

An ATV-Transmitter for the 24 cm Band Constructed from Modules Described in VHF COMMUNICATIONS

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SUMMARY

The following information and measured values show that it is also advisable to construct an ATV-transmitter according to the intermediate frequency method even on the 24 cm band. When a single-conversion process is used that converts the standard video and sound intermediate frequency direct to the 24 cm band, this will mean that the 70 cm ATV-band is avoided, which means that it can be used for reception and duplex operation.

Figure 1 shows a block diagram of the video and sound processing at IF-level, and is identical to that described in (1) for a 70 cm transmitter.

The IF-signals of 38.9 MHz (video) and 33.4 MHz (sound) are converted to a frequency of 1252.5 MHz (video), and 1258.0 MHz (sound) with the aid of the local oscillator frequency of 1291.4 MHz. This is shown in the form of a block diagram in Figure 2. The output power level can be increased in a transistorized linear amplifier such as DC 0 DA 008/009 described in (2) or in DJ 4 LB 008 which will be described later.

Various modules can be used for generating the crystal-controlled local oscillator frequency of 1291.4 MHz: e.g. DF 8 QK 002 in (3). The module DF 8 QK 001, which was described in (4), is suitable for use as transmit mixer after carrying out the following modifications.

CIRCUIT DESCRIPTION

1. IF-MODULE

This is built up using the DJ 6 PI, and DJ 4 LB modules given in Figure 1. Figure 3 shows an additional IF-output coupling stage which should be connected directly to the output of the residual sideband filter. This stage allows the 70 cm and 24 cm transmitter to be operated from the same IF-module, and saves switching the IF-voltage when operating on either the 70 or 24 cm band. The output of the additional IF-stage can remain disconnected. If the 70 cm mixer is not connected, it is necessary for the residual sideband filter to be terminated with approximately 60 Ω at this position.

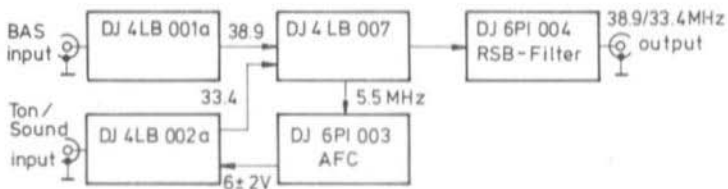


Fig. 1: Video and sound processing at IF-level, as was used in the DJ 4 LB 70 cm ATV-transmitter

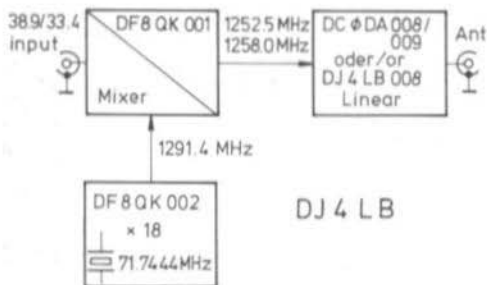


Fig. 2:
Modules and frequencies for converting the ATV-signal to the 24 cm band

2. LOCAL OSCILLATOR MODULE DF 8 QK 002

This module provides the eighteenth harmonic of the crystal frequency. This means that one will need a crystal whose frequency is $1291.4 \text{ MHz} \div 18 = 71.74444 \text{ MHz}$. No further modifications are required to this module.

3. LINEAR CONVERTER DF 8 QK 001

3.1. IF-Input Circuit

The original version of this module was designed for SSB operation at 1296 MHz using an intermediate frequency of 28 MHz. **Figure 4** shows the circuit of the IF-input circuit of the mixer.

An IF-input circuit having a wider bandwidth is more suitable for ATV-operation. This should be designed for a mean intermediate frequency of approximately 36 MHz, as is shown in **Figure 5**. The following modifications should be made to the original version shown in **Figure 4**:

- Delete the parallel capacitance C 1 (22 pF trimmer), otherwise unwanted oscillation can occur in the video-frequency range !
- Wind inductance L 1' : 2 x 6 turns of 0.3 mm dia. enamelled copper wire on a coil former of 5 mm diameter, bifilar wound. Separate the windings and connect in

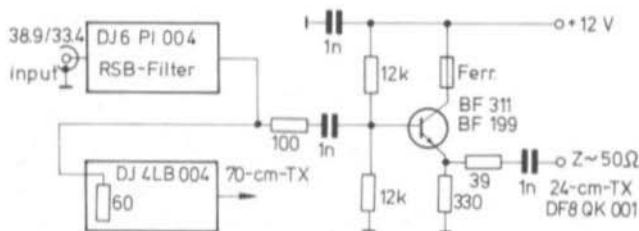


Fig. 3:
Both mixers can be connected simultaneously by using an additional buffer stage

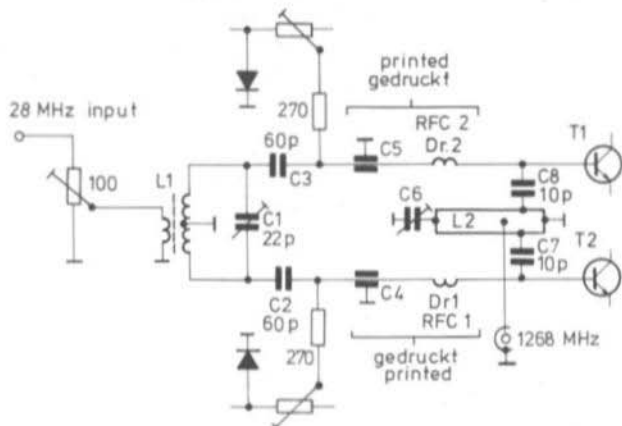


Fig. 4:
This original circuit of the mixer is not suitable for our application

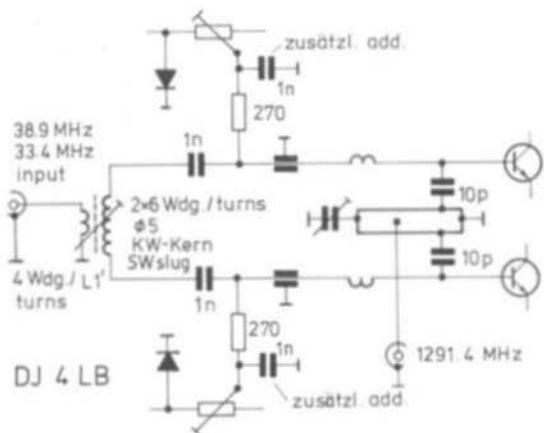


Fig. 5:
This is the modified
mixer circuit for
24 cm ATV

series. Do not connect the resulting center tap to ground since the IF-circuit is balanced capacitively! Wind four coupling windings symmetrically to the center tap of the coil. Tune the IF-circuit using a HF-core to approx. 36 MHz.

- Replace the 60 pF capacitors C2 and C3 by 1 nF types. The DC-blocking instead of the capacitive divider ensures that the 270 Ω resistors dampen the whole IF resonant circuit.
- Add one 1 nF each from the cold end of the 270 Ω resistors to ground in order to achieve a defined dampening of the resonant circuit – independent of the adjustment of the potentiometer – and to isolate the IF-voltage from the diodes of the base-voltage divider.

3.2. Operating Point of the Transistors

Extensive experiments have shown the following:

- All transistors should be operated with stabilized collector DC-voltages. The resistors in the collector circuits are only provided to measure the collector currents without cutting the lines. They should have the lowest possible value.
- The active mixer will have its largest linear drive range with a collector DC-voltage between 8 and 9 V.
- The amplifier transistors T3 and T4 should be operated with a maximum collector DC-voltage of 8 V for thermal stability reasons.

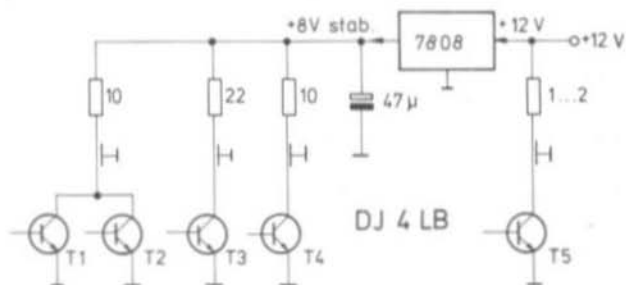


Fig. 6:
The new collector-
voltage supply of
module DF 8 QK 001

The circuit given in **Figure 6** shows how these demands can be satisfied using an integrated 8 V voltage stabilizer such as type 7808. It is also advisable to redesign all base voltage dividers to suit the stable 8 V supply.

Since the DC-gain of RF-transistors is not very high (e.g. $B \geq 25$ in the case of the BFQ 34), the base voltage should be taken from a low-impedance source. **Figure 7** gives a suitable circuit which also includes a temperature compensation. The collector current of the BFQ 34 (T 5) should be adjusted to the most favorable value of approximately 150 mA.

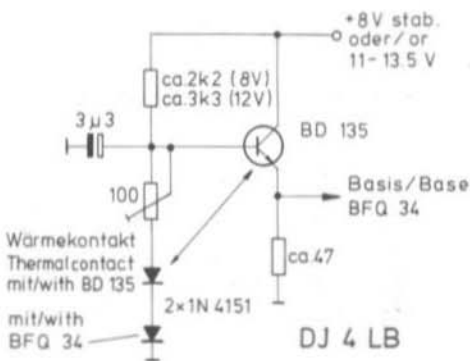


Fig. 7:
A low-impedance, base-voltage supply with temperature compensation

3.3. Measured Values

Complement:

T 1, T 2, T 3: BFR 34a
T 4: BFR 96
T 5: BFQ 34

Operating voltage: 12.0 V

IF-voltage (video + sound) at the IF-input connector: 50 mV RMS

Local oscillator power at the LO-input connector: approx. 3 mW

RF-output power for 1 dB compression: approx. 800 mW.

Overall bandwidth: Approx. 1 dB at $\Delta f = \pm 4$ MHz from the center frequency.

3.4. Spectrum Analysis

Figure 8 shows the most important components of the output frequency spectrum in a double-logarithmic display.

The sound carrier is a constant 11.5 dB down on the video carrier; according to the CCIR standard, values of 10 to 13 dB are permissible. At an output power of 0.8 W for the video carrier, the sound carrier is reduced by 1 dB, which is a sign of the commencing limiting of the sum signal of video and sound carrier. Roughly speaking, this point represents the upper limit of the drive during ATV-operation, since the synchronizing pulses of the video modulation will also be limited by approximately 1 dB at this output level.

The strongest intermodulation product during ATV-operation using a 5.5 MHz video/sound spacing is at a frequency of $f_{\text{video}} - 5.5$ MHz (curve 4). The amplitude of this line will increase considerably faster than the output power on increasing the drive level. Further, weaker intermodulation products can be seen at the frequencies $f_{\text{video}} \pm 11$ MHz (curves 5 and 6).

The image frequency of the video carrier is spaced 77.8 MHz higher than the required frequency, and is depressed by approximately 33 dB. If a linear amplifier having a similar construction to DC 0 DA 008/009, or DJ 4 LB 008 is connected after the mixer module, this will increase the image rejection per (single or parallel) stage by at least a further 8 dB.

The local oscillator frequency is only optimally suppressed at the IF-level at which the transistor push-pull mixer is balanced with the aid of the base-bias voltage. This IF-level corresponds to an RF-output power of approx. 0.3 W in our example. The range of best balance and thus best rejection of the local oscillator frequency can be adjusted to any output power level by alignment.

A spectrum analysis such as given in Fig. 8 provides suitable criteria for calculating an output filter to provide further rejection of the spurious waves.

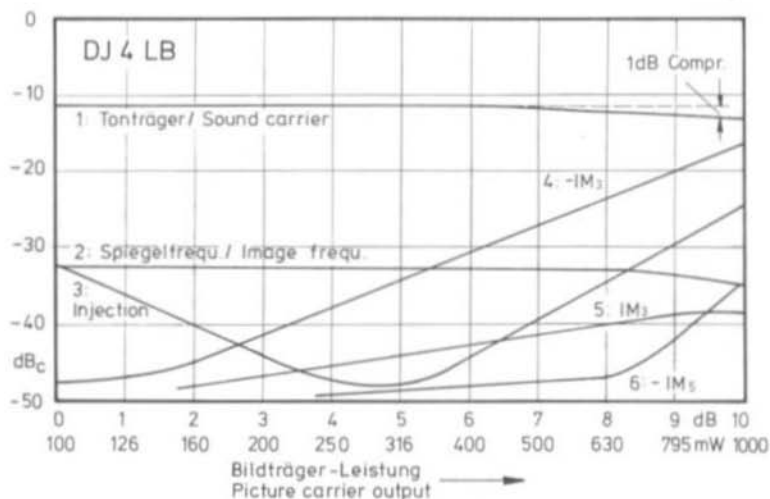


Fig. 8:
The most important finding on this diagram is that a transmit power increase of 3 dB will cause an increase of the strongest intermodulation product (curve 4) by approximately 10 dB !

- 1) Sound carrier = 1258.0 MHz
- 2) Image frequency = 1252.5 MHz + (2 x 38.9) MHz = 1330.3 MHz
- 3) LO = 1252.5 MHz + 38.9 MHz = 1291.4 MHz
- 4) $-IM_3 = 2 \times 1252.5 \text{ MHz} - 1258 \text{ MHz} = 1247 \text{ MHz}$
- 5) $IM_3 = 2 \times 1258 \text{ MHz} - 1252.5 \text{ MHz} = 1263.5 \text{ MHz}$
- 6) $-IM_5 = 3 \times 1252.5 \text{ MHz} - 2 \times 1258 \text{ MHz} = 1241.5 \text{ MHz}$

4. TRANSISTORIZED LINEAR AMPLIFIERS

The following linear amplifiers are suitable for amplifying the output power level of an ATV-signal from module DF 8 QK 001. This can be seen by comparing the power levels at the 1 dB compression points (s. **Table 1**).

Each of these single, or parallel stages has a power gain of approximately 7 dB at the 1 dB compression point. Since the power limit of an amplifier stage equipped with the BFQ 68 is only approximately 3.5 dB over that of the transmit converter (0.8 W to 1.7 W), a gain reserve of 3.5 dB is provided.

Modules	Output power for 1 dB compression
DF 8 QK 001 on its own	approx. 0.8 W
DF 8 QK 001 + amplifier with 1 x BFQ 34	approx. 1.2 W
DF 8 QK 001 + amplifier with 2 x BFQ 34 parallel	approx. 1.7 W
DF 8 QK 001 + amplifier with 1 x BFQ 68	approx. 1.7 W

Table 1

k If the two modules are directly connected to another using a short coaxial cable, it is necessary for the IF-level to be reduced, in order to avoid overdriving the linear amplifier. This is made easily by adjusting the level controls provided for this in the IF-module DJ 6 PI 002 or DJ 4 LB 007.

On the other hand, it is possible to provide 3.5 dB attenuation between converter and linear amplifier in the above example. This could be in the form of a simple bandpass filter, or a longer coaxial cable (for example up to 5 m of RG-58/U), which may make it possible to mount the linear amplifier in the direct vicinity of the antenna.

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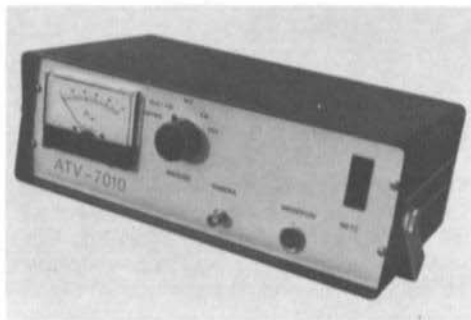
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Even Colour ATV-Communications are easy with our ATV-7010 Transmitter

The **ATV-7010** is a complete TV-transmitter for the 70 cm band. It is only necessary to connect a colour or monochrome TV-camera, microphone, antenna, and power-line (220 V / 50 Hz).

The TV-transmitter uses a video-sound spacing according to CCIR. All transmissions can be received on a domestic TV-receiver equipped with a 70 cm converter.

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Specifications:

Frequencies (xtal-controlled): Video 434.250 MHz, sound 439.750 MHz.
Third-order IM: typ. - 30 dB; f_{osc} and f_{image} typ. - 55 dB.
Unmodulated carrier output: typ. 10 W, 3 TCs, 34 transistors, 24 diodes.
Dimensions: 320 mm by 110 mm by 190 mm.
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