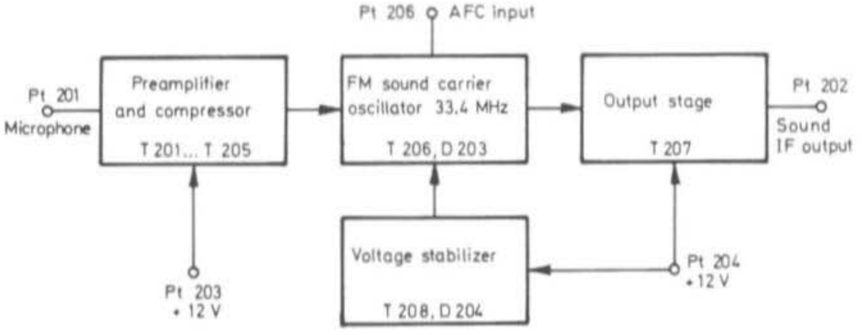


Fig. 9: Block diagram of the sound-IF module DJ 4 LB 002

3.1. CIRCUIT DETAILS

The circuit diagram of this module is given in Figure 10. The operation of this module is now to be explained step for step.

3.1.1. PREAMPLIFIER

The preamplifier comprising transistor T 201 is designed for low-impedance, dynamic microphones of approximately 200 to 500 Ω. The output voltage of this transistor is fed via R 206, C 209 and C 210 to the high impedance input of a three-stage amplifier. The operating point of the DC-coupled transistors T 203, T 204 and T 205 is stabilized via a feedback link comprising R 214, C 211 and R 211.

3.1.2. MEASURES TAKEN AGAINST UHF INTERFERENCE

A combination of UHF-chokes, feedback and short-circuit paths (Ch 201, C 203, C 204) ensure that any UHF voltages are not amplified and demodulated. The $\lambda/4$ choke Ch 202 in the emitter lead of transistor T 203 operates as feedback for UHF voltages which would otherwise affect the amplifier due to the high transit frequency of the silicon AF transistors used.

3.1.3. DYNAMIC COMPRESSION

A positive control voltage is obtained from the AF voltage at the collector of transistor T 205 by rectification in the voltage doubler circuit comprising diodes D 201 and D 202. This influences the internal impedance of transistor T 202 which forms a AF-voltage divider together with resistor R 206. The control voltage will increase with increasing AF output voltage. As soon as the forward voltage of the base emitter diode of T 202 is reached, base current will commence flowing and the collector-emitter path of this transistor will represent a low resistance. Due to the voltage division, the AF level at the collector of T 202 and thus at the input of the subsequent amplifier stage will fall. The filter link comprising C 208, R 207 and C 207 ensures that the amplifier does not break into oscillation and also has an effect on the time constant of the control circuit which is extraordinary short (approx. 100 ms).

The dynamic compression reduces voltage differences having a ratio of 1 to 100 (0.2 mV to 20 mV) at the input to a ratio of approximately 1 to 2.5 at the output of the amplifier.

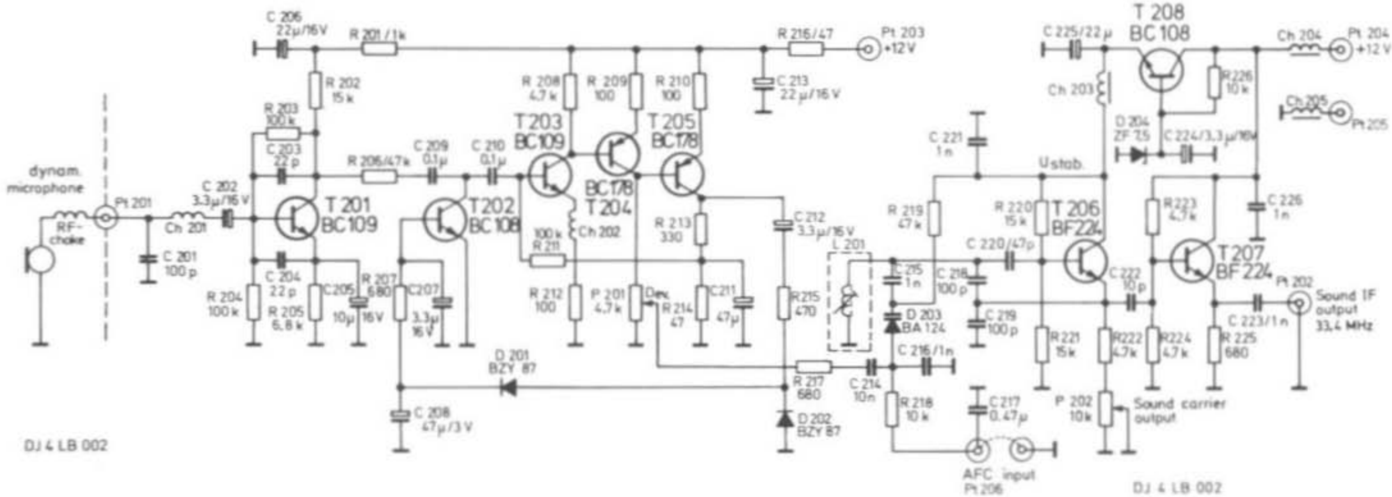


Fig. 10: Circuit diagram of the sound-IF module DJ 4 LB 002

3.1.4. AF OUTPUT, FREQUENCY DEVIATION ADJUSTMENT

The AF output voltage of transistor T 205 is not used for modulation since distortion would occur due to the loading of the rectifier path. A virtually constant, and low-distortion AF signal for frequency modulation of the sound carrier oscillator is provided by the previous transistor T 204. The AF output voltage and thus the frequency deviation can be adjusted on the collector resistor of T 204, which is in the form of a potentiometer (P 201).

3.1.5. PREEMPHASIS

The preemphasis of the AF signal has been standardized to correspond to a CR-link with a time constant of 50 μs (e.g. 5 nF/10 kΩ). In the case of the described preamplifier, the bass reduction (mainly caused by the relatively low capacitance of C 211 in the feedback path) forms, in conjunction with the CR-link C 214/R 218 the standardized preemphasis up to modulation frequencies of approximately 7 kHz. If a correction of the frequency response is required due to the effect of the microphone type (speech or music microphone), this can be obtained by varying the value of the coupling capacitor C 214 to values of between 5 nF and 0.1 μF.

3.1.6. SOUND IF OSCILLATOR

The oscillator comprising transistor T 206 generates the sound IF of 33.4 MHz. The feedback is made from the emitter at the interconnection of C 218 and C 219, whose series connection represents approximately half the circuit capacitance of the IF resonant circuit comprising inductance L 201. The other half is formed by the varactor diode D 203, which is used for frequency modulation of the oscillator.

3.1.7. FREQUENCY MODULATION

The modulation characteristics shown in Figure 11 indicate the virtually linear relationship between the DC-voltage across the varactor diode and the oscillator frequency. It will be seen that an AF-voltage of approximately 0.3 V (peak-to-peak) is required for a frequency deviation of $\pm$ 40 kHz.

3.1.8. AUTOMATIC FREQUENCY CONTROL (AFC)

An AFC-voltage can be fed to connection Pt 206. The effect of this voltage is also given in Figure 11. The AFC-voltage of a 5.5 MHz ratio detector ensures that the frequency of the sound IF oscillator remains exactly 5.5 MHz from the crystal-controlled video IF signal. When the transmitter is to be operated without AFC, connection Pt 206 should be grounded, and the AFC filter capacitor C 217 will not be required.

3.1.9. OUTPUT POWER OF THE SOUND IF MODULE

The emitter current of the oscillator transistor is adjusted by potentiometer P 202 and allows adjustment of the IF output voltage. A voltage ratio of more than 1 to 3 is obtained (approx. 0.2 V to 0.7 V peak-to-peak) which represents a power ratio of approximately 1 to 10. This means that the output power of the sound IF can be adjusted to form the correct relationship to that of the video signal. This can be very useful when aligning the transmitter. The normal power relationship between the video and sound carrier is 10 to 1.

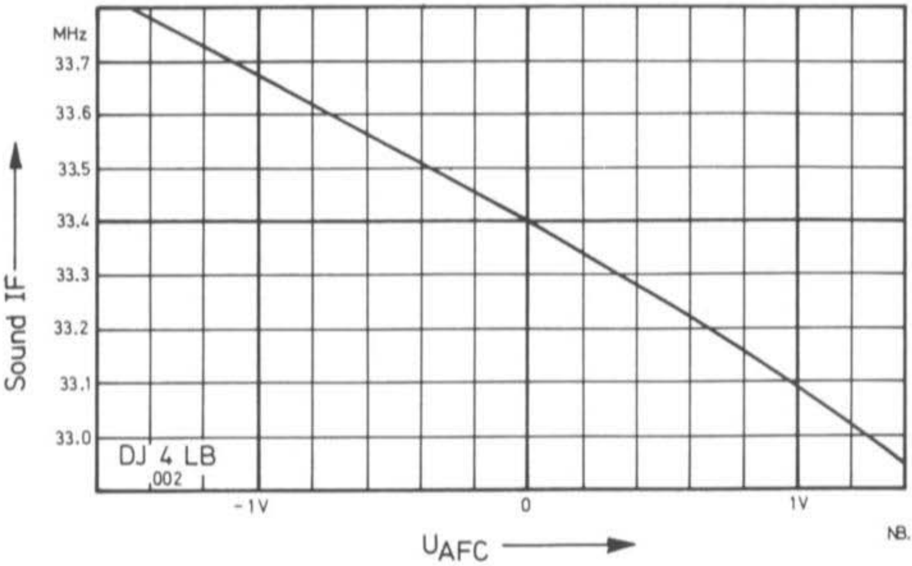


Fig. 11: Frequency of the sound-IF oscillator as a function of the voltage at Pt 206

3.1.10 OUTPUT COUPLING, VOLTAGE STABILIZATION

The sound IF signal present at the emitter of transistor T 206 possesses a very low harmonic content. It is fed via C 222 to the emitter follower T 207. The same is valid for the output coupling and voltage stabilization (T 208, D 204) as was given for module DJ 4 LB 001.

3.2. CONSTRUCTION OF DJ 4 LB 002

This module is also built up on a single-coated PC-board whose dimensions are 135 mm by 50 mm. This board has been designated DJ 4 LB 002. The same construction is valid for this module as was given for the installation of DJ 4 LB 001 in a TEKO-box size 4B. In order to avoid interference due to RF-injection, special attention must be paid that good connections exist bet-

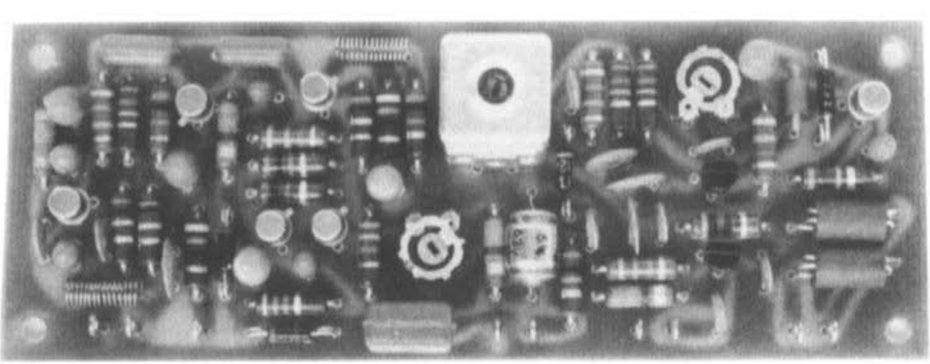


Fig. 12: Prototype of module DJ 4 LB 002

ween the four mounting points of the PC-board and the metal box. It is necessary for the protective coating of the board to be removed by soldering at these points. The microphone connector and coaxial output socket should be mounted as near as possible to the appropriate connection point on the PC-board and fed out single-ended in order to avoid interconnection via the ground connections. In the case of the microphone connection, a $\lambda/4$ choke (similar to Ch 201) is provided for making this connection. Figure 12 shows a photograph of the prototype, Figure 13 the printed circuit board together with component locations.

3.2.1. SPECIAL COMPONENTS

T 201, T 203: BC 109 or similar low-noise AF transistor
T 202, T 208: BC 108 or similar
T 204, T 205: BC 178, BC 213 or similar (silicon PNP)
T 206, T 207: BF 224, BF 173

D 201, D 202: BZY 87 (1 N 4148 can be used, but provides inferior dynamic compression)
D 203: BA 124 (approx. 50 pF at 2 V)
D 204: BZY 85/C7V5, ZF 7.5 (7.5 V zener diode)

L 201: 7.75 turns of 0.8 mm dia. (20 AWG) silver-plated copper wire wound on a 5 mm coilformer, coil length approx. 10 mm facing away from the ground end of the PC-board. Special coil set available.

Ch 201, Ch 202: Approx. 18 cm of 0.4 mm dia. (26 AWG) enamelled copper wire wound on a 3 mm former, coil length approx. 10 mm, self-supporting.
Ch 203: Ferrite bead on insulated wire.
Ch 204, Ch 205: Wideband ferrite chokes Z = 800 Ω (6-hole core, 6 mm dia., 10 mm long, Philips 4312 020 36700).

Trimmer potentiometer: For horizontal mounting, spacing 5 mm/10 mm.

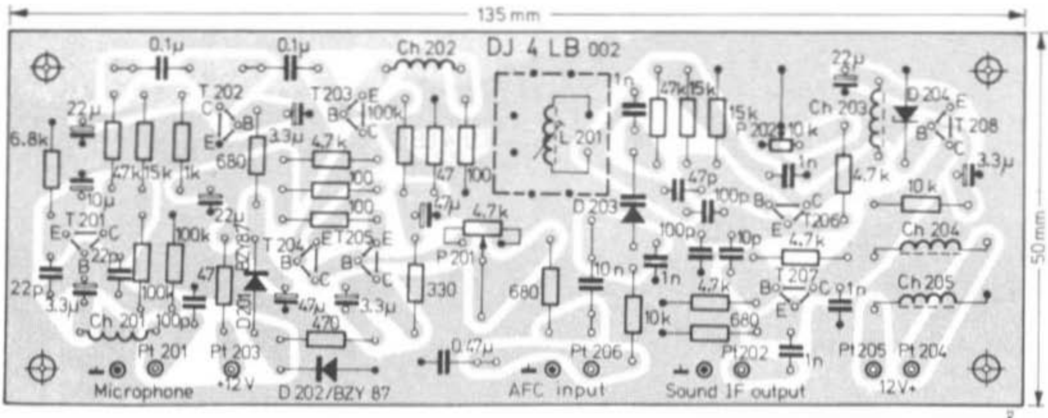


Fig. 13: PC-board and component locations of the sound IF module

A spacing of 12.5 mm is available for all resistors.
All electrolytic capacitors: Tantalium drop types for 2.5 mm spacing.
All capacitors up to and including 1 nF: ceramic disc types for 5 mm spacing.

C 209, C 210: 0.1 μF plastic-foil capacitors, spacing 7.5 mm or 10 mm.
C 214: 10 nF or other value (see text), styroflex, length up to 15 mm.
C 217: 0.47 μF plastic foil capacitor, spacing 7.5 mm or 10 mm.

3.3. CONNECTION AND ALIGNMENT

The preamplifier can be checked in a simple manner by connecting earphones via a capacitor between the collector of T 205 and ground.

The sound IF voltage is checked at connection Pt 202. The maximum output voltage should be obtained in the fully clockwise position of P 202 (wiper at the hot end). The core of inductance L 201 should be coarsely adjusted to the frequency of 33.4 MHz. A fine alignment can be made after connection of the other modules by monitoring on a television receiver.

The modules DJ 4 LB 003, 004 and 005 are to be described in the next edition of VHF COMMUNICATIONS.

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VHF COMMUNICATIONS 4 (1972), Edition 3, Pages 184-190

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to be described in one of the next editions of VHF COMMUNICATIONS.

RECOMMENDED MODIFICATIONS TO THE CALIBRATION SPECTRUM GENERATOR

by D. E. Schmitzer, DJ 4 BG

Two possibilities of modifying the calibration spectrum generator module DJ 4 BG 004 are to be given:

1. IMPROVING THE DRIVE FOR THE FIRST FREQUENCY DIVIDER

It has been noted a few times that the first frequency divider of module DJ 4 BG 004 (IC 3 in Fig. 3 of (1)) does not divide correctly inspite of the fact that the oscillator is operative. The cause of this is that the decade counters type SN 7490 N used in the frequency dividers are now able to operate at higher frequencies, but require steeper pulses to drive them. This can be achieved in two ways: The voltage at connection 3 of gate 1a is not completely square-wave and the edges are not quite as steep as would be provided by the gate when operating at a switch. On the other hand, the voltage decoupled via gate 1c possesses steeper slopes. The drive signal for IC 3 should therefore be taken from the output of gate 1c instead of from the input. To do this, it is necessary to disconnect the interconnection from pin 3 of IC 1 (to pin 14 of IC 3 on the component side, commencing at resistor R 2) and to connect pin 14 of IC 3 via a bridge to pin 8 of IC 1. However, the disadvantage of this is that this point has an external connection which means that the steepness of the impulses can be effected by external capacitances (e.g. by the screened lead to module DJ 4 BG 010).

The second possibility is for the quadruple NAND-gate IC 1 (SN 7400 N) to be replaced by the quadruple NAND-Schmitt-trigger SN 74132. The pins of both ICs are identical, however, the Schmitt-trigger provides steeper output pulses. In this case, no modifications to the PC-board are necessary. It is not known whether the use of this IC-type has a positive or negative effect on the oscillator circuit which has sometimes been found to not commence oscillation readily. We would therefore like to hear of the results obtained in this manner.

2. 25 kHz CALIBRATION MARKERS

A slight modification to module DJ 4 BG 004 can be made so that 25 kHz calibration lines are provided, which are very advantageous now that a 25 kHz spacing has been agreed for FM transmissions in Europe.

If the conductor lane to pin 14 of IC 7 is disconnected on the component side and this point connected via a bridge to pin 12 of IC 6 instead of to pin 11, this will mean that the frequency divider IC 7 is no longer driven with 10 kHz but with 50 kHz, and will provide output signals of 25 kHz via gate 8a and 5 kHz (Pt 10) as before, however, Pt 11 will now provide the output signal of 25 kHz and Pt 12 a signal of 5 kHz. Since spectral lines of 1 kHz are very seldom used, this modification should provide a more favourable and useful combination than the original circuit.

3. REFERENCES

D. E. Schmitzer: A Digital Calibration-Spectrum Generator
VHF COMMUNICATIONS 3 (1971), Edition 4, Pages 194-205

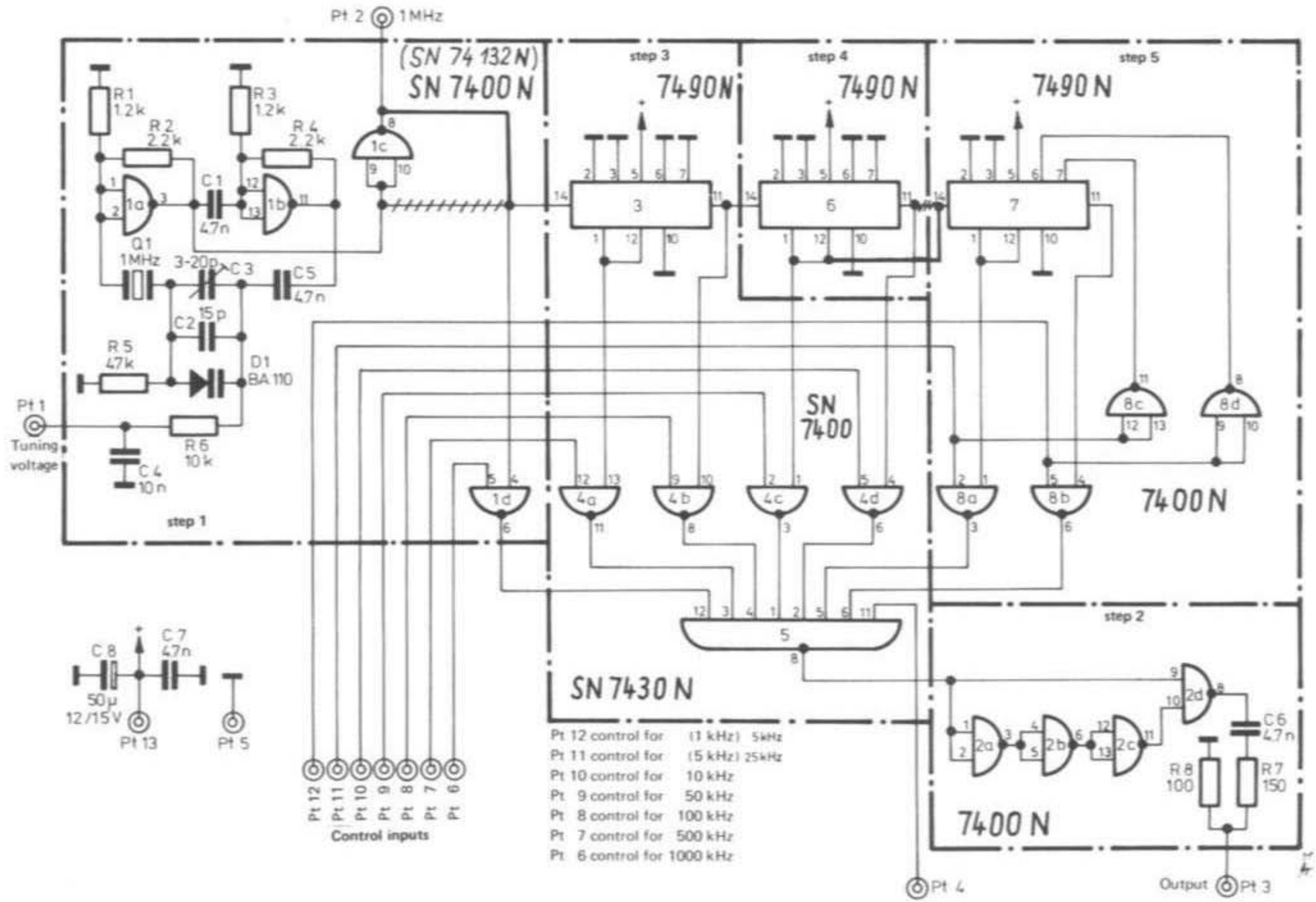

Fig. 1: Circuit diagram of the calibration-spectrum generator with modifications

VHF TRANSEQUATORIAL PROPAGATION
Part 2

by Roger Lenned Harrison, VK 2 ZTB

12. CLASS II TEP-CAUSES AND CHARACTERISTICS

The characteristics of Class II, or evening-type TEP, are generally well known, but the mode of propagation is not yet known or completely defined. Several different explanations have been put forward based on the correlation observed between night-time TEP-observations and the occurrence of equatorial spread-F (7), (11), (14). Experimental results, when applied to the various theories, have shown them to be incorrect, but it is well established that there is some definite connection between spread-F along the paths considered and the occurrence of Class II TEP (7), (10), (11), (14).

The higher frequencies propagated by Class II TEP offer some interesting possibilities to the communicator.

There is a maximum occurrence between 2000 and 2300 LMT with a pronounced peak somewhere in this range for different seasons and particular paths. This means that just about every circuit has an individual peak occurrence time for different seasons but it will be somewhere between 2000 and 2300 LMT.

This coincides well with the occurrence of equatorial spread-F but the duration of TEP signals is usually less than the duration of spread-F (7), (10). It has not yet been established why this is so. Class II TEP has been observed to last until the early hours of the morning, but only rarely. The occurrence of Class II TEP openings is greatest during the equinoxes (7), (10-12), (14)as is spread-F - this is more pronounced than in the case of Class I TEP. These openings are fewest during the winter solstice (7), (10), (11), (14) over the magnetic equator, which occurs during December-January for the Asian and African sectors and June-July for the Americas (7).

Start times for openings via Class II TEP are less dependent on path geometry than for Class I TEP as also are the times of duration. Class II is much more tolerant of asymmetrical path geometry than Class I.

Usually contacts are dependent on:

a) Appearance of e q u a t o r i a l spread-F at an appropriate geomagnetic latitude.
b) Season of the year, i.e. proximity to the equinoxes.
c) Sunspot number.

12.1. PATH CHARACTERISTICS

Path lengths for Class I TEP are generally from 3,000 km to 6,000 km (7), (10-12), (14) and terminals are quite often asymmetrically and obliquely situated with regard to the magnetic equator (7), (11). Some very long night-time paths have been observed (7), (11), (16) but these can be explained by the occasional continuance of the Class I TEP mode after sunset (11) or another mode of propagation assisting in extending the range of signals. Again, sporadic-E is likely to be the reflector at the lower end of the VHF range. Tropospheric ducting could extend the range in a similar fashion at the higher frequencies, but little work has been reported in this direction. Nielson mentions Es in this regard in his paper (12).

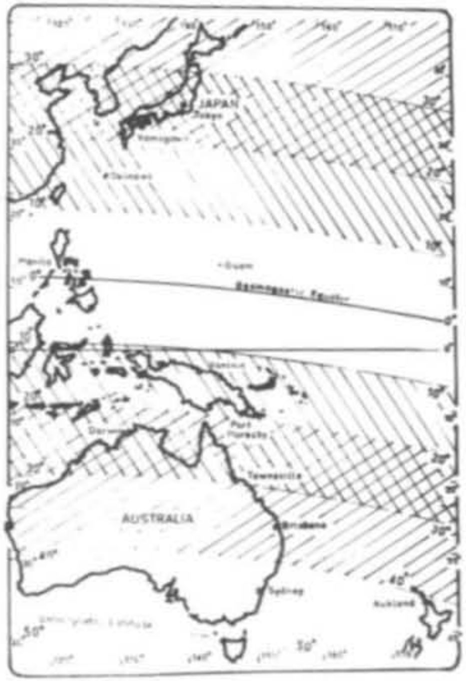

Fig. 2: Australian sector of the world showing terminal zones for class I TEP (20° to 40° geomagnetic latitude) and class II TEP (10° to 30° geomagnetic latitude)

Fig. 3: The American sector of the world showing terminal zones for class I TEP (20° to 40° geomagnetic latitude) and class II TEP (10° to 30° geomagnetic latitude)

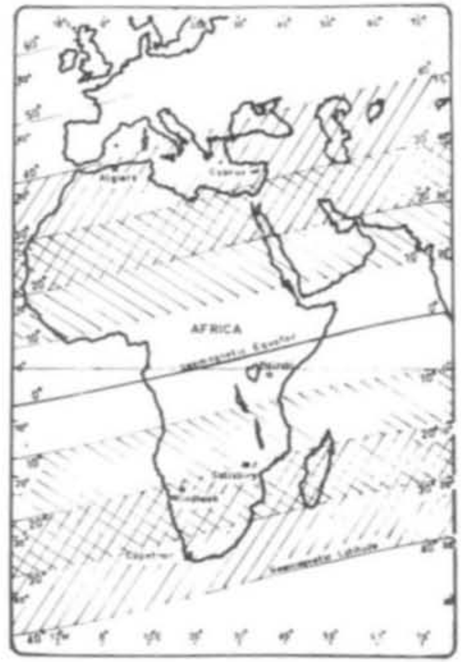

Fig. 4: The African-Mediterranean sector of the world showing terminal zones for class I TEP (20° to 40° geomagnetic latitude) and class II TEP (10° to 30° geomagnetic latitude)

You have probably noticed that the possible, and observed, ranges of the two types of TEP overlap. Thus there is a zone where stations (or circuits) will experience both modes, and zones where stations will only experience one or the other. The area between 20^o and 30^o geomagnetic latitudes (see Figs. 2, 3, 4 (crosshatched to the left)) is common ground for both Class I and II TEP. Stations located in these areas will encounter both modes from time to time with perhaps a gradual transition from Class I to Class II (evidenced by an increase in flutter fading after 2000 hours) or a signal dropout of up to an hour's duration (11).

Stations north and south of about 30^o geomagnetic latitude will tend to see only afternoon-type TEP while those stations closer than about 20^o to the geomagnetic equator will tend to see only evening-type TEP.

The westward movement of contacts via Class II TEP is not generally noted as it is for Class I TEP. The irregularities that occur in the base of the F-layer, are certainly known to move westward, but their longitudinal "spread" is usually considerably wider than for the equatorial anomaly. As Class II TEP appears to depend to a large extent on these irregularities, the westward movement may be masked by their longitudinal width and the tolerance to asymmetrical paths that is noted (11), (14).

12.2. SEASONAL CHARACTERISTICS

There is a marked dependence of Class II TEP on the equinoxes and sunspot number. The same dependence is noted for equatorial spread-F (10-12), (14).

Class II TEP has a maximum number of occurrences which lags the sunspot maximum by a year or so - as is noted for Class I (11), (16). The reasons for this are not yet clear, but further research should elucidate the causal mechanisms.

Similarly to Class I, contacts can be had almost every night around the equinoxes (1), (2), (7), (10), (16) during peak occurrence years. There is a rapid drop off in the number of occurrences after this time, few contacts being noted during the solstices and the years spanning the sunspot minima. Observations carried out using oblique sounders and beacon transmitters also bear this out (10), (12).

12.3. SIGNAL CHARACTERISTICS

The most surprising and exciting aspects of Class II TEP signals are the high frequencies that it will support and the high signal strengths that are recorded.

Beacon transmissions on 102 MHz from Darwin have been recorded in southern Japan on many occasions. But, as yet, there have been no reports of higher frequency signals. No upper frequency limit has been proposed for Class II TEP as the mechanism by which it is reflected or refracted in the ionosphere is not yet known. Here is an opportunity for enterprising Amateurs who would like to try for some exotic DX on 144 MHz - and make a contribution to a body of scientific knowledge on a phenomenon about which we know little. Unfortunately, 144 MHz contacts might have to wait till the next sunspot maximum. But don't let me discourage you from trying.

Generally speaking, high signal strengths are experienced having a considerable amount of flutter. The flutter rate is mostly between 5 and 15 Hz and a power spectral density graph shows that Doppler shift is mainly between ±40 Hz. This means that, at times, A3 (DSB or SSB) signals will be seriously degraded (12). The effect on wideband systems (FM or PM) would be much less, but TV would suffer owing to the spread of time delays experienced (12).

Paths whose terminals are magnetic conjugates (have the same angle of magnetic dip but the opposite sense, i.e. 25° N and 25° S) experience the higher frequencies more often and with greater reliability. The signal strength for these paths is higher than for the less favourable asymmetric paths and path lengths are generally shorter.

As Class II TEP is probably supported in some way by field guided ionisation (12), the closer a ray can be launched to tangency with the magnetic field, the more favourable are its characteristics, i.e. higher frequencies will be supported, higher signal strengths will be guaranteed and greater reliability will be obtained than for less favourable rays.

Many people refer to Class II TEP as transequatorial scatter. This quite wrong for a number of reasons. Scatter propagation involves incoherent reflection from tropospheric or ionospheric irregularities. Signal strengths are weak and have a considerable flutter component. Transmitted and received angles of elevation from the ground are much greater than for a field guided mode and signals are not necessarily received over a great circle route. Ranges for scatter propagation are much less than for Class II TEP. It appears that the considerable flutter component often observed on evening-type TEP leads to a confusion involving the modes of propagation. Class II TEP is dependent on many factors (season, sunspots, geomagnetic latitude, etc.) that seem to have no bearing on true scatter modes.

13. CURRENT RESEARCH

The Ionospheric Prediction Service Division is currently conducting research into TEP, particularly the evening-type or Class II. Equipment is being set up to examine the signal characteristics of VHF beacons located in Japan and Korea as part of this research which is aimed at elucidating the propagation mechanism of evening-type TEP and eventually predicting its occurrence. The ionosonde located at Vanimo, New Guinea, is ideally situated to study the equatorial ionosphere. It will be equipped with an interferometer system to assist in studying the irregularities that cause spread-F. It is hoped that, by September 1972, experimental short-term TEP warnings broadcast on an HF transmitter will be operative, giving 30 to 40 minute warnings of possible openings.

13.1. THE AMATEURS CAN HELP

Reports of TEP from Amateurs and other observers are welcome and should be sent to:

Mr. Roger Harrison,
Amateur Observer's Reports
Ionospheric Prediction Service Div.,
162-166 Goulburn Street,
Darlinghurst, N.S.W., 2010
Australia

Reports should contain as much of the following information as possible:

a) Date.
b) Time (note whether local or GMT).
c) Frequency or band.
d) Signal strength.
e) Fading characteristics.
f) Location of your station and call sign (with location if possible) of stations heard or worked.
g) Other observations, i.e. was sporadic-E noticed at the time; if so, to what areas? Did the signals start in one area and move to another or not? When were signals first noticed and when did they disappear?

Printed report forms for the assistance of observers can be obtained from me at the above address.

Eventually, it is hoped that TEP will be included in the normal predictions issued by I. P. S. D.

14. CONCLUSION

Armed with this information, and making reference to the maps in Figs. 2, 3 and 4, any keen VHF man in the right location can work some quite exotic DX.

Relatively simple equipment gives good results with TEP, most people, who have worked this mode, running less than 20 watts input. Antenna requirements are also minimal; many people using a 3 or 4 element Yagi and some only a dipole or ground-plane antenna.

Run-of-the-mill receiving set-ups involving a converter to tuneable IF or converted carphone give good results as signals are usually quite strong. AM, FM, PM, DSB, SSB, CW or FSK (RTTY) can be used with the advantage going to CW, SSB and FM or PM.

Predicting TEP on a daily basis is not yet possible, but keeping a watch on a suitable located beacon will indicate when the band is open. When the I. P. S. D. TEP warning service comes into being a powerful tool will be available to assist Amateurs (and others) in taking advantage of the existing possibilities afforded by Class II TEP.

Suitable beacons are generally listed in various Amateur journals ("QST", "Amateur Radio" etc.) but a suitable beacon service is not available in many places. Perhaps this could be investigated by the Amateur Societies in the areas where such a service does not exist.

14.1. ACKNOWLEDGMENT

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The publishers would also like to thank the Amateur Radio Magazine for their assistance in obtaining permission for VHF COMMUNICATIONS to publish this interesting article.

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A SHORTWAVE RECEIVER MODULE FOR USE WITH VHF CONVERTERS OR FOR DIRECT RECEPTION UP TO 70 MHz

by D. E. Schmitzer, DJ 4 BG

INTRODUCTION

The shortwave receiver to be described exhibits a high intermodulation and cross modulation rejection and high sensitivity. It is designed for use in the TEKO modular system described in (1), but it is just as suitable for reception of any single shortwave amateur band between 3.5 MHz and 70 MHz. Both a narrow-band version for just coverage of a limited part of the band, e.g. CW-band, or a wideband version to cover the whole of the amateur band in question are given. Details are also given for dimensioning the receiver for each of the amateur bands. Figure 1 gives a block diagram of a possible combination for an FM/SSB/CW receiver either for VHF or one of the shortwave bands.

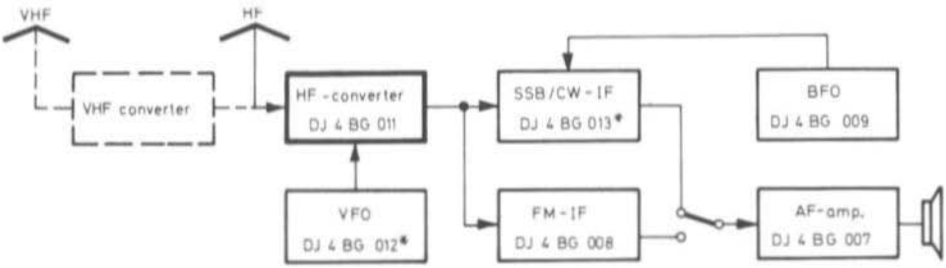

Fig. 1: Block diagram of a single band receiver using the modular system. + Modules in preparation

If several shortwave bands are to be received, it will be necessary for several such receiver modules to be constructed since it has not be designed as a switchable receiver for several amateur bands. The main application for which the author designed the receiver was for reception of VHF and UHF signals in conjunction with a suitable converter. The direct use of this module for two and four metres will be discussed in section 6.

1. CIRCUIT DESCRIPTION

Figure 2 gives the circuit diagram of the receiver module, which comprises RF-preamplifier, mixer, crystal filter and IF-preamplifier.

1.1. RF-PREAMPLIFIER

The input stage is equipped with a diode-protected dual-gate MOSFET and is dimensioned for an input impedance of 50 to 60 Ω. This stage is, however, not power-matched, since it would be necessary to considerably increase the input voltage if the 60 Ω input impedance was to be matched to the input impedance of the MOSFET, which is extremely high in the shortwave region. This increase of the input voltage would in turn most probably cause intermodulation problems and effect the large-signal characteristics of the receiver. For this reason, it is necessary to keep the gain between the antenna input and the mixer stage as low as possible including the increase of voltage caused by transformation in the resonant circuits. The limits are given by the required

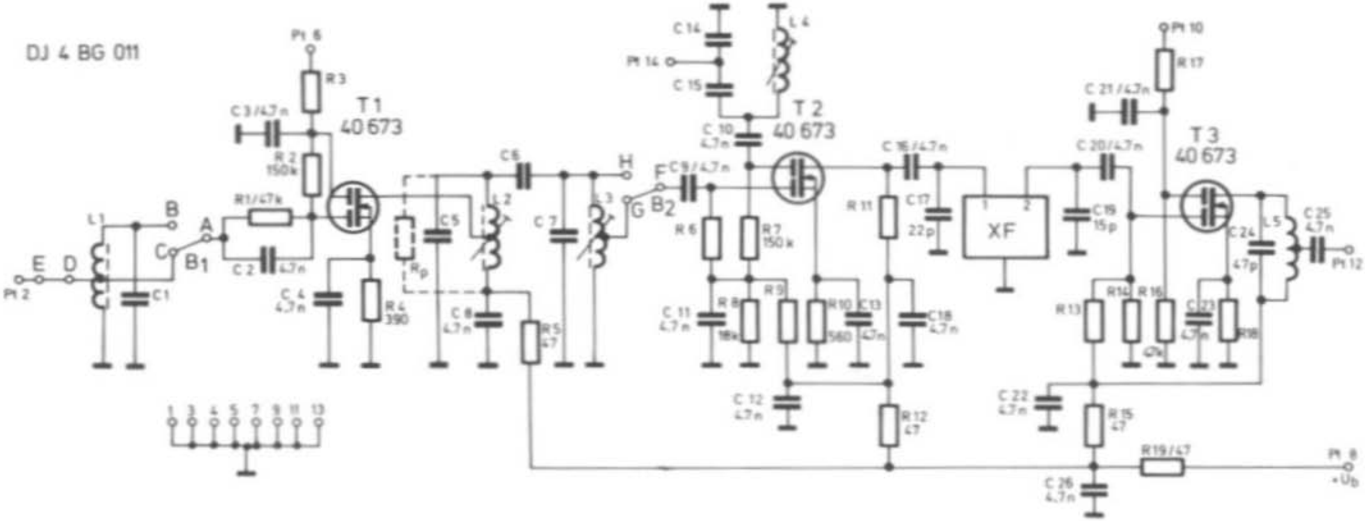

Fig. 2: Circuit diagram of the shortwave receive module

sensitivity, however, this need usually not be carried out to such lengths in the shortwave region as at VHF, since the noise from the antenna is usually higher than that of the transistor. Gate 1 of transistor T 1 is therefore connected to the same tap on inductance L 1 as the input. The input circuit is only slightly damped and therefore has a considerable effect on the selectivity. In order to keep the high dynamic impedances encountered in the shortwave region, in spite of the steep slope of the MOSFET, within limits, the drain connection is also connected to a tap of its resonant circuit comprising L 2. The drain circuit represents a bandpass filter in conjunction with the subsequent resonant circuit comprising L 3/C 7. The input circuit together with this bandpass filter ensures a very high image rejection which is greater than 60 dB even at an input frequency of 30 MHz. The gain from the input to gate 1 of the mixer amounts to 15 dB to 17 dB with all versions (6 to 7 times).

1.2. MIXER

The mixer stage is also equipped with a dual-gate MOSFET (T 2). The mixer stage has been dimensioned according to the experiments given in section 3. of (1). The local oscillator voltage is fed to gate 2 of the mixer transistor via a low-impedance tap on the resonant circuit comprising L 4. This arrangement allows the use of a low-impedance coaxial cable between the local oscillator and the mixer stage, and also filters out any harmonic content of the local oscillator voltage. It also provides a certain degree of decoupling between the input of the receive module and the local oscillator. The screened module therefore exhibits a very low spurious signal radiation, which is further decreased due to the fact that the local oscillator signal is fed in via an RF-feedthrough or coaxial socket and not via the 13-pin connectors. The low-capacitive feedthrough should be mounted at the side of the TEKO-box near to point Pt 14 on the PC-board. The oscillator module should have an output impedance of 50 to 60 Ω.

The mixer is followed immediately by a crystal filter as was given in (3). This ensures that the required signal is filtered out from the unwanted signals relatively early so that the latter are not amplified to such a high level that it is difficult to suppress them later. Together with the low gain of the input stages of the module, this guarantees a very low intermodulation level and good large-signal capabilities.

The filter should be selected to suit the required operating mode. If the receiver is to be designed for several modes, the widest filter should be provided in the receive module and followed by a narrower filter in the subsequent IF amplifier. For instance, the receive module can be equipped with the FM crystal filter XF-9E, and since two crystal filters will be in use, it will be sufficient for an XF-9A SSB filter to be used in the SSB-IF because the ultimate selectivity will have already been provided by the FM filter. If a narrow band CW receiver is to be constructed, an XF-9A can be used in the receiver module and followed by an XF-9M CW filter in the IF amplifier.

With the exception of the XF-9E FM filter, all KVG 9 MHz crystal filters exhibit an impedance of 500 Ω/30 pF; the FM filter has 1200 Ω/30 pF. The values of resistors R 11 and R 14 must be dimensioned accordingly. Since R 11 determines the conversion gain, the overall gain is higher when the higher impedance FM filter XF-9E is used. According to the author, it is not necessary to align the parallel capacitances (which is virtually impossible to do with amateur means) since capacitors C 17 and C 19 correspond sufficiently accurately to the required values together with the connected transistors and circuit capacitances. The selectivity curves obtained in this manner are more than sufficient for practical operation.

1.3. IF PREAMPLIFIER

Since the gain of the RF-preamplifier and the mixer stage has been kept low in order to obtain the best large-signal capabilities, the crystal filter is directly followed by an amplifier stage. This stage decouples the low-impedance output (50 to 60 Ω) from the crystal filter and provides a gain of approximately 13 dB. If the subsequent IF amplifier possesses a high-impedance input and can be connected to the receive module via a short wire connection, it is possible for the output taping to be placed higher on L 5 in order to obtain a higher voltage gain.

2. GAIN CONTROL

The gain of the RF-preamplifier (T 1) and IF-amplifier (T 3) can be controlled via gate 2 of these transistors. Both of these connections are fed to the 13-pin connector so that the AGC or manual control can be made as desired (Pt 6 and Pt 10).

In order to obtain maximum gain, the voltage at these two connections should be equal to the operating voltage and should be reduced towards 0 V in order to decease the gain. The gain of each of the MOSFETs will be decreased by 20 dB in this position. If one or two more IF-stages are controlled down to 0 V in this manner, the total control range of 60 to 80 dB will be sufficient for operation in the shortwave region.

If it necessary to increase the control range for VHF reception where a control range of up to 120 dB is required, it is possible for the control voltage at gate 2 to be reduced to approximately - 2 V. The gate 2 connection of any stage that is not controlled should be connected to the full operating voltage (Pt 8).

3. COMPONENT DETAILS

3.1. VOLTAGE-DEPENDENT COMPONENTS

The operating voltage of the receiver module is in the range of 12 V to 18 V. Attention must only be paid that the gate 2 voltages of the MOSFETs are adjusted to the most favourable values. The values of the appropriate resistors R 3, R 9 and R 17 are therefore given in Table 1 as a function of the operating voltage. The table also lists the values of resistors R 11 and R 14 as well as R 18 and R 13 which are dependent on the crystal filter used in the receiver.

Filter	XF-9A to XF-9D and XF-9M			XF-9E		
U_b	12 V	15 V	18 V	12 V	15 V	18 V
R 3, R 9	270 k	390 k	470 k	270 k	390 k	470 k
R 11	510 Ω	510 Ω	510 Ω	1.2 k	1.2 k	1.2 k
R 13	10 k	15 k	18 k	10 k	15 k	18 k
R 14	560 Ω	510 Ω	510 Ω	1.3 k	1.3 k	1.3 k
R 17	100 k	150 k	180 k	100 k	150 k	180 k
R 18	270 Ω	270 Ω	270 Ω	390 Ω	390 Ω	390 Ω

Table 1: Voltage and filter-dependent resistors

3.2. FREQUENCY-DEPENDENT COMPONENTS

Table 2 lists the frequency ranges, the bandwidths and gain figures measured on the prototypes. The gain figures represent the value present between input Pt 2 and gate of the mixer. The bandwidth of the narrow-band version was kept narrow in order to just cover the CW portion of the amateur band in question. On the other hand, the bandwidth of the wideband version is dimensioned so that the whole of the amateur band is within the 1 dB bandwidth limits. Of course, the given bandwidth and gain values are dependent on the tolerances of the components used, especially the inductances, so that slight deviations from these figures may be encountered.

Band m	Input freq. narrow (n) wide (w)	Range MHz	Oscillator frequency MHz	3 dB bandwidth kHz	Gain up to T 2 dB
80	n	3.5 - 3.6	5.5 - 5.4	180	17
80	w	3.5 - 8.8	5.5 - 5.2	400	17
80	n	3.5 - 3.6	12.5 - 12.6	180	17
80	w	3.5 - 3.8	12.5 - 12.8	400	17
40	(n)	7.0 - 7.1	16.0 - 16.1	200	17
20	n	14.0 - 14.15	5.0 - 5.15	400	16
20	w	14.0 - 14.35	5.0 - 5.35	700	17
15	n	21.0 - 21.15	12.0 - 12.15	350	16
15	w	21.0 - 21.45	12.0 - 12.45	600	17
10	n	28.0 - 28.2	19.0 - 19.2	350	15
10	w	28.0 - 30.0	19.0 - 21.0	3500	16
6	(w)	50.0 - 54.0	41.0 - 45.0	6000	20

Gain from the input upto IF-output (60 Ω load):

with XF-9E approx. 40 dB

with XF-9A to D and M approx. 33 dB

Image frequency rejection:

= 60 dB with the 10 w version and considerably greater on the lower bands.

Table 2: Frequency bands and measured values of the module DJ 4 BG 011

The values of the frequency-dependent components are given in Table 3. The 80 metre version of the receiver module uses a local oscillator frequency in the region of 5 MHz, which is often used in shortwave SSB equipment. Atten-

Band	L 1 turns	L 2 turns	L 3 turns	Type	wire mm dia.	L 4 turns	Type	wire mm dia.	C 1 pF	C 5 C 7 pF	C 6 pF	C 14 pF	C 15 pF	R 6 kΩ	R 7 kΩ	Rp kΩ
80 n	36 Z 7	36 Z 14	36 Z 20	I	0.25	23	I	0.2	150	150	6.8	1000	220	150	150	-
80 w	36 Z 7	36 Z 20	36 Z 25	I	"	23	I	0.2	150	150	15	1000	220	4.7	150	10
40	30 Z 5	30 Z 7	30 Z 13	I	"	13	II	0.25	47	47	1	470	100	150	150	-
20 n	20 Z 4	20 Z 4	20 Z 10	II	"	30	II	0.2	47	47	1	1000	220	150	150	-
20 w	20 Z 4	20 Z 6	20 Z 14	II	"	30	II	0.2	47	47	2	1000	220	4.7	150	12
15 n	13 Z 3	23 Z 8	23 Z 13	II	"	18	II	0.25	47	15	-	470	100	150	150	-
15 w	13 Z 3	13 Z 5	14 Z 7	II	"	18	II	0.25	47	47	1	470	100	4.7	150	15
10 n	17 Z 4	17 Z 5	17 Z 8	II	"	14	II	0.25	15	15	-	220	47	150	150	-
10 w	17 Z 4	17 Z 6	17 Z 12	II	"	14	II	0.25	15	15	2	220	47	3.3	150	6.8
6	9 Z 3	8 Z 3	8 Z 4	II	"	8	II	0.25	10	15	2	100	22	0.56	150	3.3

Bridge B 1: between A and C for all shortwave bands; between A and B for six metres.
Bridge B 2: between F and G for all bands.

Table 3: Values of the frequency-dependent components

tion should be paid that this will cause an inversion of the sidebands and will require that the scale is marked accordingly. The lowest input frequency will be obtained with the highest local oscillator frequency and vice versa. If a frequency counter is used for indication of the frequency, it should be programmable and be able to count backwards. If this is to be avoided by placing the local oscillator frequency above the intermediate frequency in the 12 MHz region, the resonant circuit for the local oscillator frequency comprising L 4 should then be dimensioned as for the 15 metre version. As shown in the first four lines of Table 2, the gain and bandwidth figures are not altered.

If no values are given in the table for capacitor C 6, the capacitance of the conductor lanes will be sufficient and no capacitor will be required. The abbreviation for the coil data is as follows: 36 Z 20 means that the inductance consists of 36 turns with the tapping point "Z" 20 turns from the cold end.

3.3. FURTHER COMPONENT DETAILS

T 1, T 2, T 3: 40673 (RCA)
L 5: 30 turns of 0.25 mm dia. (30 AWG) enamelled copper wire
using type II coil set.
Coil sets I and II are special coil sets available from the publishers.

All resistors for 10 mm spacings.
All capacitors for 15 mm spacings.

1 13-pin connector
1 TEKO-box 3A
1 crystal filter (KVG), see section 1.2.

4. CONSTRUCTION

The printed circuit board has been designed for installation in a TEKO-box so that the receiver can be used in the modular receiver system (2). The PC-board has been designated DJ 4 BG 011 and the dimensions are 90 mm by 65 mm. The conductor lanes and component locations are given in Figure 3, and Figure 4 shows a photograph of the author's prototype.

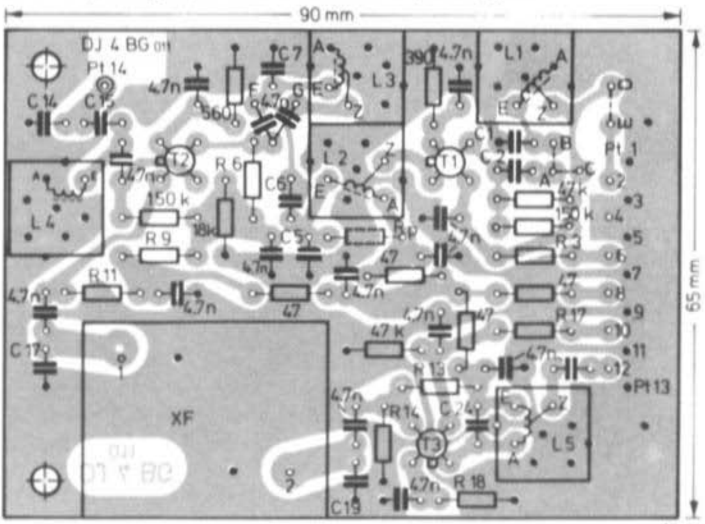

Fig. 3: PC-board DJ 4 BG 011 and component location plan

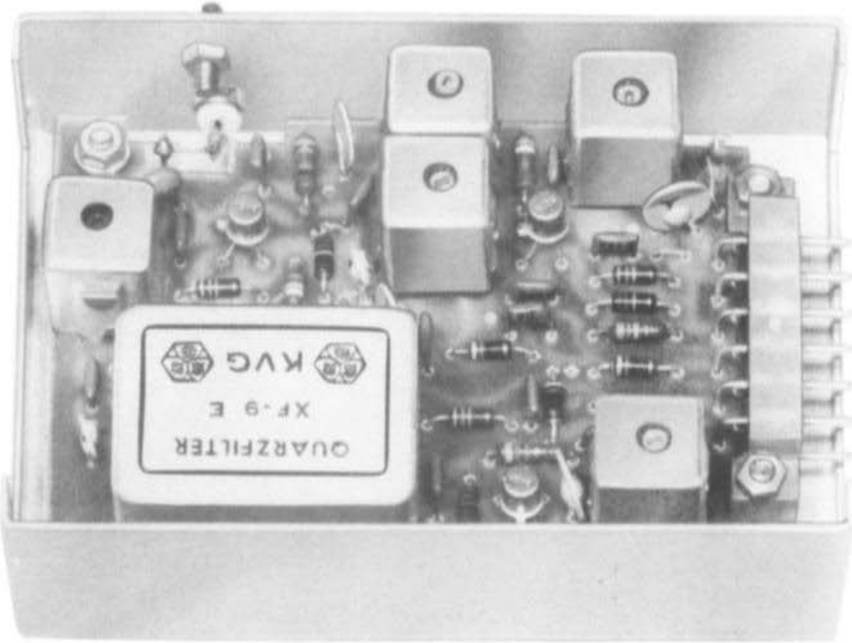

Fig. 4: Prototype of the shortwave receive module

The connections for the antenna and local oscillator should preferably be in the form of RF-feedthroughs or coaxial sockets, especially in the case of the higher shortwave bands. The antenna is normally connected to point "D". If, however, the input signal is to be fed via the 13-pin connector, it will then be necessary for a bridge to be made between points "D" and "E". The local oscillator signal is fed to Pt 14.

5. ALIGNMENT

Of course, the most favourable method of aligning the receiver module is with the aid of a sweep generator. In order to avoid any detuning effects, the RF-voltage should be taken from gate 1 of the mixer transistor at the highest impedance. The probe should therefore be coupled in via an approximately 2 pF capacitor. If such test gear is not available, the receiver module should be aligned for maximum indication on a shortwave receiver tuned to the appropriate frequency, or in the receiver system when completed.

With the wideband versions 20 w and 10 w there is a slightly over-critical coupling of the bandpass filter. The value of C 6 could be decreased from 2 pF to 1.5 pF during the alignment which will reduce the coupling and the bandwidth. However, it is better for the resonant circuits comprising L 2 and L 3 to be dampened with a resistor of 3.3 kΩ during the alignment. This damping ensures that the coupling is not too tight and that the circuits can be aligned in the centre of the band for maximum reading. These two resistors should be removed after completing the alignment, after which the circuits will become more tightly coupled again. The cores of the inductances should then only be altered when the required measuring equipment for sweeping the bandwidth is available.

The versions 20 w and 10 w exhibit a dip of approximately 0.5 to 1 dB at the centre frequency of the bandpass characteristic.

The ten metre wideband version 10 w is extremely suitable for use with VHF and UHF converters since it provides the full bandwidth of 2 MHz.

6. USE FOR DIRECT VHF RECEPTION

With the dimensioning given for 50 MHz, it was possible to obtain an image rejection of approximately 40 dB. This still acceptable value will deteriorate on increasing the frequency (however, there should be no difficulties in modifying the unit for reception of the UK-four metre band). This is why the author has not given any data for the 144 MHz band since he believes that the image rejection would no longer satisfy the demands of modern VHF equipment. However, certain details are to be given regarding possible modifications in order to obtain a better image rejection on the two metre band when using the receiver module for direct reception.

The image rejection can be improved by either using an additional filter in the antenna line or by using a crystal filter for a higher intermediate frequency. A number of manufacturers of professional VHF equipment use crystal filters in the range of 21.4 MHz. KVG also manufacture such filters. Of course, it will then be necessary for the input circuit for the local oscillator signal (L 4, C 14, C 15) and the IF output circuit (L 5, C 24) to be dimensioned for the new intermediate frequency, and for the different impedance of the crystal filter to be taken into consideration using the appropriate values of R 11, R 13 and R 14.

The coil sets used and supplied with the kit exhibit too high a loss at VHF, and short polystyrol coil formers of 4.3 mm diameter should be used together with VHF cores and screening cans of 12.5 mm by 12.5 mm. In this case, it is necessary for a hole to be drilled in the PC-board where the coilformer is to be located.

The resonant circuit capacitances C 1, C 5 and C 7 should have a low value of approximately 5 pF, or completely removed in order to ensure that the number of turns on the inductances is not too small. The same is valid for the resonant circuit comprising L 4, C 14, C 15. The variations in the input capacitance of the dual-gate MOSFETs makes it somewhat difficult to give reliable coil data for this frequency range and it will be necessary to experiment somewhat in order to obtain the correct values.

In the VHF region, it would be better for gate 1 of the input transistor to be connected to the hot end of the input circuit. This is achieved by making a bridge between points A and B. The antenna connection should be made to a tap approximately a quarter or third of the total number of turns from the cold end. It would also be favourable for gate 1 of the mixer transistor to also be connected to the hot end of inductance L 3. This is achieved by making a bridge between points "F" and "H". The drain connection of the input transistor could also be fairly near to the hot end of inductance L 2. It may even be favourable to connect it directly to the hot end, which can be done by making a small wire bridge on the PC-board.

7. REFERENCES

(1) D. E. Schmitzer: Adjusting the Operating Point of Field-Effect Transistors in one of the next editions of VHF COMMUNICATIONS

(2) D. E. Schmitzer: A Modular Receive System
VHF COMMUNICATIONS 3 (1971), Edition 2, Pages 110-114

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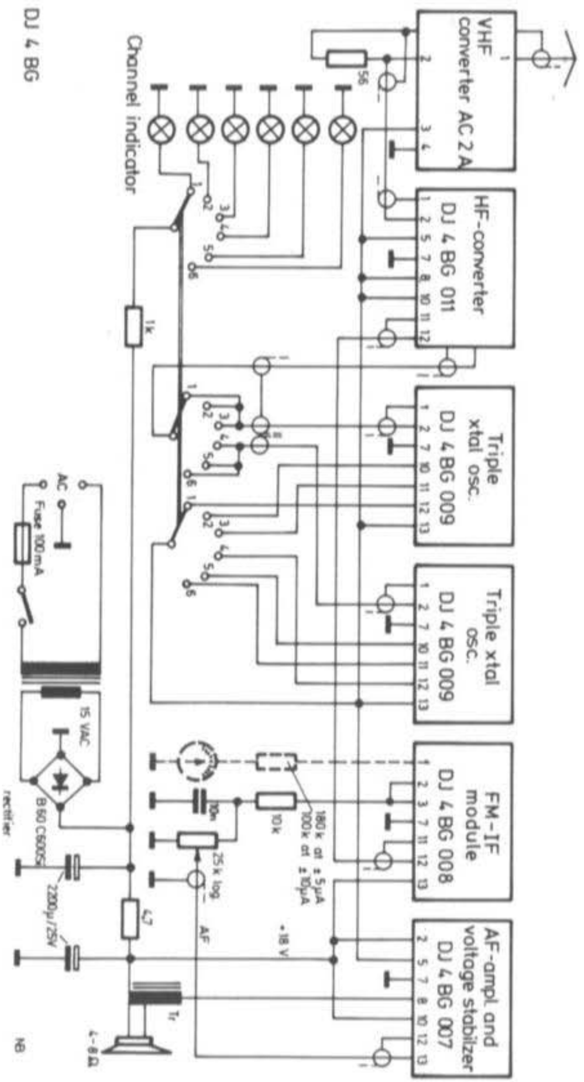

Fig. 1: Circuit diagram of the six-channel FM receiver

A MODULAR SIX-CHANNEL FM RECEIVER

by D. E. Schmitzer, DJ 4 BG

1. GENERAL

The Teko-modules already described in VHF COMMUNICATIONS allow construction of a complete six-channel FM receiver for two meters. Six channels have been chosen here, but it is possible for only three or more than six to be used by providing the appropriate number of crystal oscillator boards. The STE AC-2 two-meter converter was used by the author, but can be replaced by any other suitable converter that converts down to 28-30 MHz. The 28-30 MHz signal from the two-meter converter is fed to a receive converter module DJ 4 BG 011 type 10 w (10 meter wideband) (1) where it is converted to 9 MHz. The local oscillator signal is obtained from one or more oscillator modules DJ 4 BG 009 (2); each module provides a maximum of three crystal controlled frequencies. The 9 MHz IF signal is fed to the FM-IF module DJ 4 BG 008 (3), where it is amplified, limited and demodulated. The demodulation is made in a crystal discriminator. The resulting AF-signal from the crystal discriminator is fed to the AF-amplifier/voltage stabilizer module DJ 4 BG 007 (4), where it is amplified up to the required level.

An RC-link of 10 kΩ/10 nF is connected in front of the volume control in order to compensate for the unfavourable sound of a loudspeaker operating in a small case. The value of this capacitor should be selected in order to obtain the most favourable response of the loudspeaker to be used. Full details regarding the dimensioning of the loudspeaker transformer where given in (4).

The AF-amplifier module also contains the voltage stabilizer, which provides a stabilized DC voltage to most of the modules. The IF and AF-modules are operated from an unstabilized operating voltage of 18 V. If the receiver is to be operated from a 12 V supply, e.g. as a mobile receiver, the 18 V can be obtained by use of a modified DC-DC converter as described in (5). Figure 1 gives the block diagram of the complete FM-receiver and shows the required interconnections. An AC power supply is also given which is dimensioned generously enough to allow further equipment to be connected. The receiver requires a quiescent current of approximately 100 mA, and the current drain will increase to more than 150 mA in voice peaks. This means that the power supply or DC-DC converter must be able to provide an output current of at least 200 mA.

2. SPECIAL FEATURES OF THE INDIVIDUAL MODULES

With the exception of two points which will be now covered, all the modules are used as described in the individual descriptions (see References). Since the 10 w version of DJ 4 BG 011 is already equipped with a resonant circuit at the local oscillator input for matching the impedance, the Pi-filter of the oscillator module DJ 4 BG 009 will no longer be required. This means that capacitors C 5 and C 6, as well as inductance L can be deleted and replaced by a wire bridge so that the oscillator output voltage at R 6 is fed to Pt 2 of the 13-pin connector. If both the Pi-filter and the input circuit were to be used, this would result in a bandpass filter having too tight a coupling that would require extensive measures to align.

The same problem is presented when the DJ 4 BG 011 receiver module is to be connected to a VHF converter that possesses one or more resonant circuits at the output. Since the STE converter AC 2 possesses a bandpass filter at the output, it is not necessary to provide the input circuit of the ten meter module. This means that L 1 and C 1 can be deleted and point A directly connected to point E. Attention must be paid that no isolating capacitor is used that would break the DC-path for gate 1 of transistor T 1.

3. MECHANICAL CONSTRUCTION

The mechanical construction of the FM-receiver can be suited to the required application. However, attention should be paid that all leads carrying RF-voltages are kept as short as possible and are adequately screened. Figure 2 shows a photograph of the author's prototype that is designed as a plug-in module for another, already existing unit. If enough room is available, further additions can be added later such as a VFO for coverage of the whole two meter band as well as IF-strips for AM, SSB and CW.

4. SQUELCH CIRCUIT

The circuit given in (3) can be used in order to mute the receiver when no signal is present. However, the author suggests that a field-effect transistor be used instead of the mechanical relay employed in the original description. The description of a suitable squelch circuit is to be described at a later date. The author's prototype is not equipped with a squelch circuit at present, but room has been left on the front panel for the adjustment potentiometer.

5. ALIGNMENT

As has been mentioned previously, the alignment of the individual modules was given in the appropriate descriptions. It should therefore be possible for the nearest repeater or one of the local stations to be received immediately after interconnection, or course, providing that the correct crystal frequency has been calculated as given in Section 8, and when the tolerance of the local oscillator portion of the VHF converter is within limits. If a local signal is not available, it is recommended that a signal from a calibration spectrum generator be received at say 144 MHz or 145 MHz. This should be carried out by firstly aligning the 28-30 receive module to 29 MHz after disconnecting the VHF converter. A 29 MHz signal is then fed to Pt 2 of module DJ 4 BG 011, ground to Pt 1. This signal can be taken from a calibration spectrum generator or from the exciter of a ten meter station. A sensitive, center-zero meter is now connected to the DC-output of the discriminator of module DJ 4 BG 008 (indicated by dashed lines in Fig. 1). Any frequency deviation from the center frequency will be indicated as a deflection of the meter from the center-zero position. The appropriate trimmer capacitor of the oscillator in question is now aligned to bring the meter reading to zero. The circuit diagrams and alignment texts of the individual modules should always be consulted during the alignment process. The converter is now reconnected and the receiver now tuned to 145 MHz or the required VHF channel. If there is any deviation from the required frequency this will either be caused by the converter, or the transmitter may not be exactly correct. The oscillator of the converter can now be adjusted carefully in order to bring the discriminator output reading to zero. The frequency tolerance of most commercially available converters can deviate by up to $\pm$ 10 kHz (approx. $\pm 1 \times 10^{-4}$) and must be taken into consideration. Homemade converters will probably not be better when no accurate measuring equipment is available.

The alignment of the oscillator circuit (L 4) of module DJ 4 BG 011 is best made by monitoring the current of the mixer transistor, e.g. measuring the voltage drop across R 10. The measuring range should be selected so that approximately full scale deflection is obtained on the voltmeter so that the relatively small increase of the current can be seen easily on connecting the oscillator voltage. Inductance L 4 should be aligned at the center of the band for maximum (with the appropriate oscillator for 145 MHz). Of course, if only another portion of the amateur band is to be used, then the coil can be aligned there for maximum. Since the input of module DJ 4 BG 011 is at high impedance, whereas the output of the converter is designed for low impedance, it is necessary for a resistor in the order of 50 Ω to be connected at the interconnection point of both modules (see Fig. 1). The STE AC 2 converter is very accurately aligned on delivery so that no further alignment should be made without the required measuring equipment such as swept frequency measuring equipment and noise figure meters.

6. CONVERTERS SUITABLE FOR USE IN THE SYSTEM

Principally speaking, virtually any converter can be used that converts the VHF or UHF band to 28-30 MHz and operates with voltage of 12 V DC.

The author used the AC 2 converter manufactured by STE of Milan, and sold by the publishers of VHF COMMUNICATIONS, for his prototype. Since this converter is too long for installation in a Teko-box 3A, it was not possible for it to be mounted vertically beside the other Teko-modules. It was therefore mounted below the chassis with the aid of screws and spacing bushings.

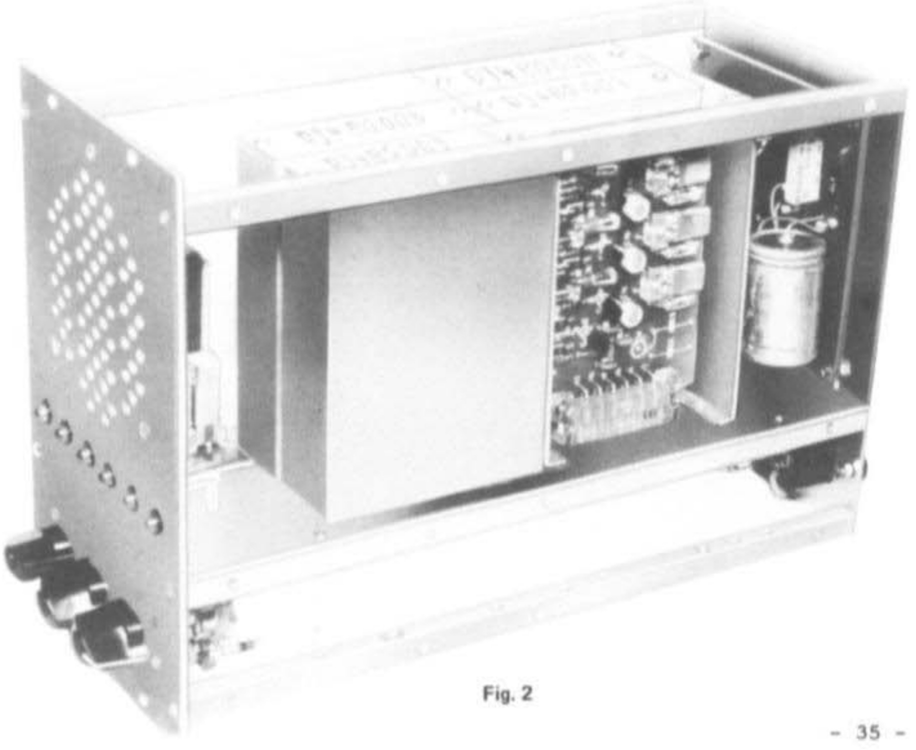

Fig. 2

7. FURTHER DETAILS

As can be seen in the circuit diagram and photograph of the author's prototype, a pilot light is provided for indicating the channel in use. Due to their low current requirements, red light-emitting diodes were used that are available relatively cheaply from a number of manufacturers. Diode type 5082-4417 manufactured by Hewlett-Packard provided a sufficiently good illumination at a current of only 18 mA, however, it is possible to decrease the current flow still further by use of a dropper resistor. The diodes were mounted with the mounting 5082-4418 manufactured by the same company. Equivalent diodes can be obtained from Monsanto or Litronix that have the same low current and brightness characteristics.

8. CRYSTAL FREQUENCY

The required crystal frequency can be obtained from the following formula: $f_{cry.} = f_{in} - 125$ MHz. This means that the crystal frequencies for input frequencies between 144 and 148 MHz will be in the range of 19 to 23 MHz. Miniature types in HC-25/U holder should be used. The following information should be given to the manufacturer on ordering: required frequency, parallel resonance, 30 pF load. See reference (2) for further details.

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AUTOMATIC 10-CHANNEL SCANNER FOR FM STATIONS

by U. Tillmann, DJ 5 UO

So-called scanners have been available in the USA for some time now. Such units are very advantageous for 2 m amateurs operating in the FM mode. In most cases, the scanner consists of an 8-channel FM receiver whose channels are switched periodically one after the other. If a channel is operative, the scanning process will be stopped for a certain period and it will be possible for the signal to be monitored on the built-in loudspeaker. After this certain period has elapsed, the scanner will switch to the next channel that is operative where it will also stop for the predetermined period of time. As soon as the eighth channel has been scanned, the unit will automatically switch back to the first and recommence the cycle.

If any one channel is not of interest, for instance, because it is blocked by a long-winded QSO or unwanted repeater, it is possible for this channel to be switched out of the scanning cycle with the aid of the appropriate switch. In this case, the scanner will scan the channel but will not stop. If, on the other hand, a channel.is to be monitored over a longer period, it is possible to switch off the pulse generator of the scanner when the required channel is selected.

The following article is to describe an accessory for use in conjunction with a multi-channel FM transceiver so that it operates in a manner similar to that described above.

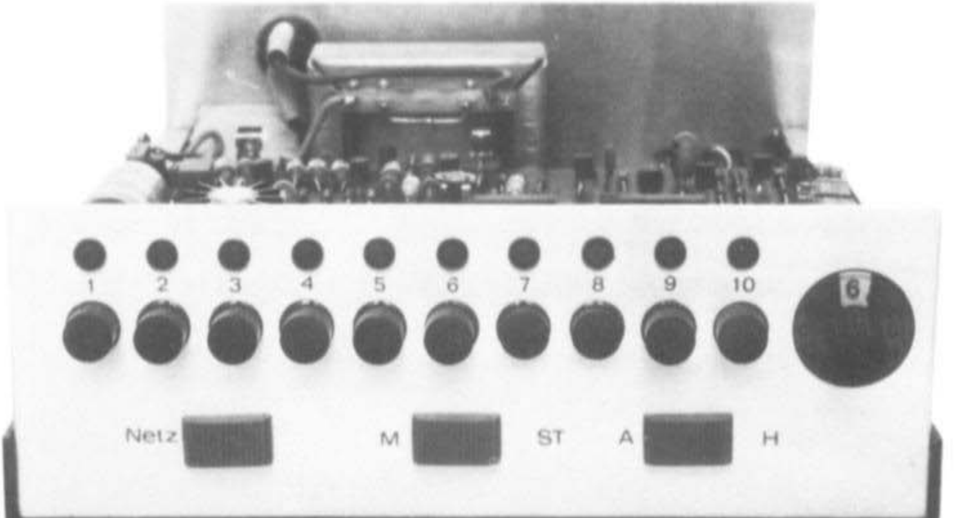


Fig. 1: Automatic 10 channel scanner for FM transceivers

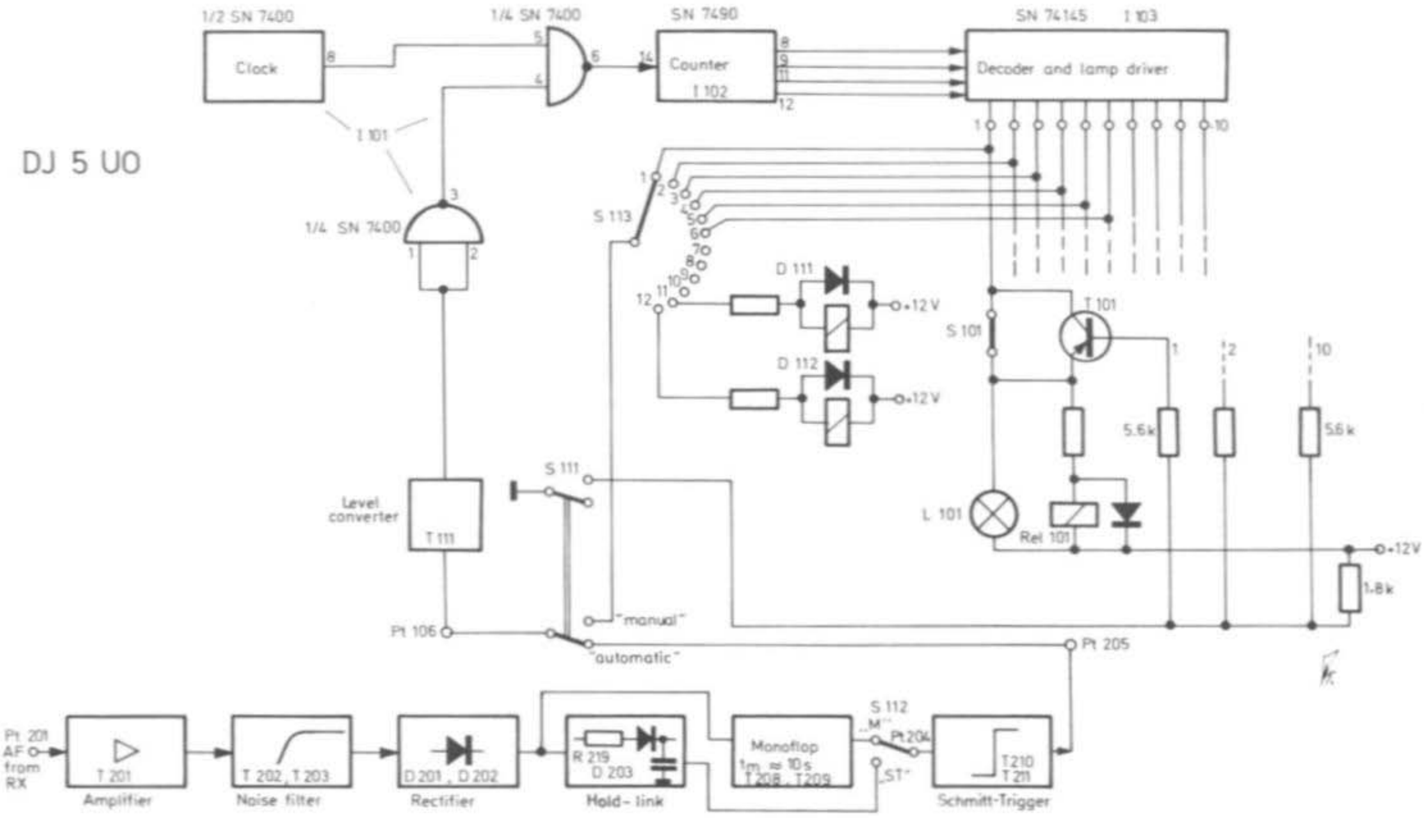


Fig. 2: Block diagram of the 10 channel scanner

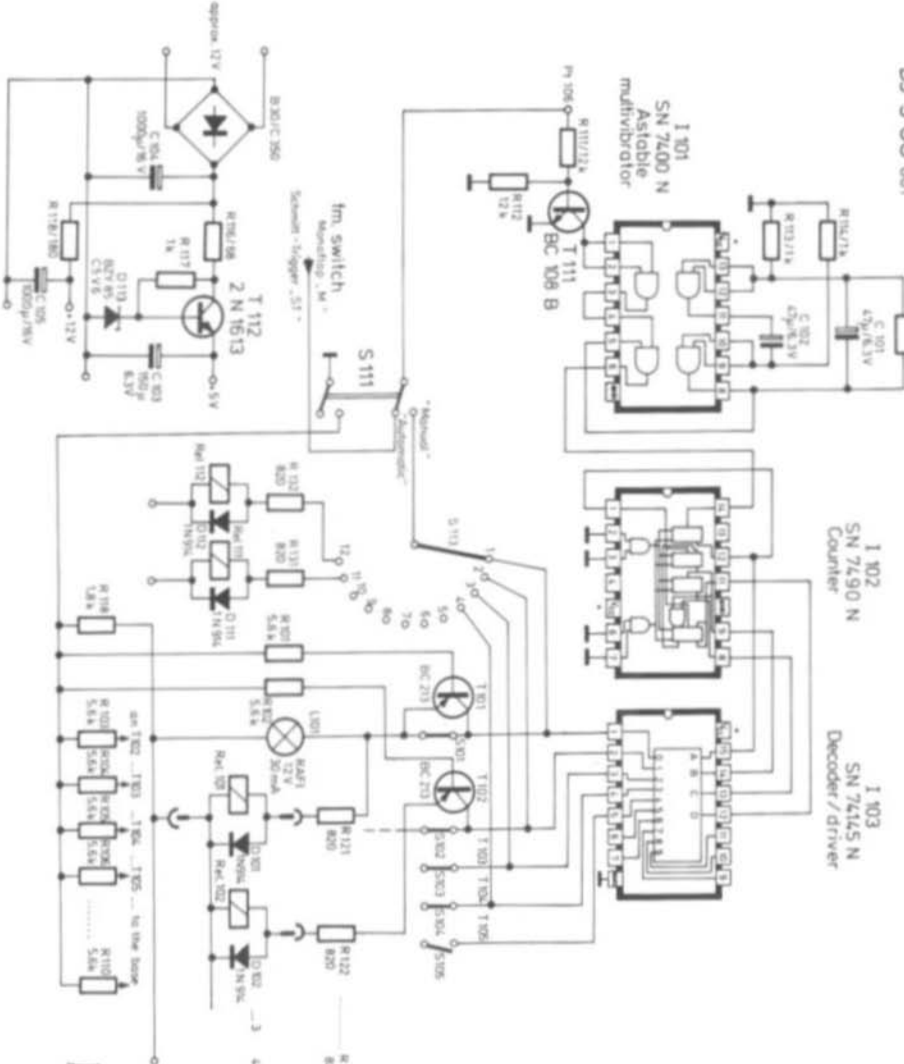


Fig. 3: Circuit diagram of the scanning control

Figure 1 shows a photograph of the author's prototype. It is relatively simple to construct the scanner for 10 channels, which is perfectly suitable for use with the popular 12-channel FM transceivers available on the market. Most FM transceivers can be operated in conjunction with the scanner when Reed-contacts or electronic switches are built into the scanner instead of the channel switch.

1. THEORY OF OPERATION

The block circuit diagram of the 10-channel scanner is given in Figure 2. The operation is as follows:

A clock generator provides square-wave pulses which are fed via a NAND-gate to a decade counter (I 102). The momentary state of the counter is given in BCD-code to an integrated decoder and lampdriver (I 103). This module switches the control lamps (L 101 - L 110) and relays (Rel 101 - Rel 110) associated to each of the channels. The relays switch the channel crystals so that the receiver is switched by the clock generator from channel to channel. The scanning process will continue until the second input (connection 4 of I 101) of the NAND-gate is fed with a logic-1-signal. There are several operating modes:

1.1. AUTOMATIC OPERATION WITH 10 s PAUSES ON ACTIVE CHANNELS

The switches given in the block diagram are shown in their settings for this mode. The input Pt 201 is connected to the AF-amplifier of the receiver to be controlled. When the channels are not active, Pt 201 will be provided with a noise voltage that is amplified and rectified. If the noise voltage is not present or is reduced, as is the case with active channels, this will cause the monoflop to be actuated. The subsequent Schmitt-trigger shapes the output voltage of the monoflop to obtain a steep pulse whose voltage is matched to the TTL-circuits in a level converter. Finally, the signal is fed via a reversal stage to connection 4 of the NAND-gate which is then blocked. The counter will then stop; the lamp and the relay will remain switched to the appropriate channel. After approximately 10 s, the monoflop will be switched back to its rest position, connection 4 of the NAND-gate will receive a 0-signal and the clock generator will be able to continue switching the counter.

The same procedure will take place at the next active channel. However, it is possible for channels that are not of interest to be jumped by opening the appropriate switch (S 101 - S 110). This will mean that the control lamp and relay of this channel cannot be switched on by the automatic circuit. This will result in the next channel being selected after a period of approximately 1/7 s.

With receivers equipped with a built-in squelch, the circuitry from potentiometer P 201 to P 202 can be deleted and the outputs of the squelch connected to transistor T 205. If the polarity is not correct, it is necessary for a polarity inverter to be provided.

1.2. AUTOMATIC OPERATION WHICH IS INTERRUPTED DURING THE WHOLE PERIOD IN WHICH A CHANNEL IS ACTIVE

In this mode, switch S 112 is switched to position "ST" (Schmitt-trigger). This means that a holding-link will be operative after the rectifier so that the Schmitt-trigger is switched immediately so that the automatic circuitry is stoped at the appropriate channel. This means that the counter will not be switched when handing the microphone over from one station to another. The holding-link maintains the Schmitt-trigger for approximately 1/2 s.

1.3. MANUAL SELECTION OF THE CHANNELS

In the manual mode of the scanner, switch S 111 is switched to position "H" (manual operation). The required channel is preselected with the rotary switch S 113. The counter will only operate until the decoder for the appropriate channel provides a logic 1-signal. This signal will block the gate between clock generator and counter via the switch contacts of S 113, switch S 111, level converter and reversal stage.

Since switches S 101 to S 110 are able to switch off the channels, it is necessary for all switches to be bridged during manual operation. This is achieved with the aid of the PNP transistors T 101 to T 110. A second contact on switch S 111 connects the base voltage dividers to ground so that all ten transistors conduct. In the manual mode, it is possible for as many channels to be switched as are available. In the case of the author's prototype, there were 12 channels; the circuit of the two channels that are not part of the automatic cycle are also given in the diagrams.

2. CIRCUIT DETAILS

Since the scanner consists of two modules, two, separate circuit diagrams have been given:

2.1. SCANNING-CONTROL

The circuit diagram of this module is given in Figure 3. Two of the four gates of the TTL-ICs SN 7400 N (I 101) operate as an astable multivibrator (1) and are used as the clock generator. It operates with a frequency of approximately 7 Hz which means that the clock period approximately amounts to 0.15 s. The frequency is determined by the components R 113, R 114, R 115, C 101 and C 102. This is followed by the integrated decade counter I 102 and the integrated decoder/driver I 103. The 10 outputs drive the 10 channel relays and the control lamps. The circuit is only given completely for channel 1.

The gate that separates the clock generator from the counter is also accommodated in I 101 (connections 4, 5, and 6). The fourth gate is used as reversal stage and transistor T 111 is used as level converter. This module also accommodates the power supply of the scanner: Stabilized 5 V for the integrated circuits and unstabilized 12 V for the transistors, lamps and relays.

2.2. AUTOMATIC STOP CIRCUIT

The circuit diagram of this module is given in Figure 4. It is possible by adjusting the level control P 201 to adjust the noise voltage of the connected receiver so that the automatic circuitry operates correctly. The amplifier stage

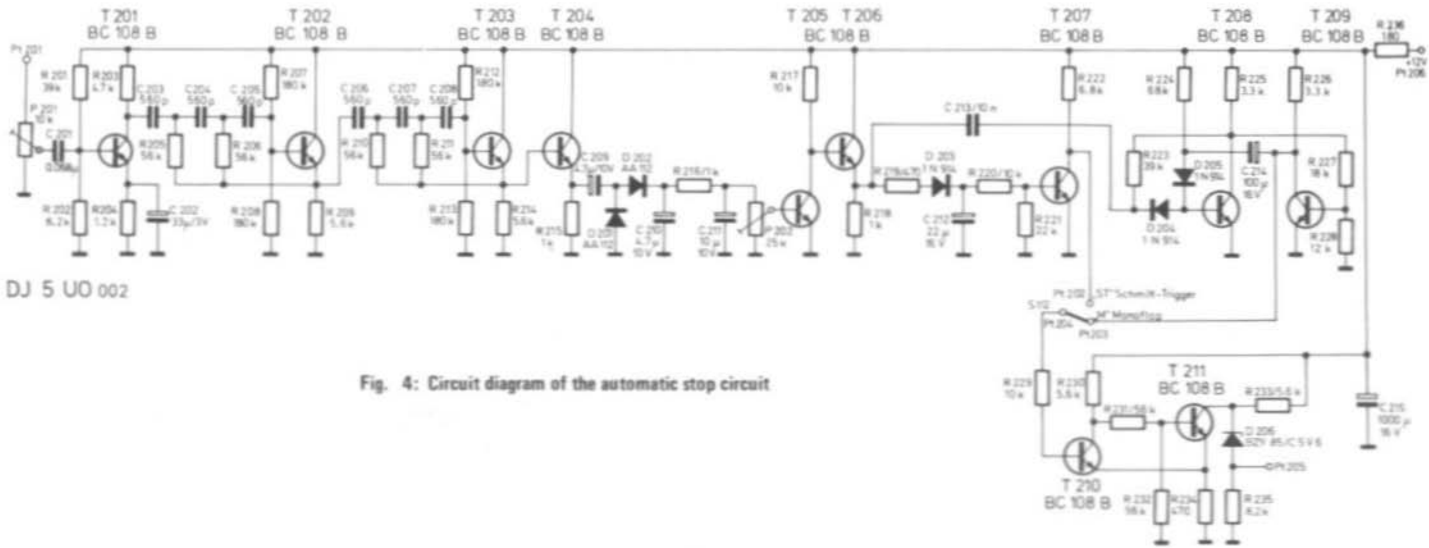


Fig. 4: Circuit diagram of the automatic stop circuit

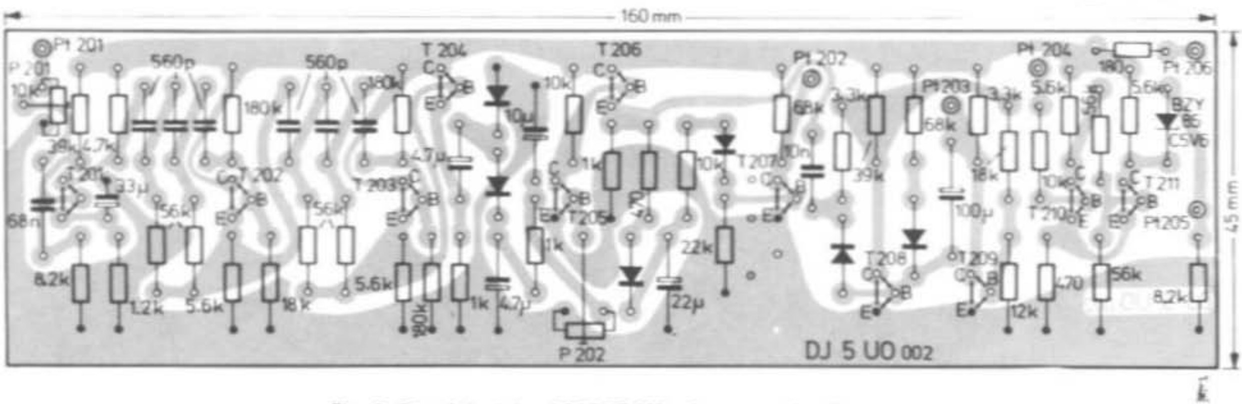


Fig. 6: Printed circuit board DJ 5 UO 002 and component locations

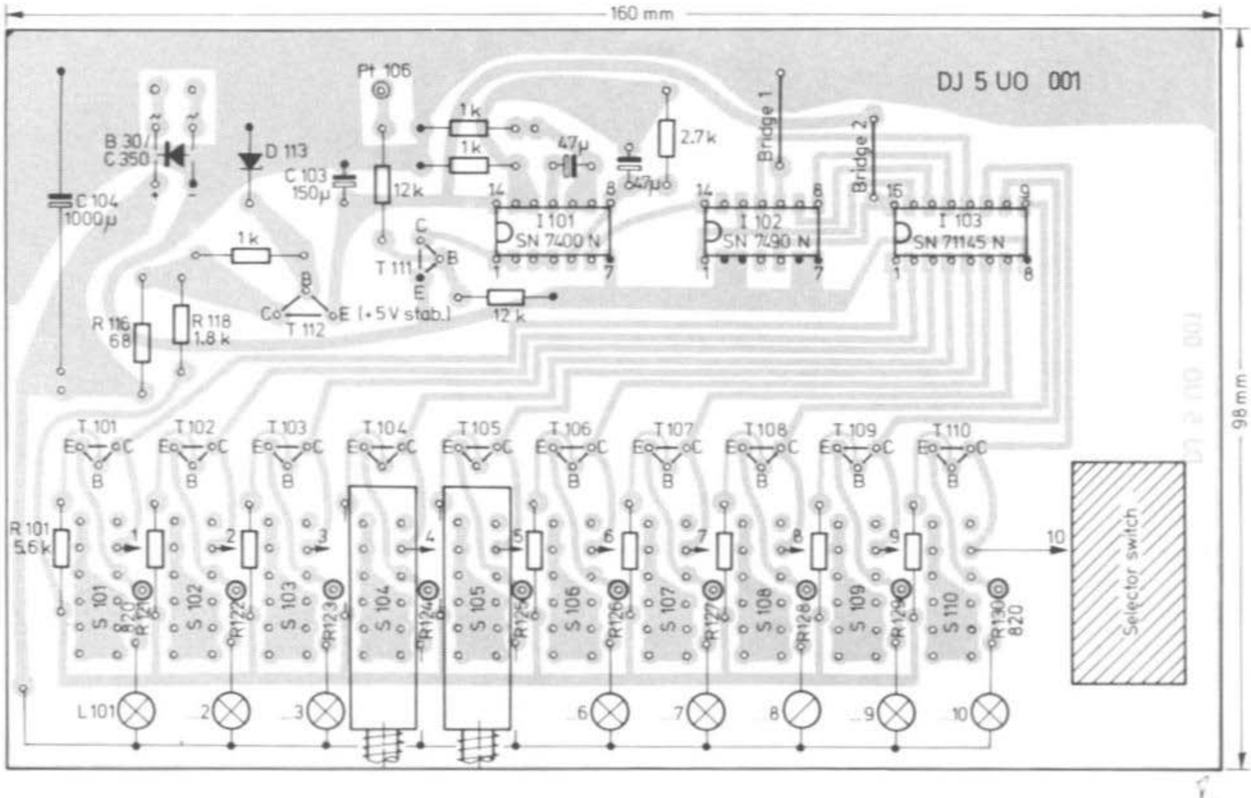


Fig. 5: Printed circuit board DJ 5 UO 001 and component locations

comprising transistor T 201 is followed by two active high-pass filter stages (T 202, T 203) as were described in (2) and an impedance converter stage (T 204). This is followed by the voltage doubler rectifier (D 201, D 202). Transistor T 205 is driven via a filter link and a further trimmer resistor and will conduct as long as the receiver provides a noise voltage. If the noise voltage disappears, or is reduced beyond a certain level, the monoflop (T 208, T 209) will switch to its energized stage so that the clock generator is disconnected from the counter by the Schmitt-trigger (T 210, T 211). After approximately 10 s, the monoflop will return to its rest position and the counter will continue to switch. The time period can be changed by varying the value of capacitor C 214.

The monoflop will not be operative when switch S 112 is connected to connection Pt 202. In this case, the Schmitt-trigger will then be actuated after the very short charge time constant determined by R 219/C 212.

The counter will then stop at the appropriate channel. Holding-link C 212/R 220/ R 221 has been included so that the counter is not switched by a short period of noise voltage that will occur when the microphone is passed from one station to another. The Schmitt-trigger will remain switched on until C 212 has been discharged via R 220 and R 221. Diode D 203 has been provided in order to assure that the time-determining capacitor C 212 is not discharged via its voltage source. This diode only allows current to flow in the charge direction, i.e. as long as the voltage at the anode is higher than at the cathode.

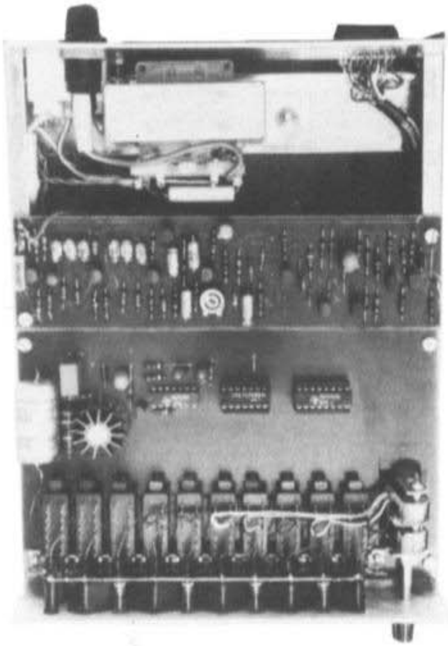


Fig. 7: Photograph of the completed 10 channel scanner

3. CONSTRUCTION

Both modules of the scanner can be easily constructed using the printed circuit boards DJ 5 UO 001 for the scanning control and DJ 5 UO 002 for the automatic stop circuit. Figures 5 and 6 give these two PC-boards together with the component locations. Room is provided on PC-board DJ 5 UO 001 for the channel switch S 113; switches S 101 to S 110 are directly soldered to this PC-board. It is hoped that suitable switches will be available in other countries. As the photograph of the author's prototype in Figure 7 indicates, it is possible for the two PC-boards to be mounted one behind the other; the on/off switch, fuse, transformer and interconnection socket to the receiver have sufficient room behind or beside them.

The control lamps are connected to a connection on PC-board DJ 5 UO 001 and the other connection to the operating voltage. One connection of resistors R 121 to R 130 is connected to the PC-board and the other connections are connected by wire to the interconnection socket. The filter capacitor C 215 was subsequently increased to 1 mF and therefore could not be accommodated on the PC-board, however, it can be connected below the board.

3.1. SPECIAL COMPONENTS

I 101: SN 7400 N
I 102: SN 7490 N
I 103: SN 74145 N

T 101 - T 110: BC 178, BC 213, BC 309 B or similar silicon PNP AF transistors
T 111: BC 108 C, BC 239 B or similar transistors with B = 100
T 112: 2 N 1613, 2 N 2219 or similar TO-5 type

D 101 - D 112: 1 N 914, 1 N 4148, BAY 93 or similar
D 113 : BZY 85/C5V6 or similar 5.6 V zener diode

S 101 - S 110: Miniature pressbutton switches
Rel 101 - Rel 112: Reed contacts and coilformers (12 V)
La 101 - La 110: 12 V/ 30 mA control lamps (red)
T 201 - T 211: BC 108 B, BC 239 C or similar (B ≥ 100)

D 201 - D 202: AA 112, AA 116 or similar germanium diode
D 203 - D 205: 1 N 914, 1 N 4148, BAY 93 or similar diode
D 206: BZY 85/C5V6 or similar 5.6 V zener diode

C 203 - C 208: 560 pF styroflex capacitor

P 201: 10 kΩ miniature trimmer potentiometer, vertical mounting, spacing 5/2.5 mm
P 202: 25 kΩ miniature trimmer potentiometer, horizontal mounting, spacing 10/5 mm.

4. REFERENCES

(1) G. Krumrein: Verzögerungsschaltungen und astabile Schaltungen mit TTL-Bausteinen
AEG-Telefunken Applikation B2/V.7.17/0670
(2) D. E. Schmitzer: Active Audio Filters
VHF COMMUNICATIONS 1 (1969), Edition 4, Pages 218-235

AN INTEGRATED RECEIVER SYSTEM FOR AM, FM, SSB and CW

by H. J. Franke, DK 1 PN

The integrated receiver system was introduced in the last edition of VHF COMMUNICATIONS. The various modules will be described one after the other in the following editions. The development of the 9 MHz input circuit and the FM demodulator required redevelopment of the overall circuit, which is indicated in the block diagram given below.

The main reasons for the modification to the receiver system are as follows:

1. The desire to have a common S-meter circuit for all modes. As well as the problem of providing modules not belonging to the 9 MHz IF chain with a control voltage, e. g. the VHF and UHF converters.

2. The second reason was that the author wished to use the new RCA integrated FM demodulator CA 3089 E, which offers a number of advantages over the previous CA 3075. These improvements are:

   Limiting takes place at a 9 MHz input voltage of typically 12 μV. The integrated circuit is also equipped with an integrated squelch circuit.

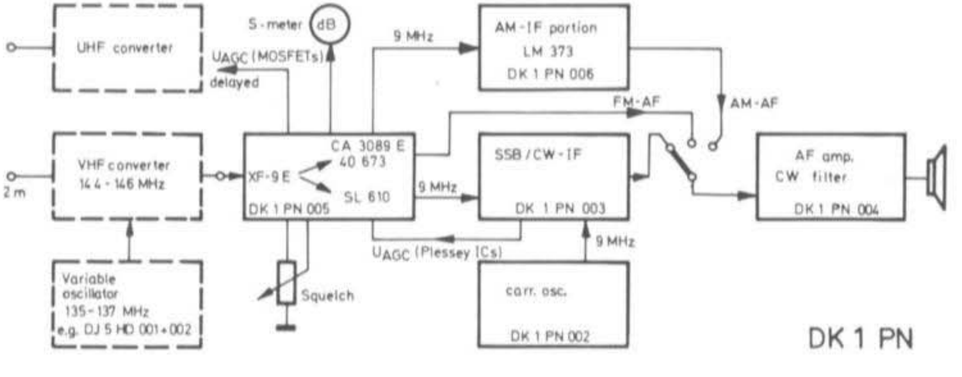
   Provision of a voltage that can be used for indicating the strength of the received signal.

   Provision of a delayed control voltage suitable for controlling MOSFETs, e. g. 4.5 V upto 9 MHz input voltages of approximately 1 mV and falling to 0 V at higher input voltages.

   This integrated circuit possesses further advantages which are not utilized here:

   The zero indication of the discriminator is not steep enough for the relatively low IF bandwidth of 12 kHz.

   The AFC-voltage for the tuner is not required in the described system.



AN INTEGRATED RECEIVER SYSTEM FOR AM, FM, SSB and CW
Part II: The SSB IF-Portion

by H.J.Franke, DK1 PN and R. Lentz, DL 3 WR

The block diagram of a 9 MHz IF system for AM, FM, SSB and CW was given in (1). As will be seen in this diagram, the most important module is the SSB/CW IF-portion which is to be described here.

The following general comments should be mentioned with respect to this IF system:All modules have been designed for use in the modular system described in (2) so that the modules described by DJ 4 BG can be extended or so that one is able to select the most suitable from both possibilities. However, attention must be paid when combining various models that the Plessey ICs require specific control, input and output voltage levels.

A further module (DK 1 PN 008) will also be provided which contains an integrated voltage stabilizer for supply of the Plessey ICs and the oscillators as well as a level converter for the control voltage.

By exchanging the crystal filter and the carrier crystals it is possible to modify the unit for other IF frequencies (e.g. 10.7 MHz) up to the maximum limit of the controlled amplifier SL 612 and the AM IC LM 373 of 15 MHz.

If the system is to be modified for direct reception in the shortwave range, module DK 1 PN 007 should be replaced by a circuit equipped with a SL 610 as controlled preamplifier and a SL 641 a mixer.

The receiver is then completed by adding a VFO. In this case, the XF 9 A filter planned for module DK 1 PN 003 should be replaced by an XF 9 B type since the ultimate selectivity guaranteed by the XF 9 E is no longer present.

The maximum input frequency of a receiver equipped in this manner is limited by the SL 641 to 75 MHz. The noise figure of the integrated preamplifier SL 610 amounts to 4 dB. Of course, it is also possible for the complete IF system with module DK 1 PN 007 to be extended with a low-noise mixer having the lowest possible gain which is then able to convert the required frequency band without preamplification. A ring modulator equipped with Schottky diodes is especially suitable for this (3). The integrated ring modulator SL 641 is not suitable due to its high noise level which means that it cannot be used without preamplifier.

1. CIRCUIT OF THE SSB/CW IF MODULE

The circuit diagram of this module is given in Figure 1. In the upper part of this illustration, a block diagram giving the gain values of the individual stages is given. The input transistor stage will receive enough feedback so that no gain occurs. This stage is only used for matching the coaxial cable to the impedance of the crystal filter. The first of the two IF amplifiers with SL 612 is controlled. The control range of this single stage amounts to 70 dB. This is added to the control range of 50 dB provided by the controlled SL 610 in module DK 1 PN 007. Figure 2 gives the gain of these two ICs as a function of the control voltage.

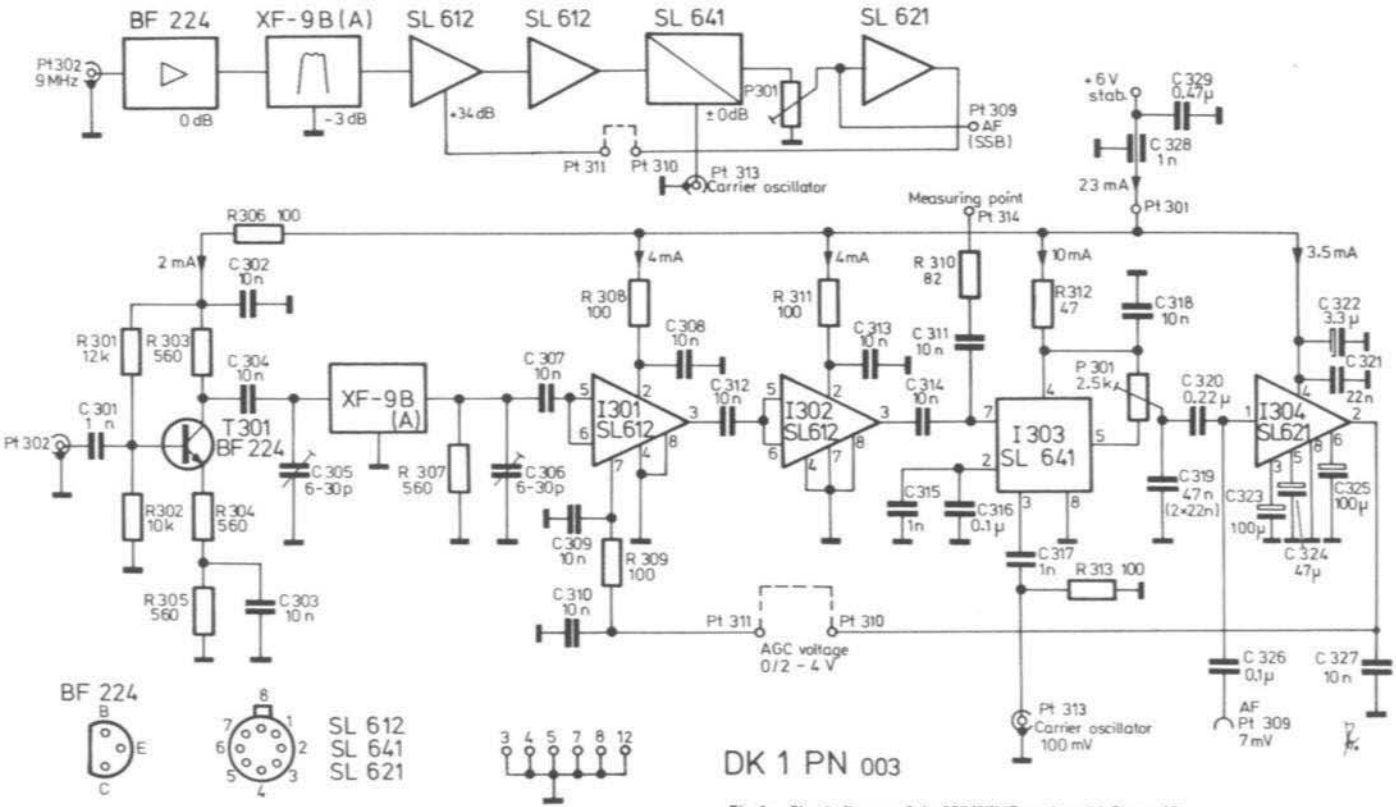


Fig. 1: Circuit diagram of the SSB/CW IF portion with Plessey ICs

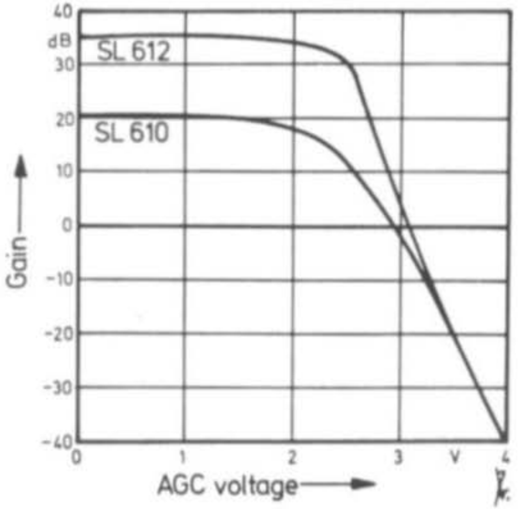


Fig. 2: Control characteristics

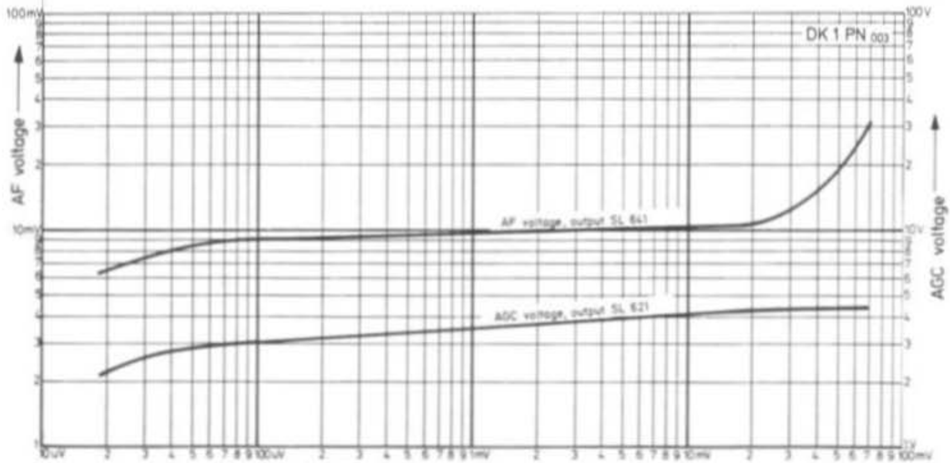


Fig. 3: Control characteristics of the SSB/CW IF module DK 1 PN 003

A decoupled IF-output is provided in front of the ring modulator that can be used, for instance, for noise measurements. The IF voltage at this point amounts to approximately 7 mV. The AF voltage at the output of mixer I 303 possesses the same value. The control threshold is adjusted to 7 mV with the aid of potentiometer P 301.

Figure 3 gives the amplitudes of the AF voltage and the control voltage as a function of the RF voltage at the input of module DK 1 PN 003. These curves are modified for the complete system to the value of the preamplification and the control of IC SL 610.

The integrated ring modulator SL 641 requires an oscillator voltage of only 50 to 100 mV. This represents a very low level especially when compared with that required by MOSFET mixers, and is of great advantage in avoiding spurious conversion products. In addition to the module DK 1 PN 002, it is also possible for the oscillator circuits DL 6 HA 003, DC 6 HL 002 or DJ 4 BG 009 to be used. The injection voltage can be brought to the required value by varying the resistance of R 313.

The most interesting integrated circuit of the SSB-IF portion is the Plessey integrated control voltage generator SL 621. This IC generates the control voltage from the AF voltage which is in the order of 7 mV to 11 mV. The characteristics are ideal for the dynamic control of voice transmissions: The control voltage is increased very rapidly on appearance of a new input voltage, it is able to follow slow voltage variations and the circuit will store the last control voltage value when the input voltage falls suddenly to zero (speech pauses) and will maintain the control voltage until the signal reappears. If the pause exceeds a certain value, the control voltage will immediately drop to zero so that the full gain is provided. In addition to this, the SL 621 provides short control voltage pulses so that interference pulses are suppressed.

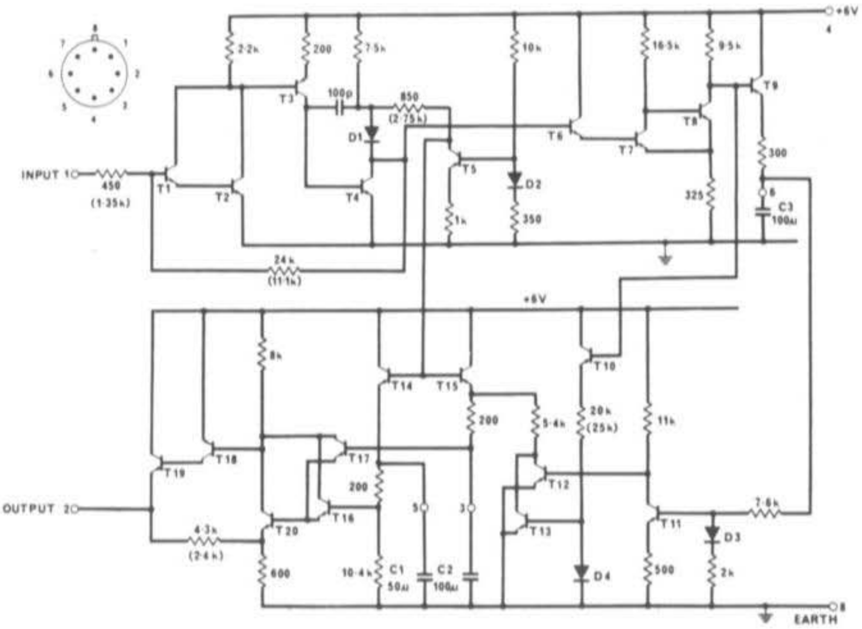


Fig. 4: Circuit diagram of the control voltage generator SL 621 (values in brackets: SL 6 20)

The following theory of operation in conjunction with Figure 4 and 5 originates from application notes of the Plessey Co: The input signal is amplified by the AF amplifier with transistor systems T 1 to T 4 and fed to two detectors (T 14, T 15) after having been provided with a DC-voltage shift with the aid of T 5. The two detectors charge the external capacitors C 1 or C 2 and the capacitors provide the detectors with short (C 1 : T 14) or long (C 2 : T 15) rise time and fall time constants. Both are connected to the output DC voltage amplifier (T 16 to T 20) which is fed by the detector with the highest voltage. When a signal appears, T 14 will ensure that a control voltage appears after the very short time t 1 (Fig. 5). After the longer time period t 3, the detector (T 15) will take over the control of the control voltage since it is somewhat more sensitive. If the input signal exceeds approximately 4 mV (RMS), the trigger circuit with transistor systems T 6 to T 8 will be activated, whose output pulses provide a low-impedance discharge path for capacitor C 2 via T 10 and T 13. The rapid fall in the voltage across C 2 and thus the control voltage ensures that fading of up to 20 dB/s can be controlled in a unit equipped with the controlled amplifier SL 612 and SL 610.

If the input signal falls more rapidly than this, or completely disappears (as is the case in speech pauses), the trigger will not operate. This means that C 2 cannot be discharged and will maintain its charge so that the last control voltage value will be stored. The output voltage of the other detector will fall to zero within the time period t 2 which does not have any effect.

The pulses of the trigger circuit also charge the third external capacitor C 3 via T 9. The voltage across this capacitor blocks transistor system T 12 via T 11. When this is non-existent, capacitor C 3 will be discharged. After the hold time t 5, T 12 will conduct and discharge C 2 within the time period t 4 so that the full gain is available. The hold time t 5 amounts to approximately 1 s when C 3 is 100 μF. If the input signal returns within the time period t 5, C 3 will be recharged and the circuit will once again operate in the normal manner.

Figure 5 also shows how the very rapid generation of the control voltage is able to suppress an interference pulse superimposed on the voice signal. The detector with the short time constant is responsible for this, whereas the other detector stores the control voltage value present before appearance of the interferring pulse.

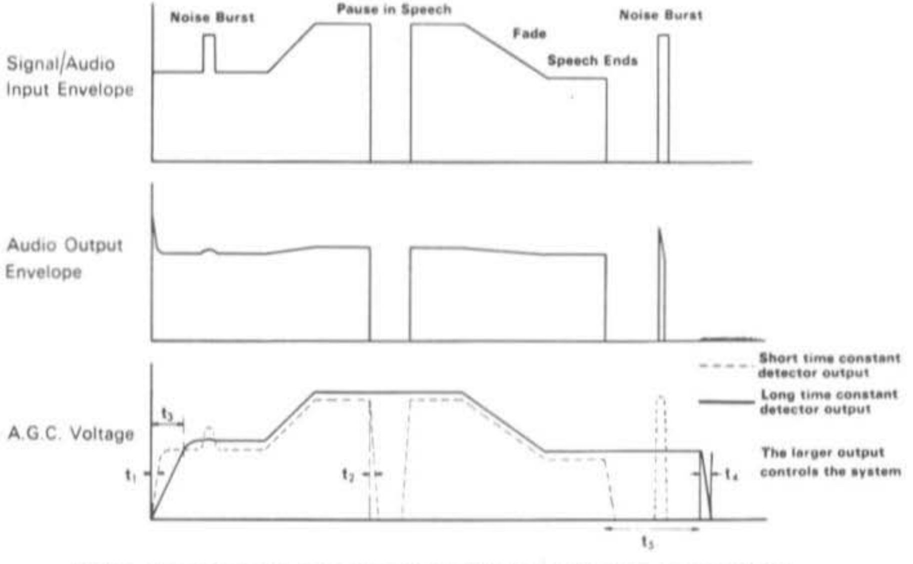


Fig. 5: Dynamic behaviour of a system controlled by the control voltage generator SL 621.

2. CONSTRUCTION

The printed circuit board DK 1 PN 003 (Fig. 6) has been developed for accommodation of the SSB/CW IF portion. The dimensions of this PC-board are 90 mm x 65 mm. If this PC-board is not to be used for the construction, special attention must be made to the decoupling. Control voltage generator SL 621 must be able to feed very high currents into the time-determining capacitors and thus be provided with a very low-impedance voltage source. A sufficient number of decoupling resistors and bypassed capacitors are therefore provided on the PC-board DK 1 PN 003.

The test output Pt 314 is not fed to the plug-in connector with the aid of a conductor lane in order to avoid any intercoupling. It should be connected with the aid of a thin coaxial cable to the vacant pin 6 or to a feedthrough in the screening can. The crystal filter is also connected with short pieces of wire to the corresponding conductor lane on the lower side of the board. This method avoids too many breaks in the ground surface by conductor lanes and has also proved more favourable due to the relatively large connections of the crystal filter. Figure 7 shows a photograph of the author's prototype.

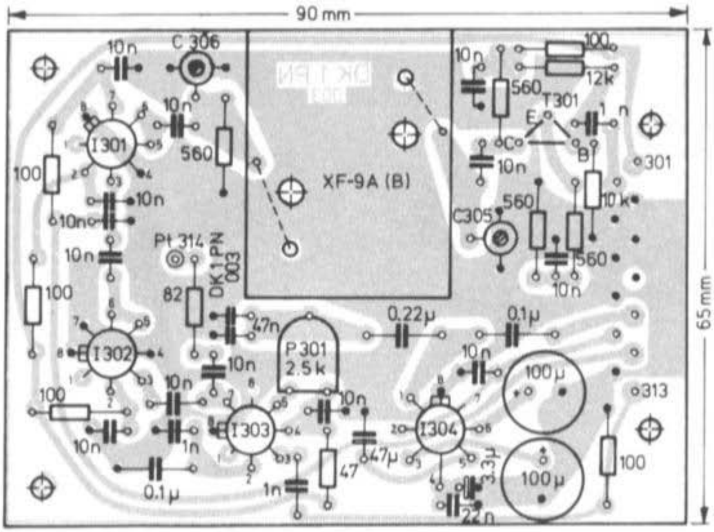


Fig. 6: PC-board DK 1 PN 003

2.1. COMPONENT DETAILS

T 301: BF 224 or similar RF transistor

I 301, I 302: SL 612 C; I 303: SL 641 C; I 304: SL 621 C (Plessey)

C 305, C 306: 6-30 pF ceramic trimmer, 7 mm dia.
C 316, C 320, C 326: 0.1 µF or 0.22 µF plastic foil capacitors
for 10 mm spacing.

All other non-poled capacitors: ceramic types of uncritical value,
spacing 5 mm.
C 322, C 324: 47 µF tantalium capacitor, drop type
C 323, C 325: 100 µF aluminum electrolytic, can 10.7 mm dia.,
spacing 5 mm

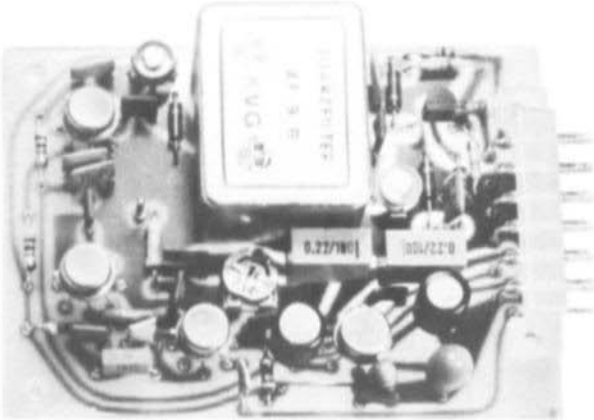


Fig. 7: Photograph of the author's prototype

P 301: 2.0 to 2.5 kΩ potentiometer, horizontal mounting, spacing 10 mm/5 mm
Crystal filter: see introduction
TEKO-case size 3 A with 13-pole connectors.

3. AVAILABLE PARTS

See material price list.

4. REFERENCES

(1) H. J. Franke: An Integrated Receiver System for AM, FM, SSB and CW
In this Edition of VHF COMMUNICATIONS

(2) D. E. Schmitzer: Plug-in Modular Equipment
VHF COMMUNICATIONS 3 (1971), Edition 2, Pages 107-114

(3) R. Lentz: A Wideband Ring Mixer with Schottky Diodes
VHF COMMUNICATIONS 4 (1972), Edition 2, Pages 121-124

(4) J. M. Bryant: Using the SL 621 AGC Generator
Radio Communication 47 (1971), No. 9, Pages 604-605

AN ATV PULSE CENTER

by K. Wilk, DC 6 YF

This pulse center is only suitable for the international CCIR television standard and other 625 line, 50 Hz systems as were described in (1). However, it is hoped that a similar ATV pulse center for the US-standard will be described later.

This unit can be used for providing all the synchronizing pulses for the whole ATV system, e.g. for the camera, monitor and transmission. These are:

Vertical blanking and synchronizing pulses.
Horizontal blanking and synchronizing pulses.

These pulses must exhibit the pulse length and spaces laid down in the television standard. Interlaced scanning is achieved when the vertical and horizontal frequency is derived from twice the horizontal frequency. In this case, the second field of 312.5 lines will be interlaced between the lines of the first field, so that a complete 625 line TV image will be scanned every 1/25th of a second (1)..

As has been previously mentioned, this pulse center can be used for control of television camera, scanner, pattern generator or as a central pulse generator for several units. In the latter case, it is possible to switch over from one unit to the other whilst maintaining the synchronization of the receiver. The output impulses correspond to the TTL-system (fan-out = 10). They are available as negative going (1-0-1) and as positive going (0-1-0) pulses.

1. THEORY OF OPERATION

In order to obtain an interlaced image, it is necessary for both the horizontal frequency of 15 625 Hz and the vertical frequency of 50 Hz to be derived from twice the horizontal frequency, e.g. from 31 250 Hz. The 31 250 Hz signal is derived from the output signal of a 1 MHz crystal oscillator by frequency division. This part of the circuit has been designated "frequency generation and division". The subsequent stages, which have been designated "pulse processing", generate the output impulses. Figure 1 shows the block diagram of the pulse center.

DC 6 YF 001

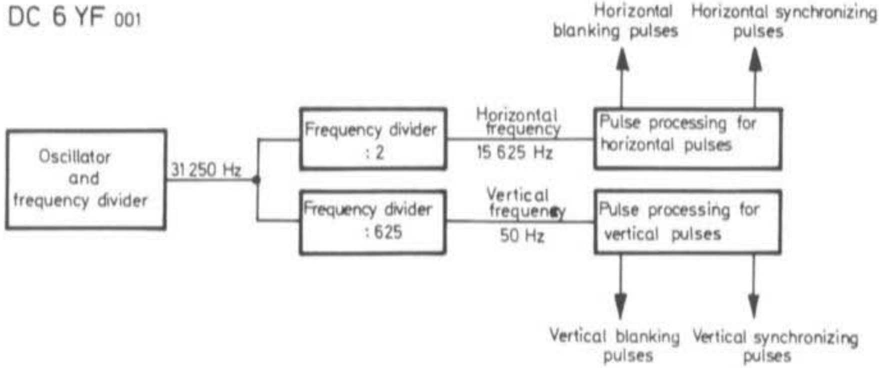


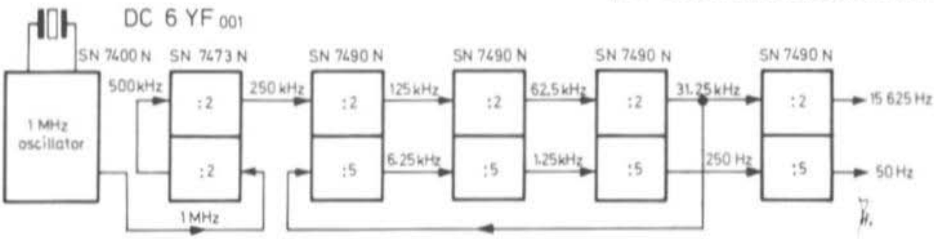
Fig. 1: Block diagram of the pulse center

2. FREQUENCY GENERATION AND DIVISION

A block diagram of the frequency generation and division circuit is given in Figure 2. The 1 MHz frequency is generated in a 1 MHz crystal oscillator which uses two gates of the multiple NAND gate type SN 7400 N. A further gate is used as buffer. The oscillator frequency is divided by four in a double flip-flop (SN 7473 N) so that a frequency of 250 kHz is present at its output. This frequency is divided to 125 kHz, 62.5 kHz, 31.25 kHz and finally to the horizontal frequency of 15 625 Hz in a chain of flip-flops using the integrated decade counters SN 7490 N. The double horizontal frequency is divided in the divide-by-five circuit of the same ICs to the vertical frequency of 50 Hz.

Since a crystal oscillator is used, it is not necessary for any frequency alignment to be made. In addition to this, 1 MHz standard crystals are not expensive and are readily obtainable. Any slight variation from the nominal frequency can be compensated for by slightly pulling the crystal frequency. However, this has no importance in the TV-mode due to the high degree of frequency division. For this reason, no trimmer capacitor has been provided in the crystal oscillator circuit.

Fig. 2: Frequency generation and division



3. THE MONOSTABLE MULTIVIBRATOR TYPE SN 74 121 N

The impulse processing circuit uses six integrated circuits type SN 74 121 N. It is felt that a short description of this component will be of interest.

Figure 3 shows the connection diagram. An RC-link determines the lability time of the connected multivibrator. The following relationship is valid: $T = \ln 2 \times R \times C = 0.69 \times R \times C$. The capacitor C is connected between connection 10 and 11; the resistor R, whose value must be between 2 kΩ and 40 kΩ, between connection 11 and the positive supply voltage. A resistor of approximately 2 kΩ is connected between pin 9 and 11 which can be used as required.

The inputs at pin 2 and 3 are equal-priority OR-inputs. The multivibrator can be triggered when they are fed with a negative-going (logic 1 to 0) TTL-pulse. Pin 4 must, of course, be connected to +5 V. The input at connection pin 4 is a Schmitt-trigger input which can be used together with a slowly changing input voltage from logic 0 to 1. For this, it is necessary for pins 3 or 4 or 3 and 4 to be connected to 0. The integrated circuit possesses two outputs: A positive impulse is available at the Q-output at pin 6 and a negative impulse at Q-output at pin 1.

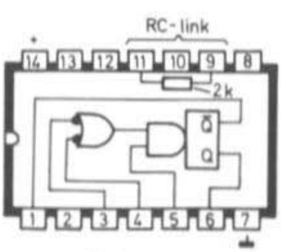


Fig. 3: IC type SN 74 121 N (from above)

4. PULSE PROCESSING, OUTPUT PULSES

All SN 74 121 N circuits in the pulse processing circuit illustrated in Figure 4, are actuated by the positive going pulse at the input (pin 4). The vertical blanking pulses of 1.26 ms duration are directly obtained from the 50 Hz vertical frequency with the aid of multivibrator I 7. The vertical synchronizing pulses (160 μs) at the output of I 9 appear with a delay of 160 μs, since I 9 will not receive a positive going pulse via the Q-output of I 8 until the operation of I 8 is completed. The same is also valid for the processing of the horizontal blanking pulses and the horizontal synchronizing pulses.

Of course, it would have been possible to use simpler circuits in the pulse processing module. However, the arrangement used here is very reliable and only requires a few external components. The output pulses correspond to the simplified pulses used in closed circuit television systems (1). The pulse diagram and the corresponding connections on the PC-board are given in Fig. 5.

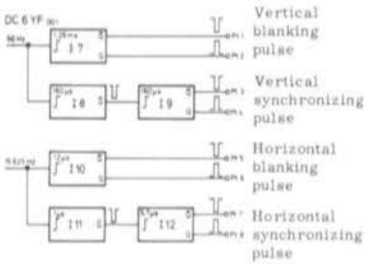


Fig. 4: Pulse processing

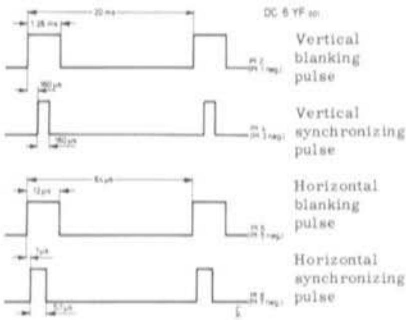


Fig. 5: Output pulses

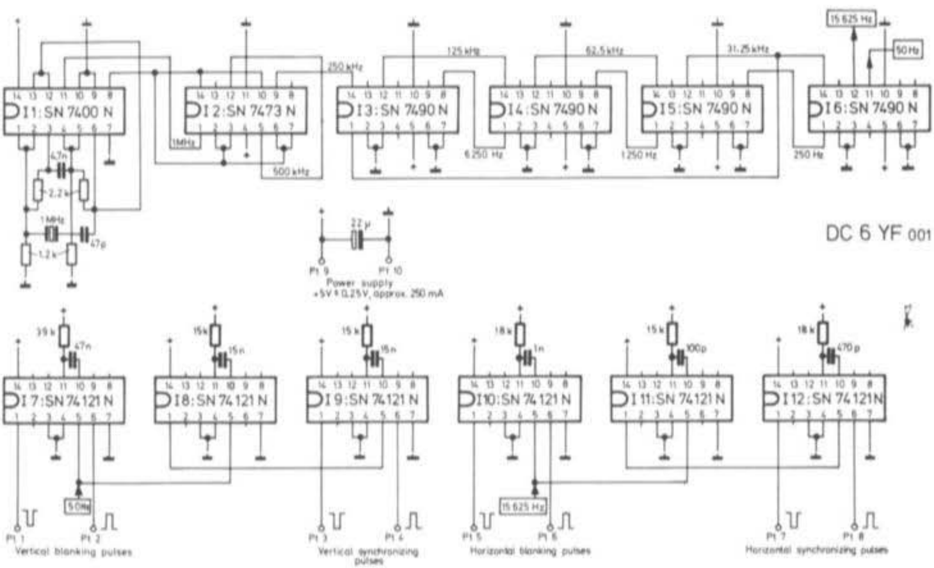


Fig. 6: Circuit diagram of the TV-pulse center

5. OVERALL CIRCUIT

The overall circuit comprises both the previously described modules. The circuit diagram is given in Figure 6. It will be seen that, with the exception of the integrated TTL-circuits, only very few additional components are used in the crystal oscillator and multivibrator stages as well as capacitors in the power supply lines. A current of approximately 250 mA will be required at an operating voltage of 5 V.

5.1. POWER SUPPLY

The operating voltage is connected to connections Pt 9 (+5 V) and Pt 10 (0 V) on the printed circuit board DC 6 YF 001. The integrated power supply described in (2) is very suitable for operating this module. Whatever power supply is used, attention should be paid that the ratings of the semiconductor manufacturers are maintained, e.g. nominal voltage 5 V, minimum 4.75 V, maximum 5.25 V. Special attention must be paid that the upper limit is not exceeded even in the most unfavourable conditions.

6. CONSTRUCTION

The circuit is built up on a double-coated PC-board with the dimensions 120 mm x 100 mm which is shown in Figure 7. This PC-board also possesses through-contacts.

The component locations are given in Figure 8. It is not necessary, as can be seen in the photograph of the prototype given in Fig. 9, to use sockets for the integrated circuits. However, they would facilitate exchange of a defective IC, or be useful if an IC that is already available, is to be used, which may be defective.

The following connections are provided on the PC-board:

Pt 1: neg. } vertical blanking pulses
Pt 2: pos. }

Pt 3: neg. } vertical synchronizing pulses
Pt 4: pos. }

Pt 5: neg. } horizontal blanking pulses
Pt 6: pos. }

Pt 7: neg. } horizontal synchronizing pulses
Pt 8: pos. }

Pt 9: power supply
Pt 10: see section 5.1.

6.1. COMPONENT DETAILS

All components used in this circuit are readily available and can be obtained from the publisher. The type designations and the integrated circuits used by the author are manufactured by Texas Instruments, however, equivalent types from other manufacturers can be used.

I 1: SN 7400 N; I 2: SN 7473 N; I 3 to I 6: SN 7490 N; I 7 to I 12: SN 74121 N

1 standard frequency crystal, 1 MHz, HC-6/U
1 crystal holder HC-6/U for horizontal mounting
3 styroflex capacitors: 100 pF, 470 pF, 1000 pF
3 plastic-foil capacitors: 47 nF, 2 x 15 nF; spacing 10 mm
9 ceramic capacitors: 1 x 47 pF, 1 x 4.7 nF, 7 x 22 nF
1 tantalium electrolytic capacitor (drop type) 22 μF/10 V

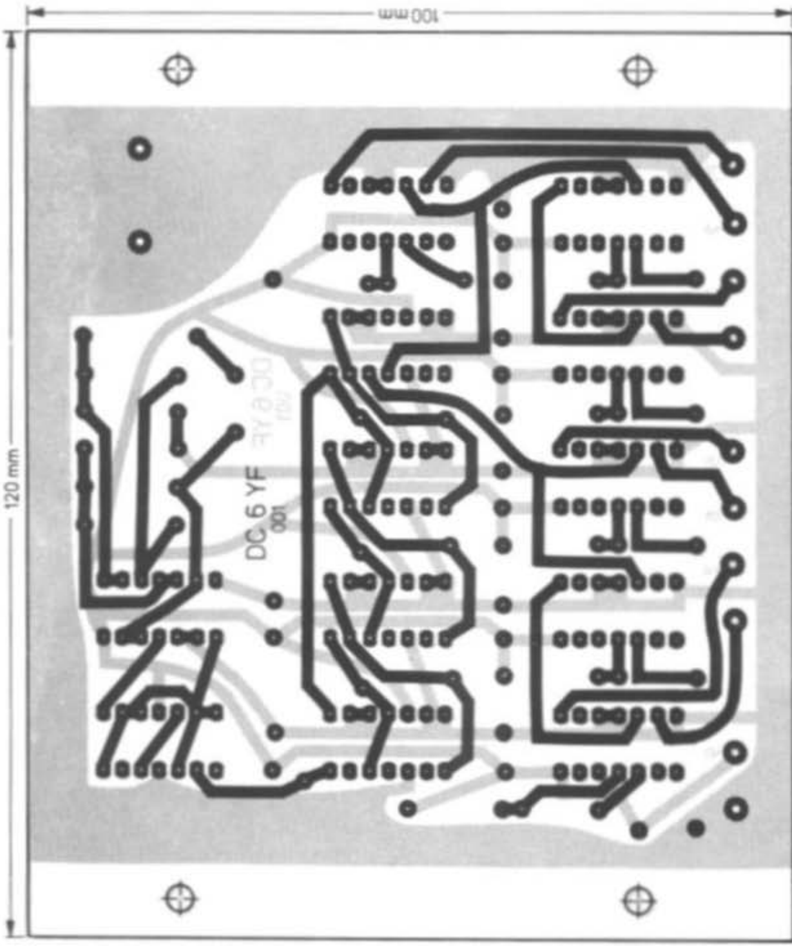


Fig. 7: PC-board DC 6 YF 001, double-coated, through contacts

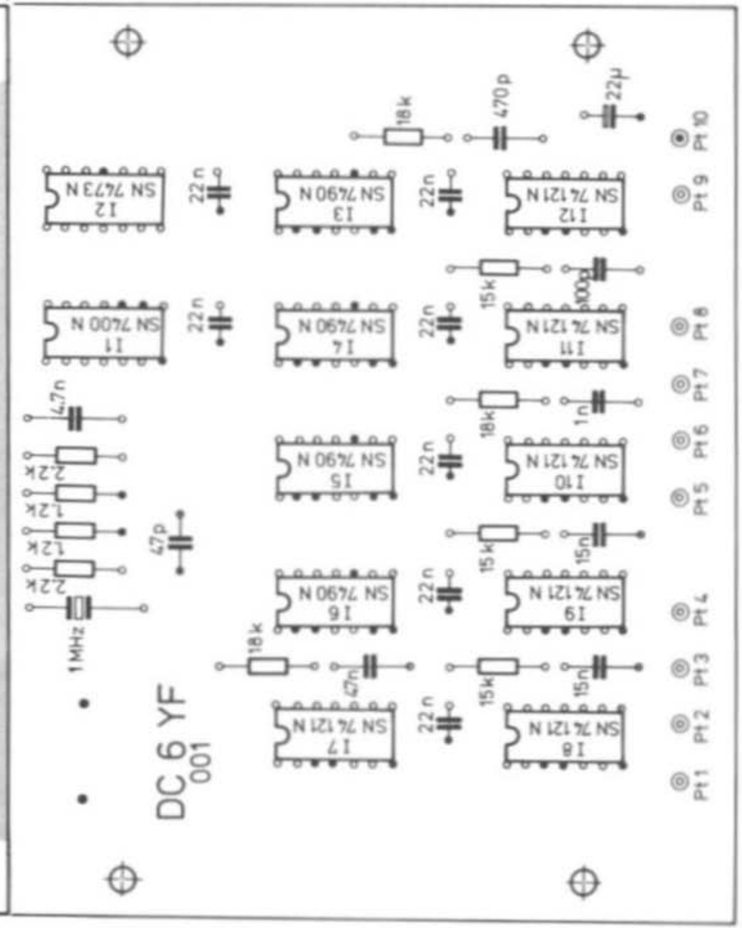


Fig. 8: Component location plan to DC 6 YF 001

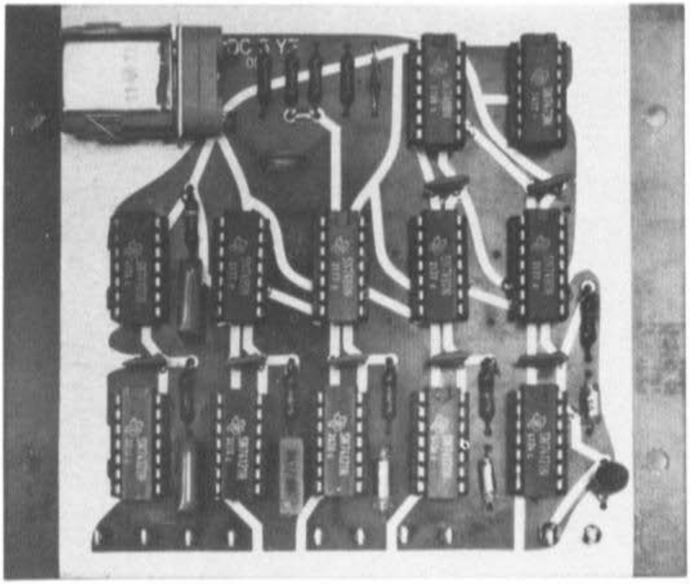


Fig. 9: Prototype of the TV-pulse center

The tolerances of the time-dependent components should not exceed 5% with the capacitors and 2% with respect to the resistors.

7. PREPARATIONS FOR OPERATION

After the PC-board has been completed, carefully study the board to see that there are no dry-joints or short circuits. Special attention must be paid that the integrated circuits have been inserted correctly (it should be remembered that one of the two possibilities is always wrong). If the components are in order, no difficulties should be encountered. After connecting the operating voltage, it is possible for the output pulses to be observed on an oscilloscope.

This pulse center is to be complemented by a TV-pattern generator which is to be described in one of the next editions of VHF COMMUNICATIONS.

8. AVAILABLE PARTS

Please see material price list.

9. REFERENCES

(1) T. Bittan: Amateur Television
VHF COMMUNICATIONS 4 (1972), Edition 3, Pages 184-190

(2) H. Kahlert: A Universal Power Supply Using an Integrated DC-Voltage Stabilizer
VHF COMMUNICATIONS 3 (1971), Edition 2, Pages 121-126

INDEX to Volume 4 (1972) of VHF COMMUNICATIONS

MATERIAL PRICE LIST OF EQUIPMENT
described in Edition 1/73 of VHF COMMUNICATIONS

DJ 4 LB 001	ATV TRANSMITTER, MODULE 1		Ed. 1/73
PC-board	DJ 4 LB 001	(with printed plan)	DM 11.--
Semiconductors	DJ 4 LB 001	(6 transistors, 2 diodes)	DM 16.90
Minikit 1	DJ 4 LB 001	(2 coilsets, 2 ferrite beads, 2 ferrite chokes, 1 Teko box 4B)	DM 12.--
Minikit 2	DJ 4 LB 001	(with all other components: 16 capacitors, 17 resistors, 2 trimmer potentiometers, 5 feedthroughs, 10 solderpins)	DM 24.50
Crystal	38.9000	(HC-6/U)	DM 20.--
Kit	DJ 4 LB 001	(complete with all components)	DM 79.50

DJ 4 LB 002	ATV TRANSMITTER, MODULE 2		Ed. 1/73
PC-board	DJ 4 LB 002	(with printed plan)	DM 11.--
Semiconductors	DJ 4 LB 002	(8 transistors, 4 diodes)	DM 26.30
Minikit 1	DJ 4 LB 002	(1 coilset, 1 ferrite bead, 2 ferrite chokes, 1 Teko box 4B)	DM 9.80
Minikit 2	DJ 4 LB 002	(with all other components: 26 capacitors, 26 resistors, 2 trimmer potentiometers, 6 feedthroughs, 10 solderpins)	DM 52.--
Kit	DJ 4 LB 002	(complete with all components)	DM 98.--

DJ 4 BG 011	SHORTWAVE RECEIVER MODULE		Ed. 1/73
PC-board	DJ 4 BG 011	(with printed plan)	DM 10.--
Semiconductors	DJ 4 BG 011	(3 dual-gate MOSFETs)	DM 22.50
Minikit 1	DJ 4 BG 011	(5 coilkits-indicate which type-, 13 pin connectors, 1 Teko box 3A)	DM 23.80
Minikit 2	DJ 4 BG 011	(with all other components: 26 capacitors, 17 resistors)	DM 18.50
Kit	DJ 4 BG 011	(complete with all components)	DM 73.--

DJ 5 UO	AUTOMATIC 10-CHANNEL SCANNER		Ed. 1/73
PC-board	DJ 5 UO 001	(with printed plan)	DM 16.50
PC-board	DJ 5 UO 002	(with printed plan)	DM 11.--
Relays	DJ 5 UO 001	(12 miniature encapsuled relays National RH-12V)	DM 120.--

DK 1 PN 003	SSB / IF PORTION		Ed. 1/73
PC-board	DK 1 PN 003	(with printed plan)	DM 10.--
Semiconductors	DK 1 PN 003	(1 resistor, 4 Plessey ICs)	DM 127.50
Minikit 1	DK 1 PN 003	(25 capacitors)	DM 32.10
Minikit 2	DK 1 PN 003	(1 trimmer potentiometer, 1 Teko box 3A, 13 pin connectors)	DM 15.30
Kit	DK 1 PN 003	(with above parts)	DM 180.--
Kit	DK 1 PN 003	(with crystal filter XF-9A)...............	DM 285.--
Kit	DK 1 PN 003	(with crystal filter XF-9B)...............	DM 315.--

DC 6 YF 001	ATV - PULSE CENTER		Ed. 1/73
PC-board	DC 6 YF 001	(double-coated, through-contacts)...........	DM 28.50
Semiconductors	DC 6 YF 001	(12 ICs)	DM 81.40
Minikit	DC 6 YF 001	(1 standard freq: crystal 1.000 MHz with holder, 12 capacitors)	DM 36.--
Kit	DC 6 YF 001	(with above parts)	DM 145.--

SPECIAL OFFER

432 MHz bandlimit indicator crystal: 27.000 MHz (HC-25/U)	.... each	DM 14.--
Miniature encapsuled relays: National RH-12	.... each	DM 10.--
Special crystal for OSCAR 6 Converter as described in 4/72 of VHF COMM. 38.817 MHz (HC-6/U)	.... each	DM 20.--

CRYSTALS and CRYSTAL FILTERS for equipment described in VHF COMMUNICATIONS.
Available ex stock when not mentioned otherwise.

Crystal filter	XF-9A (for SSB) with both sideband crystals	DM 106.--
Crystal filter	XF-9B (for SSB) with both sideband crystals	DM 137.--
Crystal filter	XF-9C (for AM; 3.75 kHz)	DM 137.--
Crystal filter	XF-9D (for AM; 5.00 kHz)	DM 137.--
Crystal filter	XF-9E (for FM; 12.00 kHz)	DM 137.--
Crystal filter	XF-9M (for CW; 0.50 kHz) with carrier crystal	DM 106.--
Crystal discriminator	XD-09-08 matching XF-9E	DM 78.--

Crystal	96.0000 MHz	(HC-6/U) for 70 cm converters (DL 9 GU, DL 9 JU)	DM 21.50
Crystal	96.0000 MHz	(HC-25/U) for 70 cm converters (DL 9 GU, DL 9 JU)	DM 28.--
Crystal	95.8333 MHz	(HC-25/U) for 70 cm converters (DC 6 HY)	DM 28.--
Crystal	84.5333 MHz	(HC-6/U) for 24 cm converters (DL 3 WR)	DM 21.50
Crystal	67.3333 MHz	(HC-6/U) for 70 cm / 10 m converters	DM 18.--
Crystal	66.5000 MHz	(HC-6/U) for synthesis VFO (DJ 5 HD)	DM 18.--
Crystal	65.7500 MHz	(HC-6/U)) for TX + RX converters	DM 21.50
Crystal	65.5000 MHz	(HC-6/U)) 130 / 130,5 /	DM 16.50
Crystal	65.2500 MHz	(HC-6/U)) 131 / 131,5 MHz	DM 21.50
Crystal	65.0000 MHz	(HC-6/U)	DM 16.50
Crystal	62.0000 MHz	(HC-6/U) for synthesis VFO (DJ 5 HD)	DM 18.--
Crystal	45.4780 MHz	(HC-25/U) for VXO (DJ 9 ZR)	DM 24.50
Crystal	42.0000 MHz	(HC-6/U) for 70 MHz converters (G 3 JHM)	DM 15.60
Crystal	38.9000 MHz	(HC-6/U) for DJ 4 LB 001 ATV-TX	DM 20.--
Crystal	38.8170 MHz	(HC-6/U) for OSCAR 6 converter	DM 20.--
Crystal	38.6667 MHz	(HC-6/U) for 2-m-converters	DM 13.70
Crystal	27.8000 MHz	(HC-25/U) for 24 MHz synthesis VFO (DL 3 WR 007)	DM 25.--
Crystal	27.0000 MHz	(HC-25/U) (bandlimit 432 MHz)	DM 14.--

STANDARD FREQUENCY CRYSTALS

5.0000 MHz	(HC-6/U)	for calibration spectrum generators (DC 6 HY)	DM 25.--
1.0000 MHz	(HC-6/U)	for calibration spectrum generators (DJ 4 BG, DC 6 HY)	DM 20.50
1.0000 MHz	(HC-6/U)	for 75°C crystal oven	DM 41.--
100 kHz	(HC-13/U)	for calibration spectrum generators (DC 6 HY)	DM 28.--

Crystals	72.... MHz (HC- 6/U) for 2 metre transmitters Please give frequency - delivery approx. 8 weeks	DM 21.50
Crystals	72.... MHz (HC-25/U) for 2 m transmitters, with crystal holder Please give frequency - delivery approx. 8 weeks	DM 33.--
Crystals	other frequencies are available on request. Please give frequency and type - delivery approx. 8 weeks.	
	HC- 6/U	DM 26.--
	HC-25/U	DM 34.--

Crystal oven	XT-1	(6 V)	DM 82.--
Crystal oven	XT-2	(12 V)	DM 82.--
Ceramic filter	CFS-455 B	(DC 6 HL 007 FM strip)	DM 75.50

TERMS OF DELIVERY and BANK ACCOUNTS

All prices are given in West German Marks. The prices do not contain post and packing for which an extra charge will be made: . . . . DM 3.--
The prices do not include any customs duty where applicable. All supplies having a value of over DM 80.-- (or less when requested) will be dispatched per registered mail and charged with: . . . . DM 1.--
Equivalent semiconductor types will be supplied if original types are not available. Only first class components are used. Semiconductors, quartz crystals and crystal filters cannot be exchanged. It is not possible for us to dispatch orders per C.O.D. All orders should be made cash-with-order including the extra chrages for post and packing, registered mail, etc. A transfer to one of our accounts or via our representatives is also possible. Any items (such as handbooks) which include post and packing are correspondingly annotated.

VERLAG UKW-BERICHTE, Hans J. DOHLUS oHG, D-8520 ERLANGEN, Gleiwitzer Strasse 45
Telephone: (09131) 333 23
Bank Accounts: Deutsche Bank Erlangen No. 476 325 - Postscheckkonto Nürnberg No. 30 455

J BEAM
ENGINEERING LTD

HIGH PERFORMANCE ANTENNAS

14 ELEMENT PARABEAM YAGI FOR 2 METERS 2/14 P

Gain: 16 dB (18.2 dB •)
Length: 595 cm (234")
Weight: 6.4 kg (14 lbs)
Hor. beamwidth (-3 dB: 24°)

Long-yagi antennas are well-known for their high gain characteristics. However, this high performance is only provided over a relatively low bandwidth when the antenna has been designed for maximum gain. The Parabeam type of antenna combines the high gain of a long-yagi antenna with the inherently wider bandwidth of skeleton slot fed arrays.

The actual Parabeam unit comprising a skeleton slot and similar reflector radiates similar to two stacked two-element yagi antennas and will therefore provide 3 dB gain over a single dipole and reflector configuration, and about 2 dB gain over a conventionally fed long-yagi. Heavy duty construction with special quality aluminium.

46 ELEMENT MULTIBEAM FOR 70 cm 70/MBM 46

Gain: 20 dB (22.2 dB •)
Length: 265 cm (104")
Width: 46 cm (18")
Weight: 2.70 kg (6 lbs)
Hor. beamwidth (-3 dB: 24°)

The ultimate UHF-antenna for long-distance communication. The Multibeam virtually comprises four 12-element yagi antennas that have been stacked and bayed to form a single, compact array. Gain is equal to two stacked 18-element yagis: 20 dB over a dipole; 22.2 dB isotropic. The Multibeam can be stacked and bayed in a conventional manner to obtain 23 dB (25.2 dB isotropic) with two antennas, or 26 dB (28.2 dB isotropic) with four antennas. Such arrays can be successfully used for EME (moonbounce) and for other extreme DX modes on 70 cm.

The gain figures marked with • refer to dB over an isotropic radiator and have been provided to allow comparison to antennas whose gain figures are given in this manner, e.g. for US antennas.

The J-Beam antennas are available from the sales organization of VHF COMMUNICATIONS which have the World sales rights for these antennas. Dealers enquiries are also requested. Please request the price list from your nearest representative.

UKW-BERICHTE, H. DOHLUS oHG, D-8520 ERLANGEN, Gleiwitzer Strasse 45

CRYSTAL FILTERS - FILTER CRYSTALS - OSCILLATOR CRYSTALS

SYNONYMOUS for QUALITY and ADVANCED TECHNOLOGY

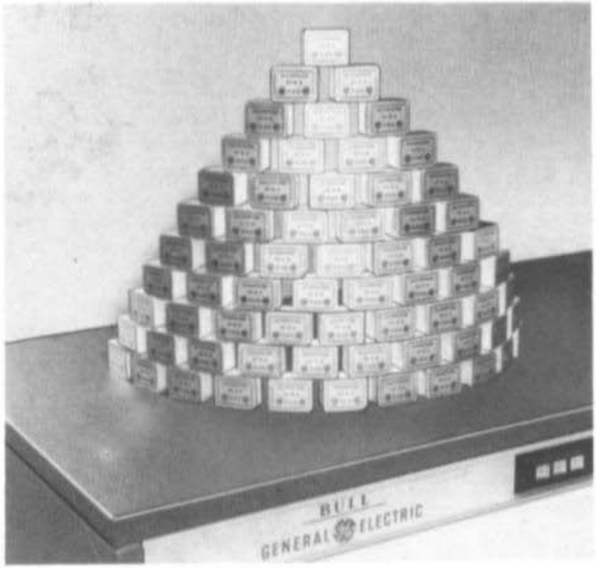
PRECISION QUARTZ CRYSTALS. ULTRASONIC CRYSTALS.

PIEZO-ELECTRIC PRESSURE TRANSDUCERS

Listed is our well-known series of

9 MHz crystal filters for SSB, AM, FM and CW applications.

In order to simplify matching, the input and output of the filters comprise tuned differential transformers with galvanic connection to the casing.



Filter Type		XF-9A	XF-9B	XF-9C	XF-9D	XF-9E	XF-9M
Application		SSB-Transmit.	SSB	AM	AM	FM	CW
Number of Filter Crystals		5	8	8	8	8	4
Bandwidth (6dB down)		2.5 kHz	2.4 kHz	3.75 kHz	5.0 kHz	12.0 kHz	0.5 kHz
Passband Ripple		< 1 dB	< 2 dB	< 2 dB	< 2 dB	< 2 dB	< 1 dB
Insertion Loss		< 3 dB	< 3.5 dB	< 3.5 dB	< 3.5 dB	< 3 dB	< 5 dB
Input-Output	Z_t	500 Ω	500 Ω	500 Ω	500 Ω	1200 Ω	500 Ω
Termination	C_t	30 pF	30 pF	30 pF	30 pF	30 pF	30 pF
Shape Factor		(6:50 dB) 1.7	(6:60 dB) 1.8	(6:60 dB) 1.8	(6:60 dB) 1.8	(6:60 dB) 1.8	(6:40 dB) 2.5
			(6:80 dB) 2.2	(6:80 dB) 2.2	(6:80 dB) 2.2	(6:80 dB) 2.2	(6:60 dB) 4.4
Ultimate Attenuation		> 45 dB	> 100 dB	> 100 dB	> 100 dB	>90 dB	> 90 dB

KRISTALLVERARBEITUNG NECKARBISCHOFSHEIM GMBH

D 6924 Neckarbischofsheim · Postfach 7