

# Drake 7-line modifications

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## 1:st mixer

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The first mixer-board is based on a high level double balanced diode mixer, named CM-1HF from Vari-L. This mixer is no longer available from Vari-L. The mixer is fed by a +13 dBm LO-signal so a Level-13 mixer from [Mini-Circuits](#) would work as a replacement. SRA-3MH seems to be the best match covering 0.025-200 MHz and handling up to +9 dBm RF in with a +13 dBm LO in.

This stage in the receiver could be improved by exchanging the original mixer, CM-1HF, with a mixer capable of even higher LO injection. The gain by doing this is better strong signal handling, and a better intercept point, IP3. The down side is that we need a higher LO level, this could be hard to achieve and/or create problems due to LO leakage.

For a LO injection level of +17 dBm Mini-Circuits have SRA-1H (RF: 0.5-500MHz), and SRA-3H (RF: 0.05-200 MHz), that can handle up to +10 dBm RF in. For even better RF-handling we have TAK-3H, covering 0.05-300 MHz and handling up to +14 dBm RF.

If one wants to go even further up in LO injection, Mini-Circuits have Level-23 mixers with +23 dBm LO-injection. For the Drake's RAY-6U seem to be good pick with an RF input of 0.01-100 MHz with a RF capability of up to +15 dBm. If one skip the first 100 kHz of the HF spectrum one could choose the SAY-1 mixer that can handle up to +20 dBm RF between 0.1 and 500 MHz.

The highest level Mini-Circuits got is Level-27. Here we only have VAY-1 that covers 0.5-500 MHz RF, and handles up to +24 dBm RF in.

Name	1 dB comp. (dBm)	LO level (dBm)	RF frequency (MHz)
CM-1HF	?	+13	?
SRA3-MH	+9	+13	0.025 - 200
SRA-1H	+10	+17	0.5 - 500
SRA-3H	+10	+17	0.05 - 200
TAK-3H	+14	+17	0.05 - 300
RAY-6U	+15	+23	0.01 - 100
SAY-1	+20	+23	0.1 - 500
VAY-1	+24	+27	0.5 - 500

## 2:nd mixer

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The second mixer consist of four 1N4148 diodes and four 15 ohms resistors (earlier TR7's had eight 1N4148.)

The improvement possible here is to replace the 1N4148 diodes with better ones. One alternative is a quad matched sets of 1N5711 hot carrier diodes (Tip from Usenet newsgroup rec.hamradio.homebrew) These diodes also goes under the name HP5082-2800, and a quad matched set of these are called HP5082-2805 (according to the HP 1N5711 Technical Data sheet.)

In a Drake TR7 I owned earlier I replaced the diodes and resistors with a HP5082-2830 Schottky diode ring mixer with good results (the receiver sounded quieter, but I did not do any measurements.) This ring mixer is no longer available from Agilent (Hewlett-Packard.)

## Translator board

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The 1N4148 based mixer here could be improved with an exchange to 1N5711 diodes.

## Local oscillator phase noise

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The Drake 7-line have at least one problem that degrades its performance. It has a rather bad phase noise of 116 dBc at 10 kHz spacing for the Drake TR7, and 114 dBc at 10 kHz spacing for the Drake R7. Take a look at Sherwood Engineerings Receiver test Data at <http://www.sherweng.com/table.html>

Exactly how to improve this is hard to tell, one has to analyze the circuitry used and see where they have cut corners, and then improve these corners.

There exist one important factor that might influence the phase noise of the Drake's, and that is the purity of the voltages feeding the VCO's. This is probably the point where I will do my first tests to improve the phase noise characteristics.

Another alternative is to do a complete redesign of the LO circuitry, and perhaps all other oscillators, and in the process make the Drake's steerable from a computer. Drake purist might think that this is wrong, but the technology have evolved since Drake designed the 7-line, and new technology might give us top performance, so why not use it?

## AF-circuit

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Ulrich Graf, DK4SX, have changed some parts in the AF-circuit to get a wider frequency response. I have not tested this myself yet. This is his message as sent to the drakelist mailing list (<http://www.zerobeat.net/drakelist/drakefaq.html>)

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From: Graf Ulrich ICM MP UC RD IT ULM 2  
To: "Drakelist Mail (E-mail)"  
Subject: [drakelist] TR-7 AF-Mods  
Date: Tue, 23 Sep 2003 09:10:00 +0200

Hi John, hello Twan,

these are the parts I modified to get a somewhat wider frequency response of the audio path in my new TR-7 project (part# / new value):

C1150 / 0.47 uF  
C1152 / 0.1 uF  
C1155 / 100 uF  
C1159 / 1000 uF

Part numbers correspond to the schematic of MC1496 version of 2nd IF/Audio board.

C1116 should be 0.005 uF. On my board it was supplied with 0.05 uF. Audio wa rather dull. I inserted a 0.005 uF capacitor instead and added a 1k resistor in series with C1170.

73 Uli, DK4SX

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Another kind of modification made by Rob Schenck, K2CU and relayed to the Premium-RX mailing list.

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From: Carcia, Frank A. HS  
Date: 10/15/03 02:04 em  
Subject: [Premium-Rx] FW: Changes to extend the bottom response of the TR-7

Hi All,

Enclosed the changes to improve TR7 audio from my friend Rob Schenck, K2CU

> Subject: Changes to extend the bottom response of the TR-7

>

> HI Frank,

>

> Here are the components and their new values. They all have an impact,  
> some more than others. The only part that is at all tricky is the 1000 uF  
> that replaces the 250 uF output coupling cap from the LM 380. You need  
> compact size part for it. I have some if you need one or more. I will be  
> doing some more work to make the top end drop off more quickly than it  
> does presently. I am also going to come up with a compact daughter board  
> to add an autodyne detector for AM. I have found that you need to side  
> tune the radio to optimize the use of the 4 KHz AM filter. When you do so,  
> you end up with one sideband plus the carrier, as in A3H, and the extra

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> distortion from the simple diode detector. It may be possible to use the
> existing 1496 by using electronic switching to replace the BFO with the IF
> signal and self detect that way. A3H is best detected with either a true
> squaring circuit, or a synchronous detector. Well, anyway, here is the
> list:
>
> Changes to extend TR-7 audio output response down to 35 Hz. top end stays
> at 2.6 KHz.
> All capacitors located on IF/detector/audio output board.
>
>
> C1159 1000uF
> C1153 100uF
> C1155 100uF
> C1152 0.1 uF
> C1150 0.47uF
> C1146 10uF
> C1170 10uF
>
> ras
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73 de Lars, sm6rpz

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