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CW Modulator Using Pin Diodes

This article describes a CW modulator for radio applications which is simple and uncomplicated from the rf technology point of view. The call sign and additional data are encoded and stored in an EPROM.

1.

Circuit description

The pin diode modulator originates from an application note by Hewlett Packard [1]. The combination of pin diodes (BA479) and resistors offers optimal matching (SWR) of the input and output in both switching positions, "On" and "Off". This guarantees good matching for the master oscillator and the later frequency multiplier stages.

Because of its attenuation behaviour and the impedance matching is dependent on the diode current, the circuit is usable only as an rf switch and not as an amplitude modulator. The graph in Fig. 1 gives a visual representation of the attenuation performance. The circuit was used as a broadband modulator for an SWR indicator [3] as long ago as 1984 by Wilhelm Schürings (DK4TJ).

The 3 pole high pass filters at the input and output, attenuate the pulses from the control circuit so that they do not affect

the oscillator and the frequency multiplier. It is a Chebyshev filter with 0.01dB ripple in its transmission range. With the specified values, at $2 \times 1\mu\text{H}$ and 270pF , a lower limiting frequency of approximately 10MHz is obtained.

The control circuit consists of an EPROM with the text data and a drive stage (IC5, T2, T3). The operational amplifier controls the switching current for the pin diodes (D1 to D4) through the two transistors: +40mA in the switching position "On" and -40mA for "Off". The transistor T1 acts as an inverter.

The text data is stored in the 27256 EPROM (IC2). This memory chip is organised for $32\text{k} \times 8$ bits. Only the most

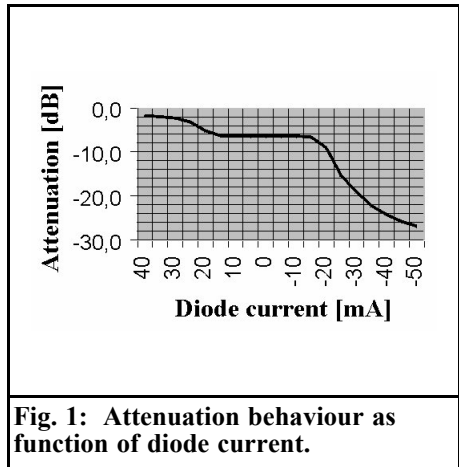


Fig. 1: Attenuation behaviour as function of diode current.

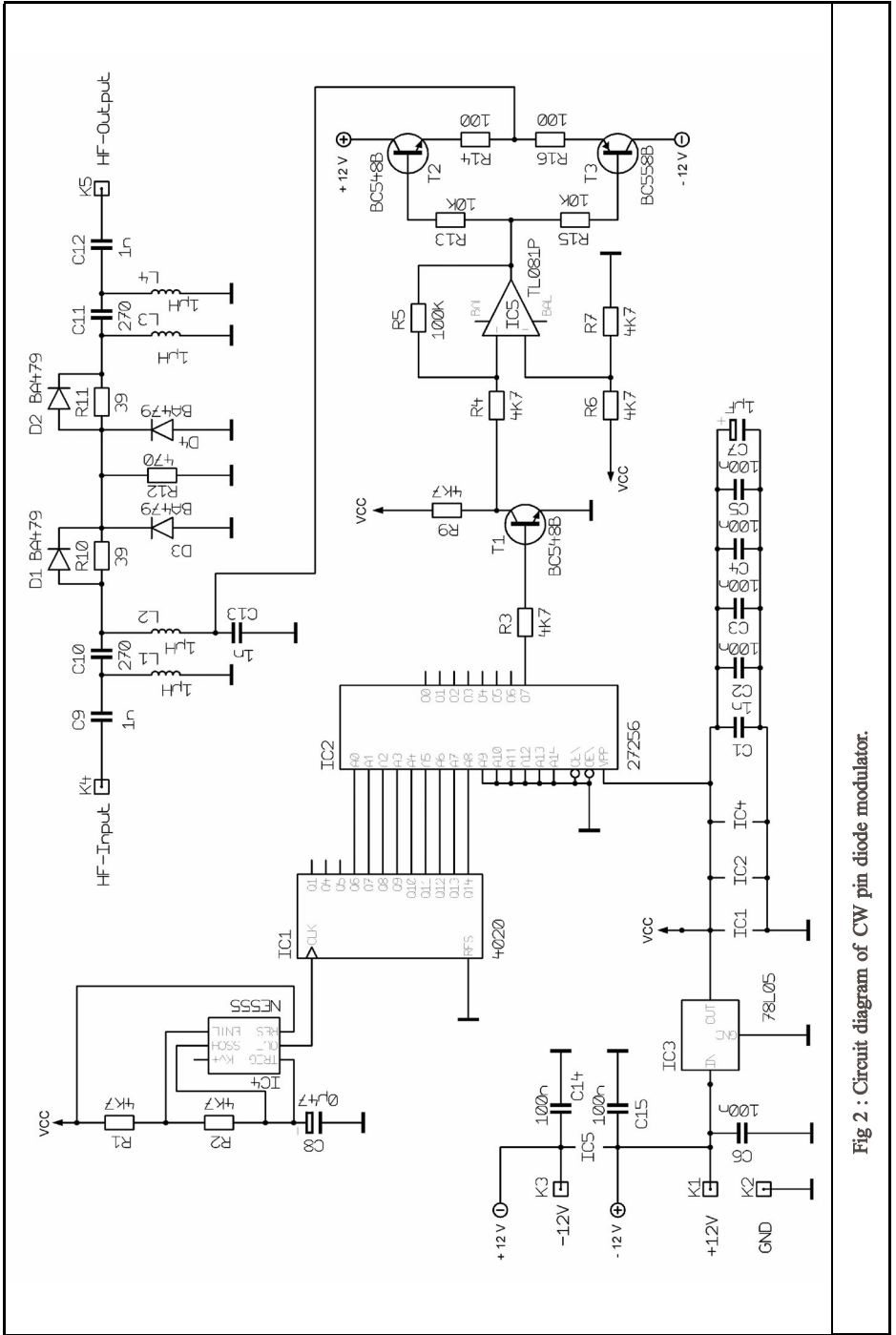


Fig 2 : Circuit diagram of CW pin diode modulator.

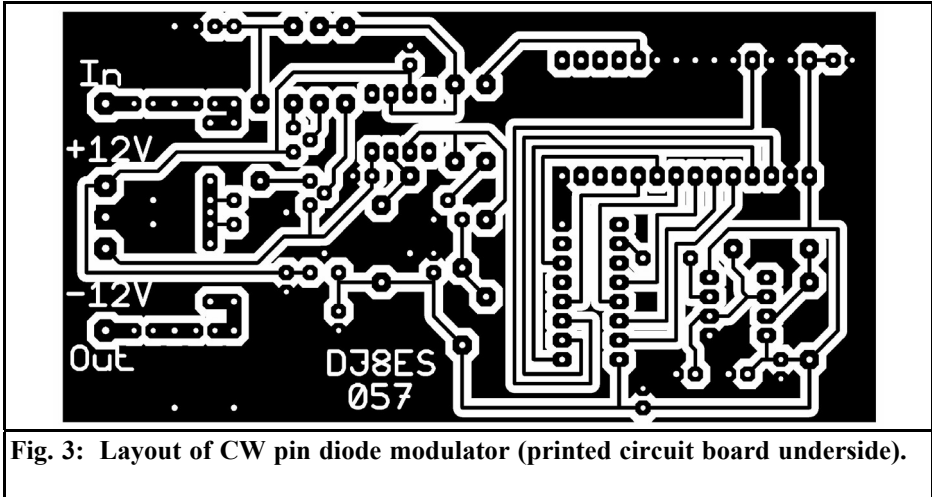


Fig. 3: Layout of CW pin diode modulator (printed circuit board underside).

significant data bit, Q7, is used to save the CW text in the above circuit. If the data bits Q0 to Q7 are switched round, 8 different CW texts can be stored.

The CW characters are serially fetched, the EPROM is addressed through its address circuit. This is achieved by a CMOS IC 4020 (IC1). This is a 14 bit binary counter, in which the 9 low value bits are used to address the EPROM.

The programmed CW text should be outputted at a rate of 60BpM. The clock frequency can thus be calculated to make

available a storage area of 512 bits at 273Hz. The address area begins at 0000H and ends at memory address 01FFH.

A standard circuit using an NE555 timer IC (IC4) is used as a clock circuit. The output frequency is defined by the RC combination of 2 x 4.7k Ω and 0.47 μ F. One of the two resistors can be replaced by a potentiometer for the precise setting of the speed if applicable.

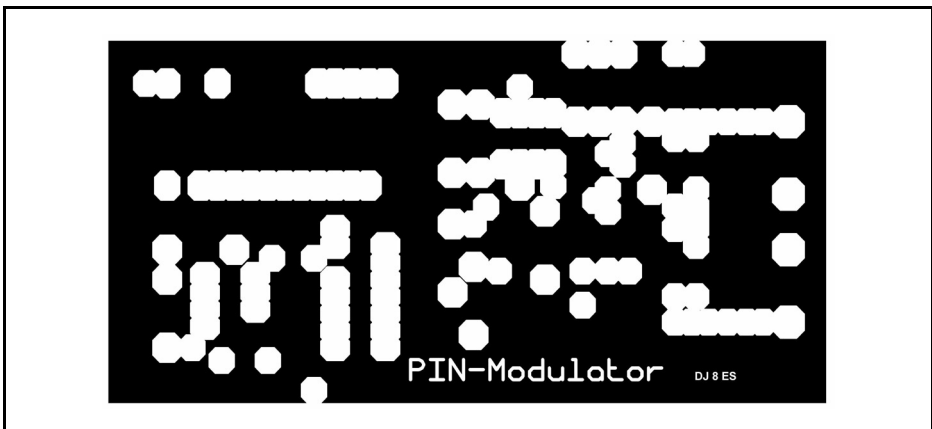


Fig. 4: Earth side of CW pin diode modulator printed circuit board.

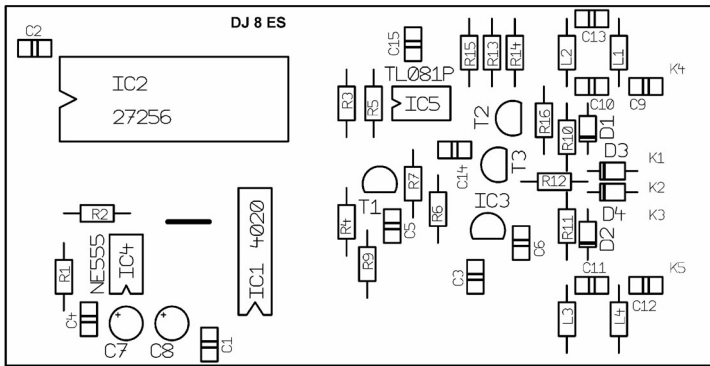


Fig. 5: Components layout of CW pin diode modulator.

2.

Assembly instructions

The CW modulator with pin diodes is assembled on a double-sided epoxy printed circuit board with the dimensions 54mm. x 108mm.. The circuit thus fits into a standard tinfoil housing with the dimensions 55.5mm. x 111mm. x 30mm.. The earth surfaces are soldered to the housing all round on both sides.

The components are inserted in no particular order in accordance with the components drawing in Fig. 5. All earth connections are soldered on both sides.

It is useful if a precision IC socket is used for the EPROM, so that the EPROM can be replaced for text amendments at any time. The photo (Fig. 6) shows the modulator before fitting into the housing.

3.

Parts list

- T1, T2 BC548B transistor
- T3 BC558B transistor
- IC1 4020 CMOS counter
- IC2 27256 E-prom
- IC3 78L05 voltage regulator
- IC4 NE555 timer IC
- IC5 TL081 operational amplifier
- D1, D2, D3, D4 BA479 pin-type diode
- L1, L2, L3, L4 1µh, axial, RM 10 mm
- C7 1µF/25V, RM 2.5 mm tantalum electrolytic
- C8 0.47µF/16V, RM 2.5 mm tantalum electrolytic

Ceramic capacitors EGPU, RM 2.5 mm.:

- 2 x 270pF
- 4 x 1nF

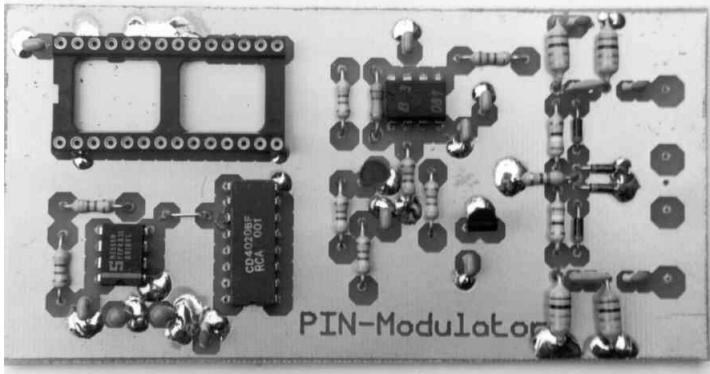


Fig. 6: Specimen assembly of CW pin diode modulator.

7 x 100nF

Resistors ¼ W, RM 10 mm.:

2 x 39Ω
 2 x 100Ω
 1 x 470Ω
 7 x 4.7kΩ
 2 x 10kΩ
 1 x 100k

4.

Putting into operation and operational experiences

The CW modulator assembly with the pin diodes can be put into operation following assembly and a final inspection of the components. No calibration is needed.

A stabilised voltage $\pm 12V$ power supply is required. The peak current consumption is approximately 50mA, depending on the actual switching position.

The CW modulator described above has been in constant use for a year now in the DB0GHZ beacon in Penneberg/Appen near Hamburg (locator JO43UP). The

beacons crystal oscillator (approximately 108MHz) is keyed through the pin diodes.

5.

Literature references

- [1] H.Vifian, F.K.David, W.L.Frederik: A Voltmeter for the microwave engineer, HP-Journal 11/72
- [2] Vishay Telefunken: Data sheet BA 479, Document Number 85527, Revision 2, 1. 4. 99, www.vishay.de
- [3] Wilhelm Schürings, DK4TJ: The SWR indicator, VHF Communications 3/84 pp 171 - 180
- [4] Wolfgang Schneider, DJ8ES: CW call sign transmitter, VHF Communications 3/93 pp 158 - 161