

Simple fixed channel DRM¹ receiver

Abstract

Direct conversion receiver with 12 kHz IF frequency. This receiver has no AGC and no image rejection. Application is only for reception of DRM signals where the image frequency band is not occupied by a stronger signal.

Basic receiver

The whip antenna is connected to a tuned antenna circuit. The signal from the crystal oscillator is fed to an additive mixer together with the received signal. The mixer is realised with a bipolar transistor and a current source. The output signal is band-pass filtered.

The circuit is realised with 4 transistors, one crystal, one tuned coil (IF transformer for 10.7 MHz without internal capacitor²) and some resistors and capacitors.

Specifications

Receiving frequency	15440 kHz (Deutsche Welle, Sines, Portugal)
IF frequency	12 kHz
Supply voltage	3 Volt DC
Supply current consumption	1 mA
Noise-limited sensitivity	25 μ V rms. for usable DRM reception
Output voltage	>25 mV rms.; nominal 100 mV rms (in central Europe)

Alignments

There are two alignments. One is the oscillator frequency, in this example 14428 kHz within 500 Hz. The second alignment is the antenna tuning which is not very critical.

The oscillator crystal

Nominal Frequency: 15.432 MHz, fundamental, Holder: HC49/U, Load Capacitance Cl: 10 pF, Parallel Capacitance Cp(max): 7 pF, Motional Capacitance: (standard), Series Resistance R1(max): (standard), Maximum Drive Level: (standard).

(The reason for the 4 kHz offset is the fact that the oscillation frequency can be adjusted lower, but never higher).

The oscillator level is measured across the 68 Ω resistor and has to be in the order of 400 mV p-p.

Antenna filter

Transformer 2.8 μ H with tap at 30 to 50 % from ground. Example: 10.7 MHz IF transformer with 7+7 windings, or 12:5 windings.

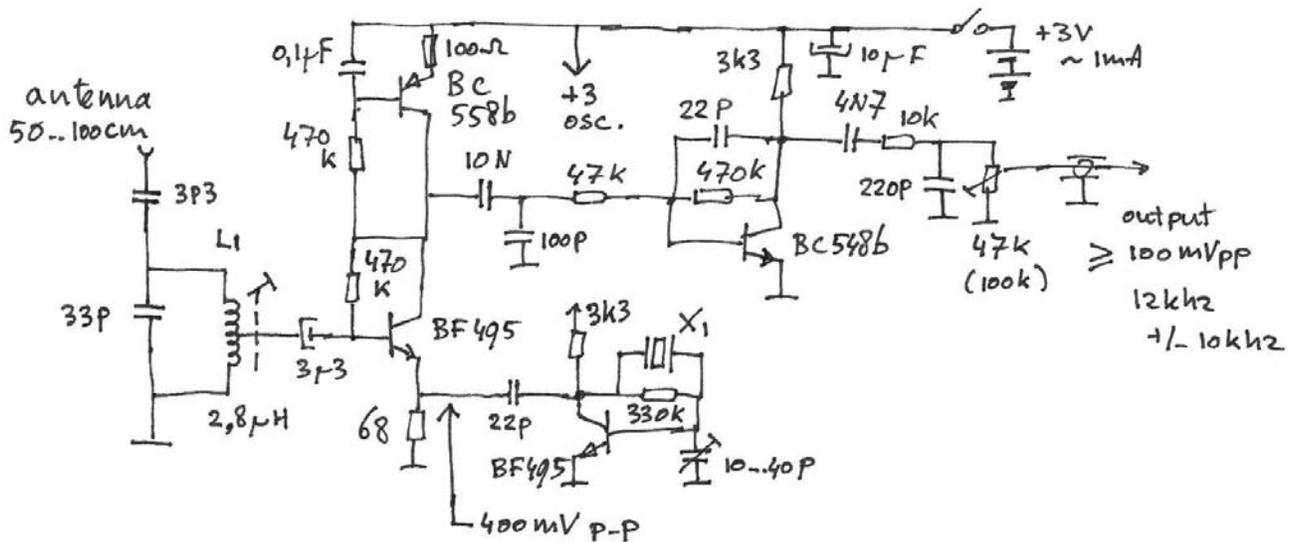
Attention: transformer without internal resonance capacitor!

¹ DRM: Digital Radio Mondiale, see www.drm.com

² Internal capacitor is removed by crunching (destroy mechanically)

Circuit

The circuit diagram is given below.



→ L_1 is IF transformer (10.7MHz) nominal $2.8\mu\text{H}$.
(Attention: remove internal capacitor!).

→ X_1 : CRYSTAL 15430kHz, OSCILLATION TUNED TO 15428kHz

Fig. 1. Circuit diagram. The antenna filter is tuned to 15440 kHz.

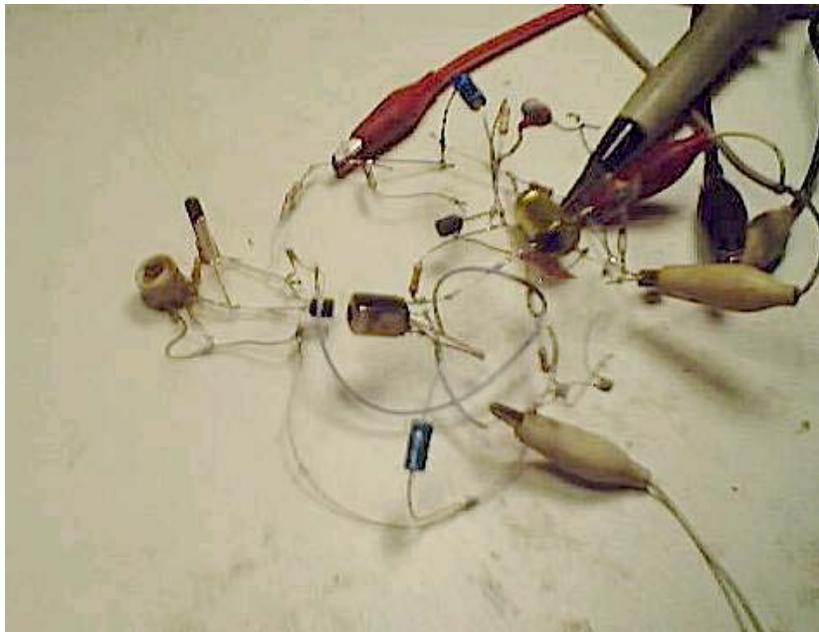


Fig. 2. First realisation

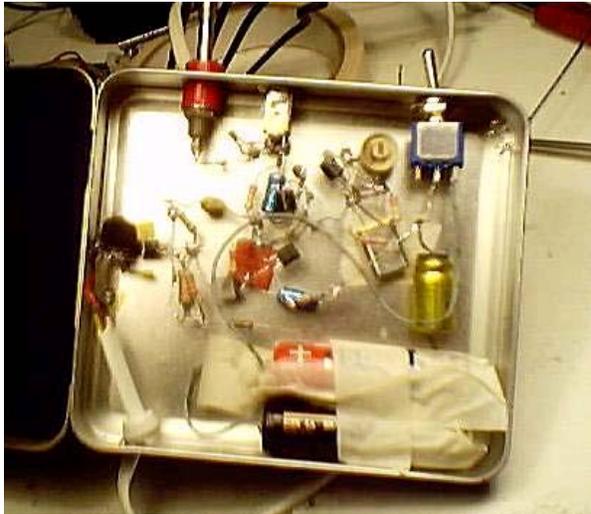


Fig. 3. Final realisation, ready for use

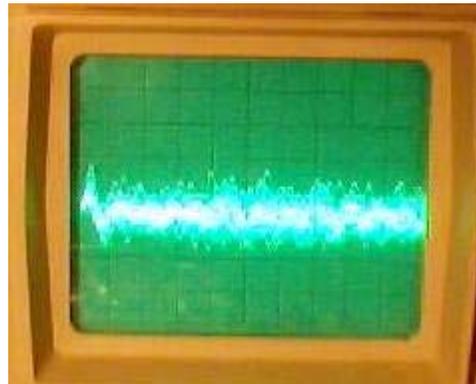


Fig. 4. Output signal versus time on oscilloscope (1 V p-p; 0.5 V/div)

Sound card with AGC

The used computer is a Sony Vaio notebook with a Yamaha DS-XG PCI AUDIO CODEC (WDM) sound card. The signal from the receiver is connected to the microphone input. The input level is required to be BELOW a certain level. May be the system is sensitive for overload or unwanted activation of the audio AGC. The receiver output level has to be adjusted, together with the microphone recording input level setting. The level indication (LED-alike) on the screen (fig. 5) is of help. A proper setting results in an operational system.

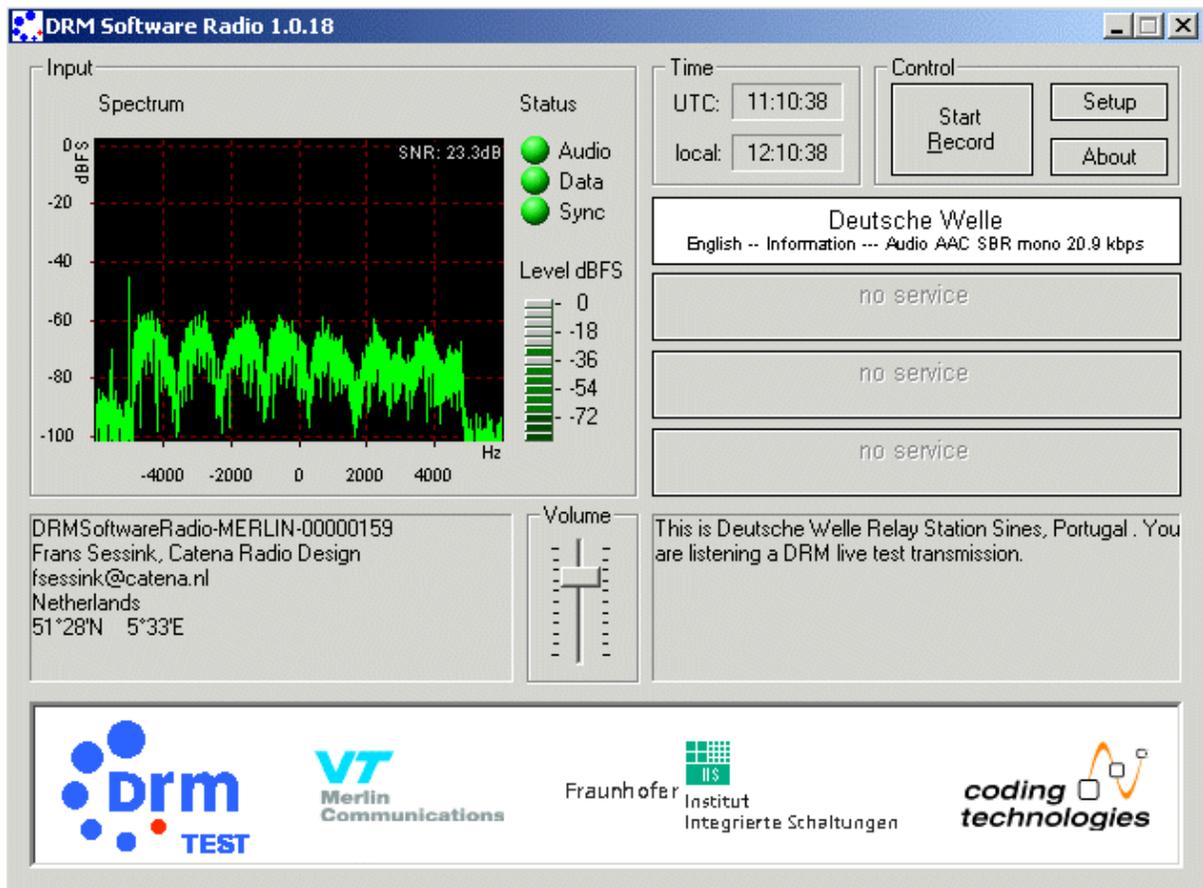


Fig. 5. Screenshot during reception

Part from logfile:

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Starttime (UTC) 2003-01-16 09:32:32
Frequency      15440 kHz

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MINUTE	SNR	SYNC	AUDIO	TYPE
0000	23	150	1492/10	0
0001	22	150	1218/10	0
0002	25	150	1500/10	0
0003	23	150	1500/10	0
0004	26	150	1500/10	0
0005	24	150	1500/10	0
0006	25	150	1500/10	0

Conclusion: a demonstration receiver can be realised in very short time.

2003 January, 16
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