I7SWX

GIANCARLO MODA

YAESU
FT1000MP-MKV
PROPOSED MODIFICATIONS

1st IF ROOFING FILTER
2ND MIXER
2nd IF AMPLIFIER
PSU VOLTAGE REGULATOR NOISE MOD
NOISE BLANKER MOD
2nd IF ROOFING FILTER SWITCHING

The following information is given as suggested changes.
Some of these changes have not been tested yet,
although they are theoretically valid.
The INRAD roofing filter is recommended (1st IF)

ALL MODS ARE AT USERôS RISK

*10-2004 * latest Revision 2-2009*

i7swx@yahoo.com http//www.qsl.net/i7swx

YAESU - FT1000MP * I7SWX PROPOSED MODIFICATIONS

Giancarlo Moda ï I7SWX

The following information is related to possible improvements on the Yaesu FT1000 MP Transceiver. The touched part is within the Receiver areas: 1ST Mixer, 1st Roofing Filter, 2ND Mixer, 3RD Mixer.
The circuit diagrams reported are ñtheoreticalò, as only the I7SWX 2 Transformer H-Mode Mixers have been tested. The JFET amplifier is a classic circuit and should pose no problems.
Before applying any mod, a measurement on the receiver should be made as to compare each modification and related improvements, like IMD and IP3, Noise Figure and any other important feature, versus the original configuration.
It is important to compare the RX sensitivity between original and each replacement circuit. Also total RX sensitivity should be controlled. The post mixer amplifiers, formed by the original mixers, should have a total gain, at least equal to the mixer configuration conversion gain. RX sensitivity should be good enough, eventual small variations do not reduce performance as this has been increased by the higher IMD functionality.

Giancarlo Moda, I7SWX
Via Azzone Mariano 24
70010 CASAMASSIMA BA
Italy

i7swx@yahoo.com

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Latest Rev 2-2009

1st MIXER

The first mixer stage used in the FT1000 series is quite good for the FT1000. It is not necessary to perform replacement as benefits may not be detectable due to other stages limitation or/and reciprocal mixing for PLL phase noise. In case of replacement, an input RF buffer of 0dB gain should be added to avoid spurs from main mixer into front-end and 2nd Rx.

See suggested additional 1st IF INRAD roofing filter modification on page 7

2ND MIXER REPLACEMENT

The second mixer replacement is shown in figure 1.

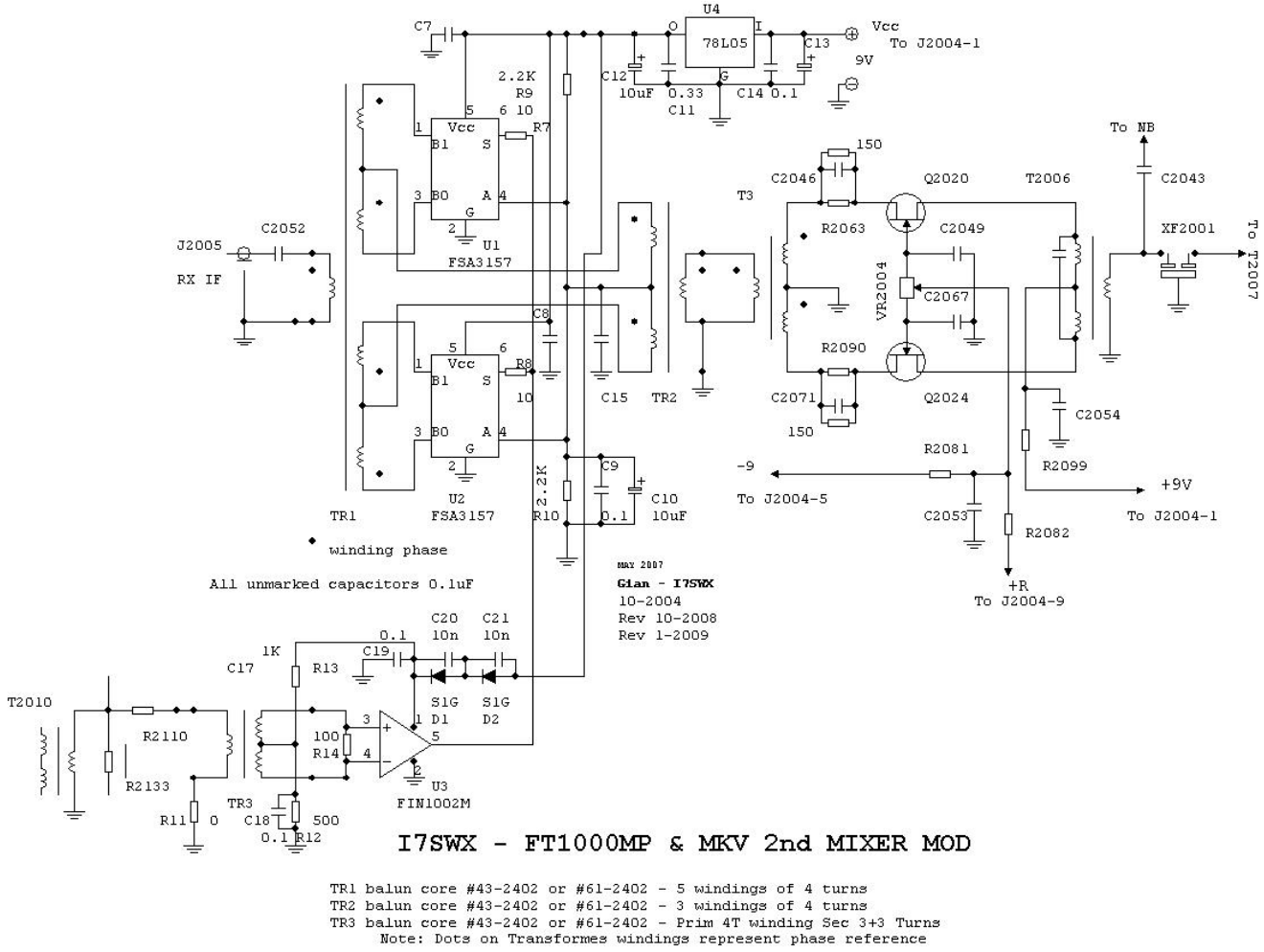


Figure 1 ï I7SWX 2T H-Mode Mixer as replacement of original circuit. This circuit is using the latest Analog Switch FSA3157 in place of classic digital FST3125.
The squarer is simplified and uses the fast LVDS RX FIN1002
The post-mixer amplifier is the original mixer modified as amplifier. VR2004 trimmer should no be touched unless it is possible to measure push-pull balance.

DISCONNECT:

1) R2110 from C2049 & C2067

REMOVE:

1) T2005

4

ADD:

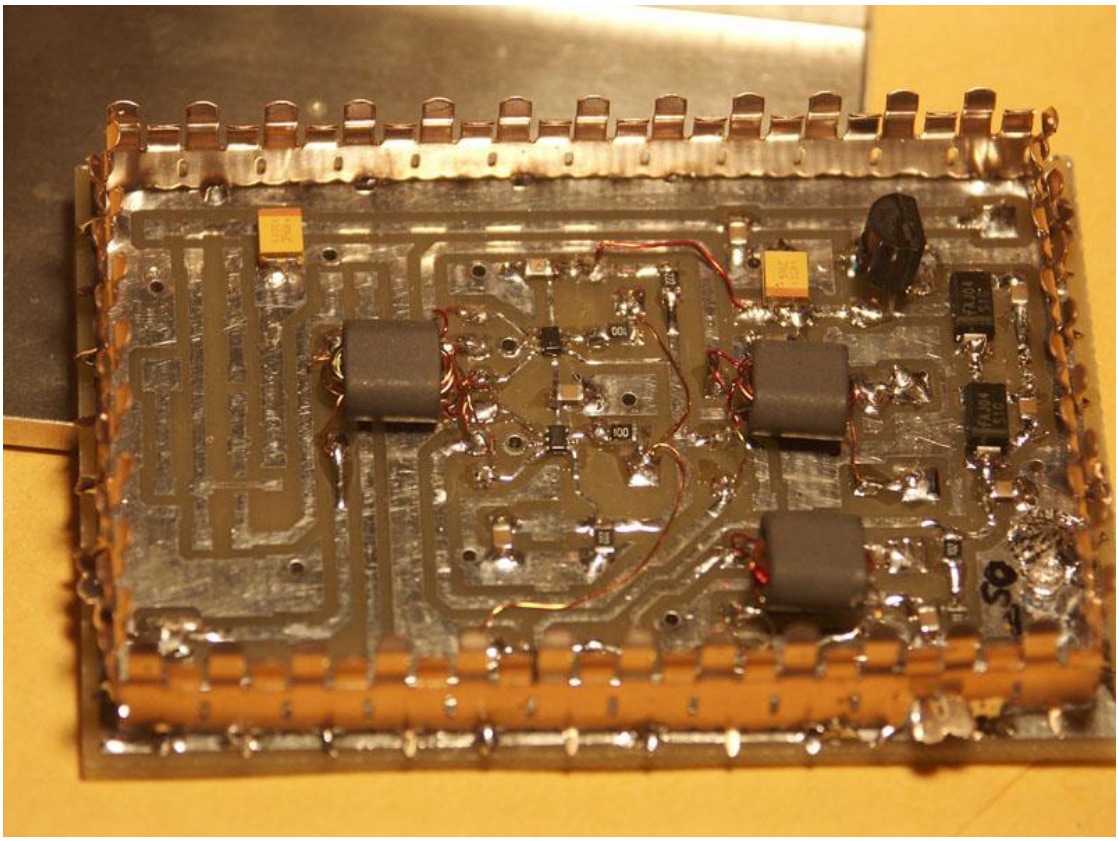
1) The I7SWX 2T H-Mode Mixer as in circuit diagram Figure 1
2) T1, home made transformer winding 3 x 4 turns on a FB, ferrite bead, or a balun core #43, and connect it as in circuit diagram.
3) 150 ohm resistor in parallel to R2063 & R2090.

CONNECT:

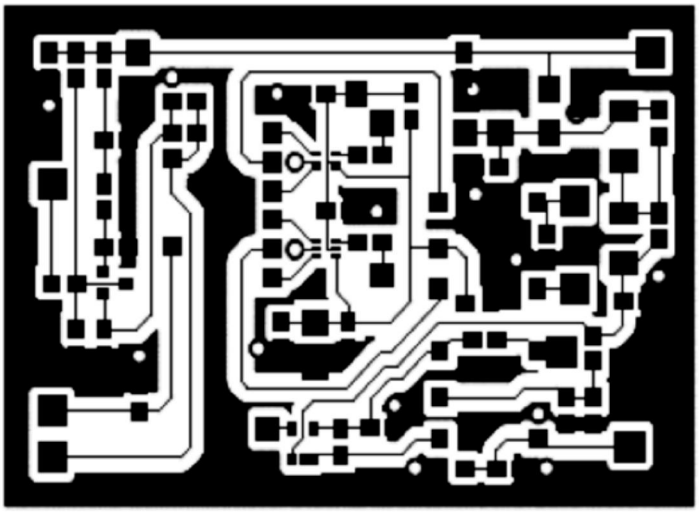
1) C2049 & C2067 to ground. See circuit diagram

NOTE:

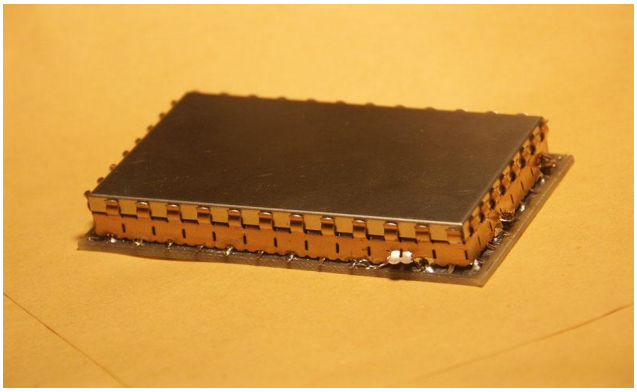
1) Check LO2 signal driving the H-Mode Mixer squarer. Oscillator signal should be at least 1.4Vpp and not more than 2.0-2.5Vpp.
2) The H-Mode Mixer to be used is the one reported in Figure 4, with balance adjustment. In case of no possibility to control balance it is OK to set the trimmer at center of range.



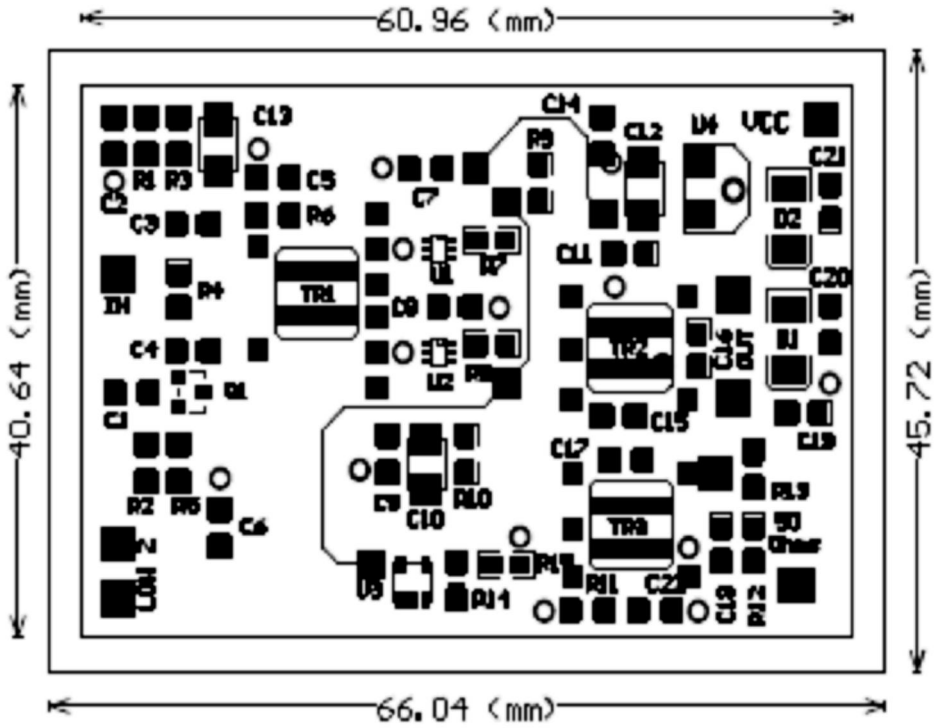
Vista 2T FSA3157 H-Mode Mixer assemblato



Circuito Stampato del Mixer

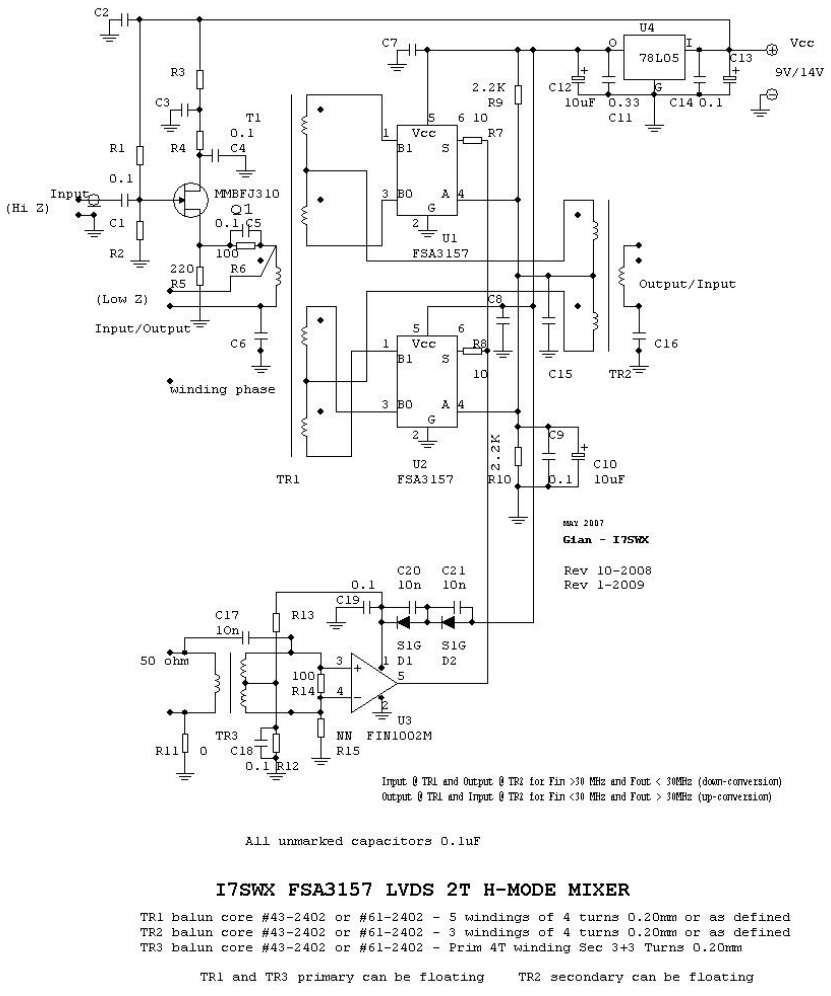


Vista esterna con schermatura



Vista Posizionamento componenti sul PCB. Le tre linee sottili sono fili di connessione

To make easier the PCB components positioning and assembly, the ñ*Universal 2T FSA3157 H-Mode Mixer*ò circuit diagram is reported. The input buffer configuration maybe confusing but it can be adapted to different original RX designs.



ADDITION OF AN IF AMPLIFIER

To recuperate some loss of gain at the 2nd mixers stage and to re-distribute gain an IF amplifier is inserted between the 2nd IF roofing filter and the 8.25MHz xtal filters bank.

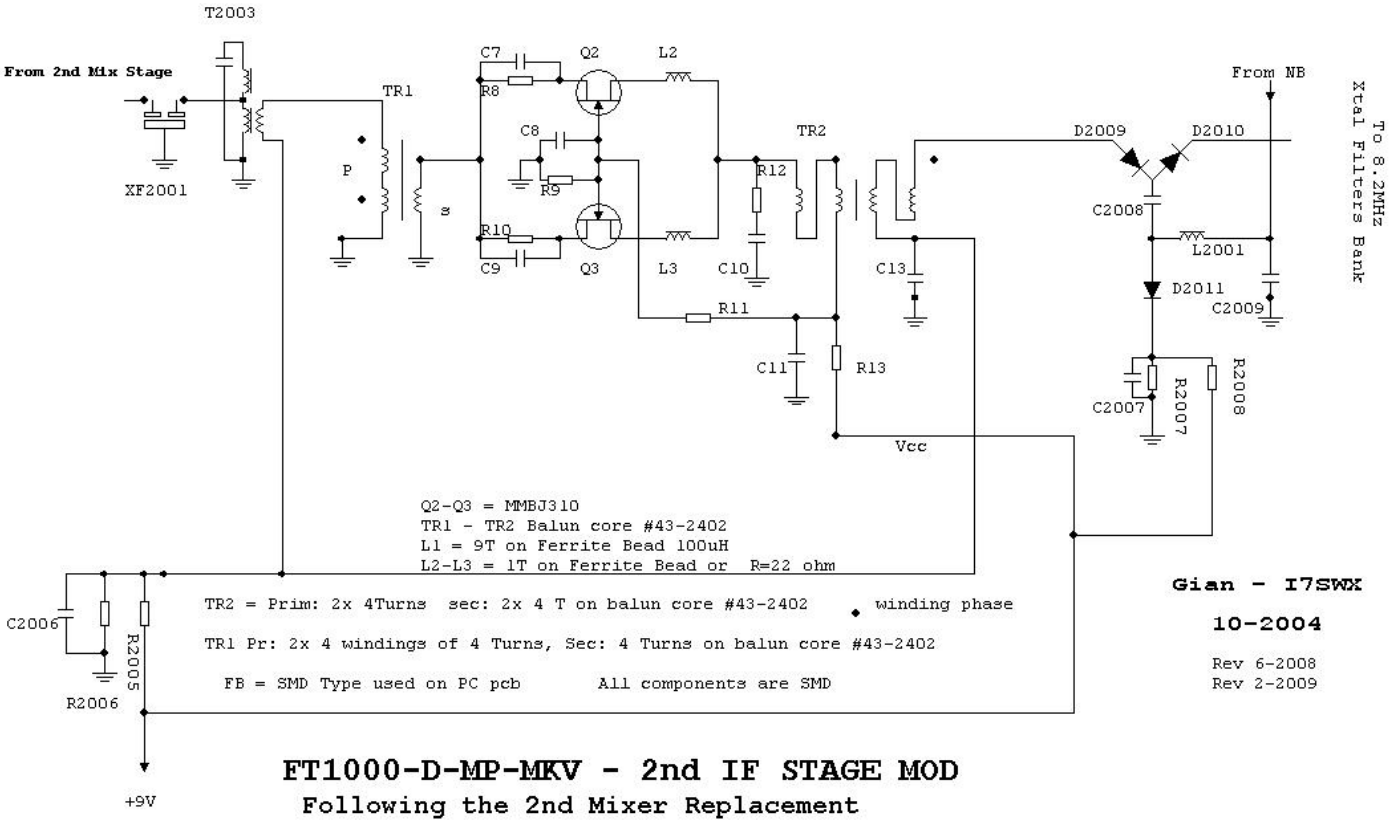


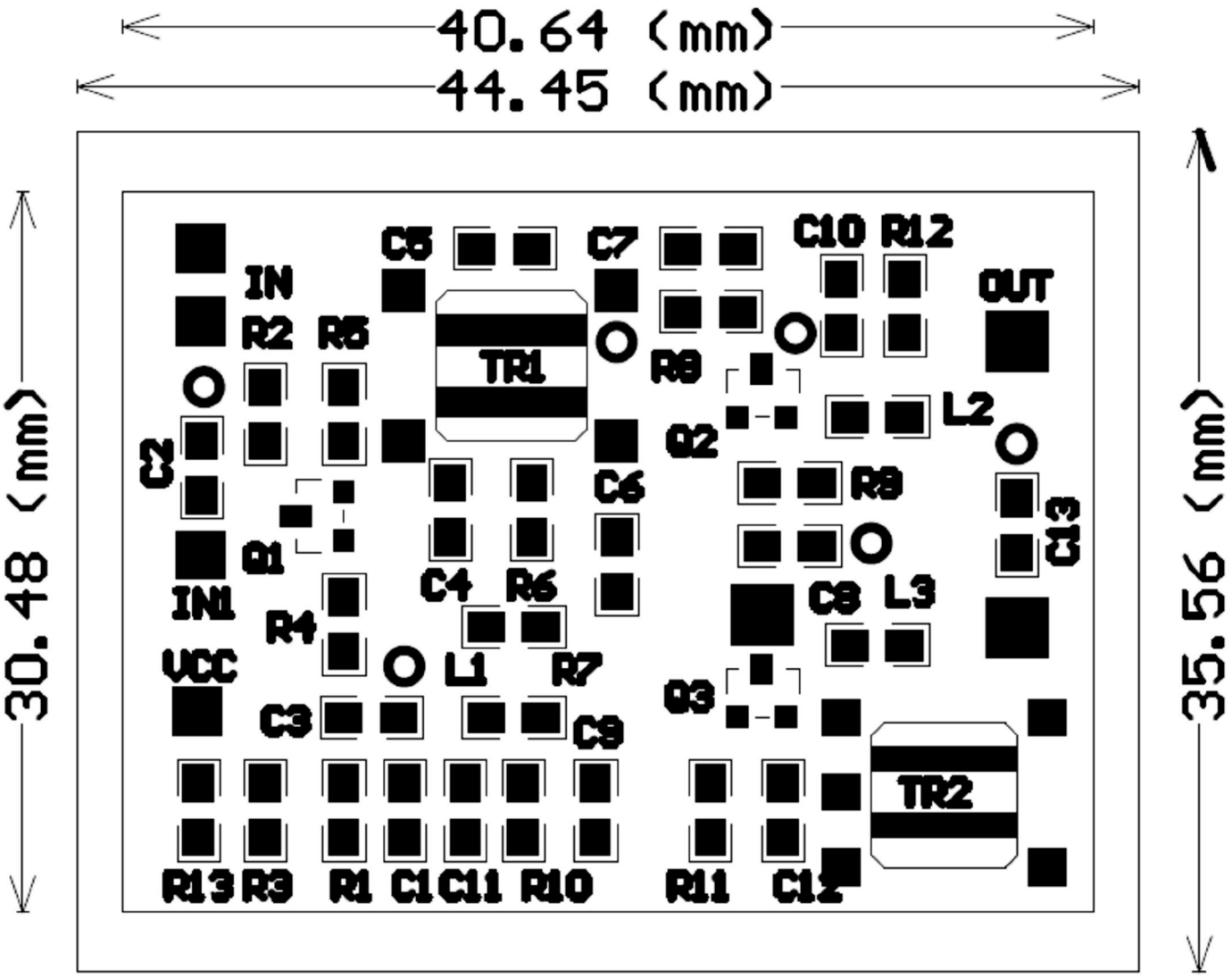
Figure 2 – I7SWX IF amplifier is added to compensate for the H-Mode Mixer loss versus the original mixer gain.

Gain of this amplifier is 7 to 8 dB. To reduce the gain is possible adding R12 and C10, see Table.

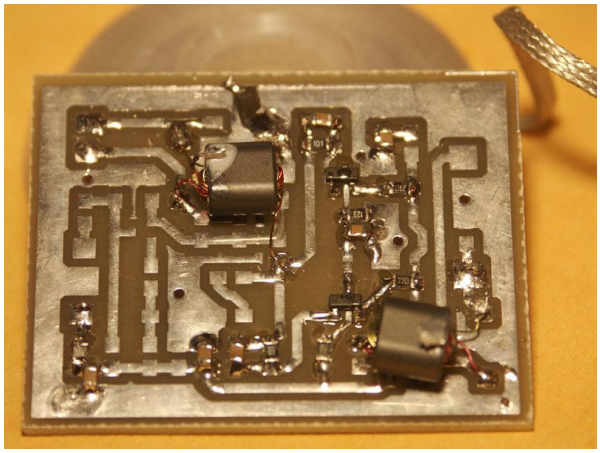
Table – Tabella

R12	Gain Red. dB	Final Gain dB
No	0	7-8
2.2k	-1	6-7
1k	-2	5-6
820	-3	4-5
470	-5	2-3
220	= amp gain	0-1

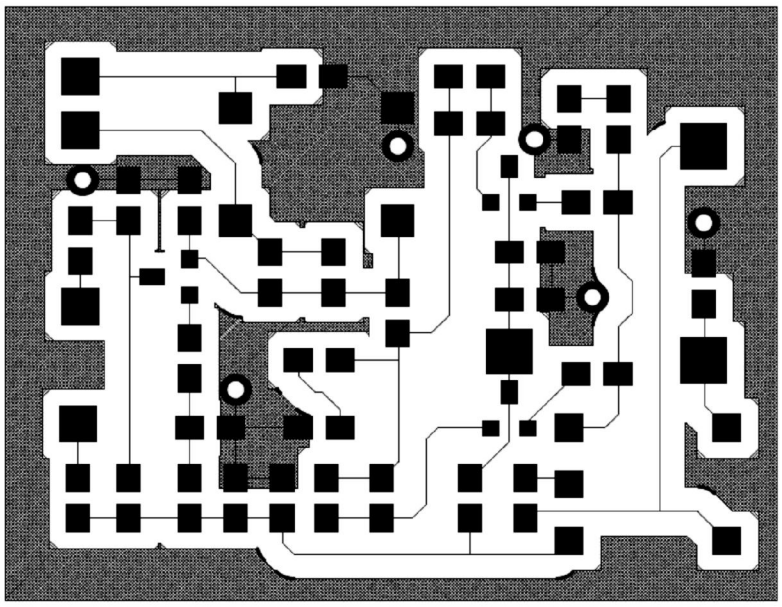
Amplifier gain reduction



Amplifier ï PCB Components positioning / Vista Posizionamento componenti sul PCB

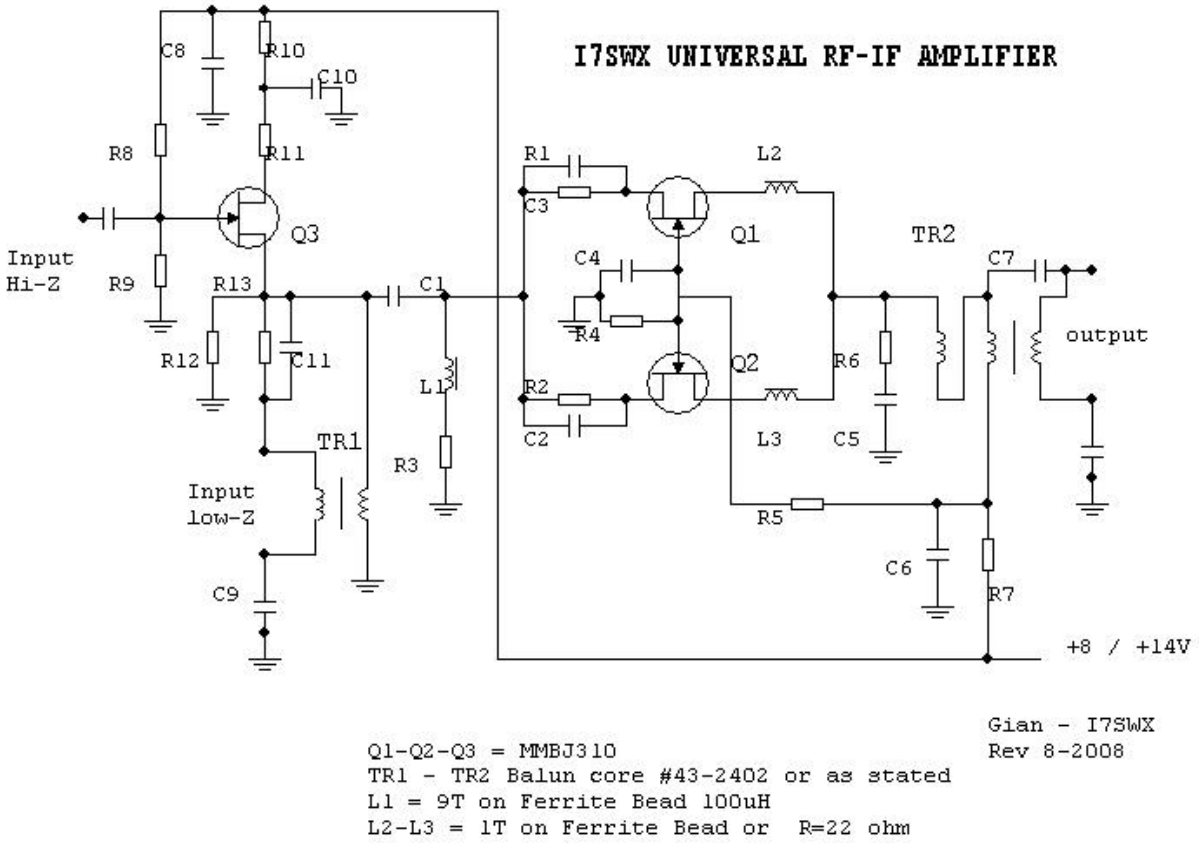


Amplifier Assembly



PCB view

To make easier the PCB components positioning and assembly, the ñ*Universal Amplifier*ò circuit diagram is reported. The input buffer configuration maybe confusing, like for the H-Mode Mixer, but it can be adapted to different original RX designs.



PSU VOLTAGE REGULATOR NOISE

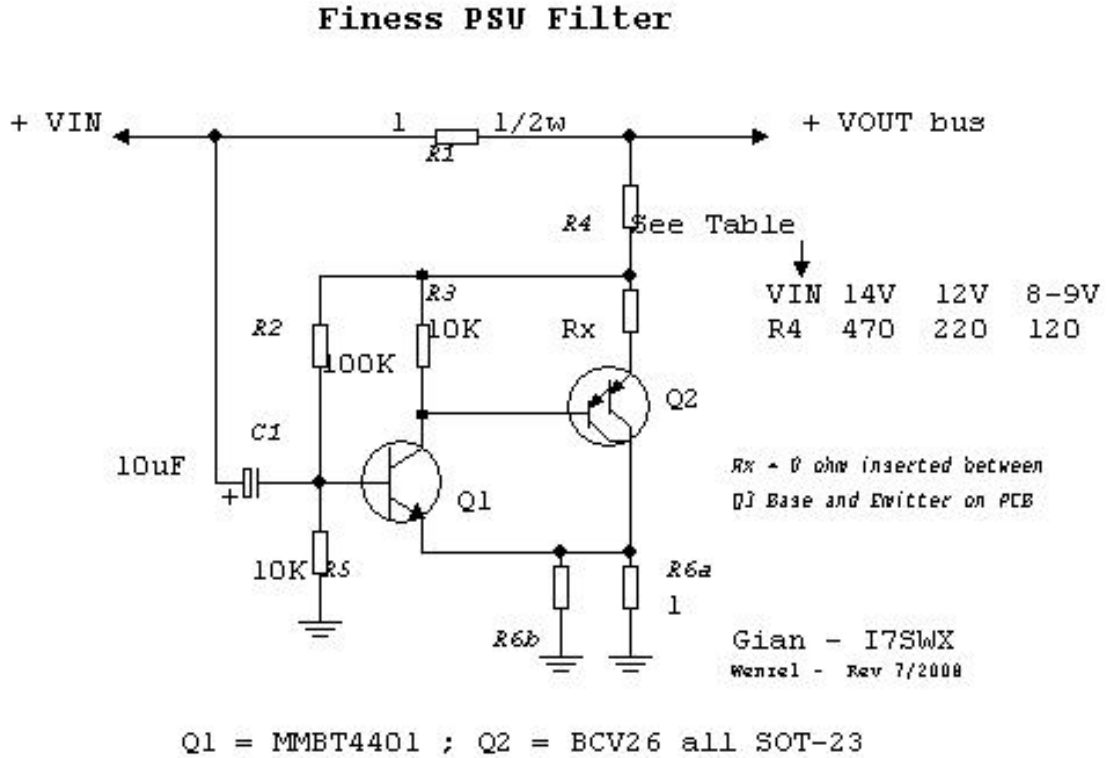
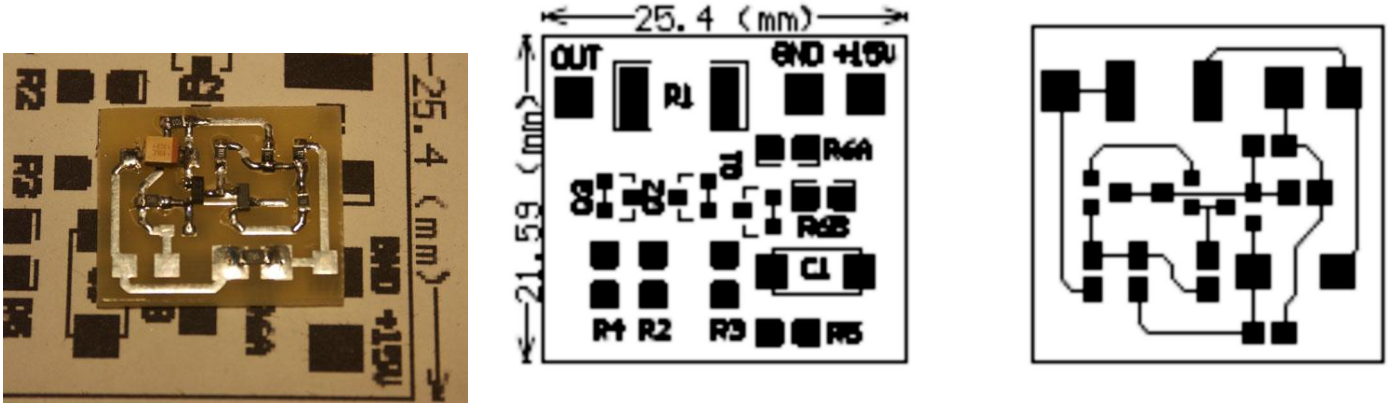


Figure 3 ï Finesse Voltage Regulator Filter

The PSU voltage regulator noise is from the Wenzel Associated Project ***ñFinesse Voltage Regulator Noise!ò.***

System designers often find themselves battling power supply hum, noise, transients, and various perturbations wreaking havoc with low noise amplifiers, oscillators, and other sensitive devices. Many voltage regulators have excessive levels of output noise including voltage spikes from switching circuits and high flicker noise levels from unfiltered references. Ordinary three-terminal regulators will have several hundred nanovolts per root-hertz of white noise and some reference devices exceed one microvolt per root-hertz. DC to DC converters and switching regulators may have switching products ranging into the millivolt range covering a wide frequency spectrum. And many systems have offending devices that "dirty up" otherwise clean supply rails.



View Assembled Unit / Vista assemblaggio Vista posizionamento componenti / Components positioning Vista PCB / PCB View

NOISE BLANKER MODIFICATION

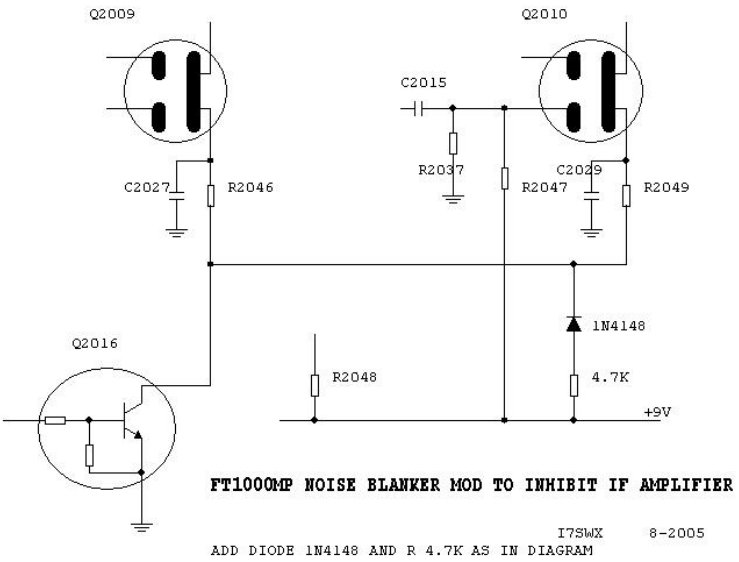


Figure 4 ï This is a simple modification applied to the FT1000 series to inhibit the Noise Blanker IF Amplifier and it consist of one diode 1N4148 and a 4.7K resistor in series connected between the +9V bus and the NB ON-OFF control rail

2ND IF ROOFING FILTER

Another recommended change is the replacement of the 2nd IF roofing filter (8.25MHz BW 20kHz) with an 8.25 MHz 6kHz (-/+3.5 KHz centered on Fo) BW xtal filter. It may require impedance matching.

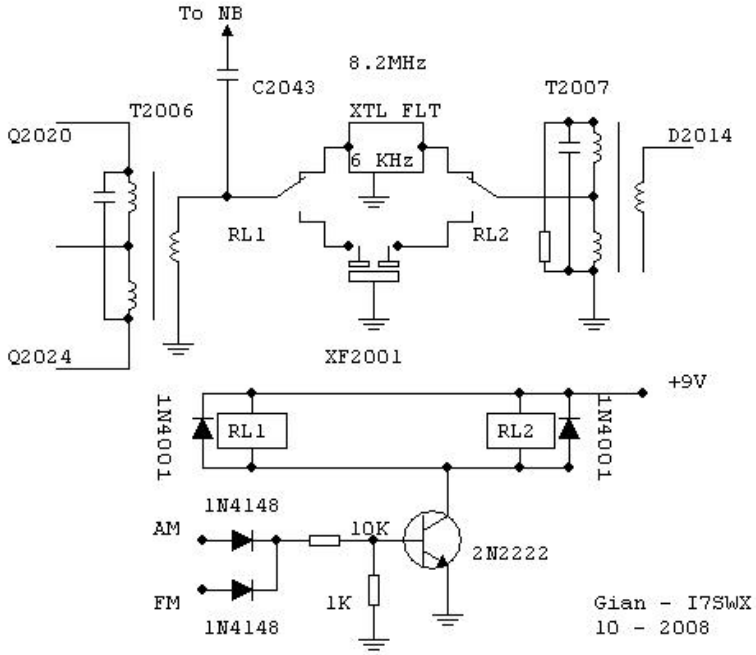
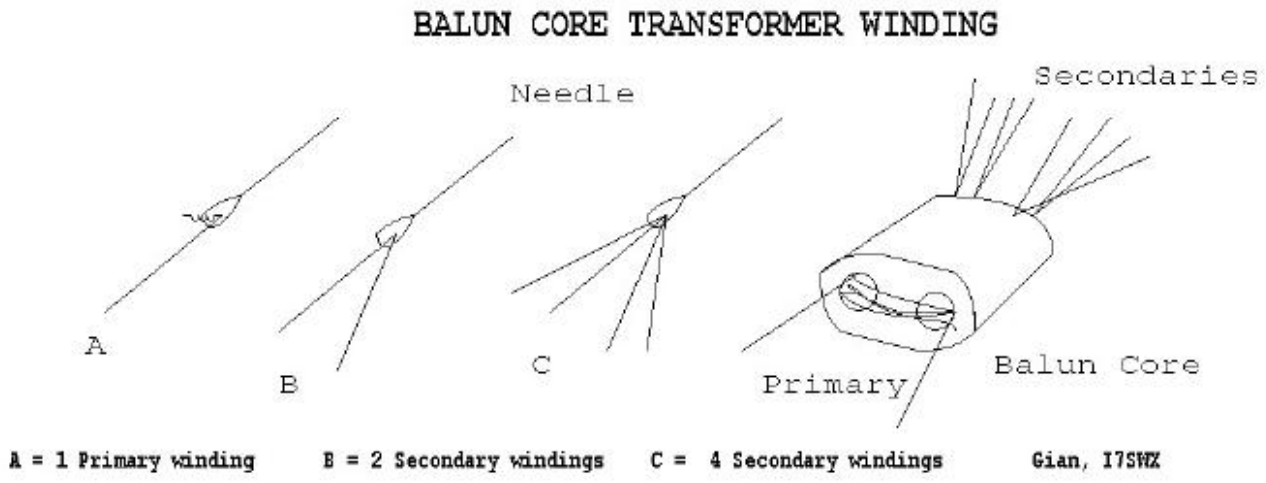


Figure 5 ï 2nd IF roofing filter switching

An additional modification could be applied to the 2nd IF roofing filter being switched between XF2001, in AM and FM selection, and a Xtal Filter Yaesu 8.2MHz 2.8kHz BW, or equivalent, during CW, SSB and Digital Modes use. Benefits: 1) Better 2nd IF selectivity and 2) lower IF noise.

WINDING TRANSFORMERS



Homemade balun core transformers winding as used by me in the I7SWX 2T H-Mode Mixer and also in some SDR QSD designs like SoftRock. The technique is to use a needle to facilitate windings when using cores type

2402 or similar. First the secondary windings should be done: B for 2 x secondary and C for 4 x secondary. The primary should be winded on the opposite side of secondary. Being a single winding the wire should be twisted at the needle eye. Wires for double windings are bifilar and should not be twisted . When forming the secondary groups an ohmmeter can be used to select the couples, see Photo 1. Center tap(s) should be arranged as in Photo 2. Generally the #43 material is valid for HF RF coverage; cores #43-2402 or #43-202 may be selected. Wire diameter should be max 0.20mm for 2402 cores, while for 202 or similar core any size that will facilitate windings.

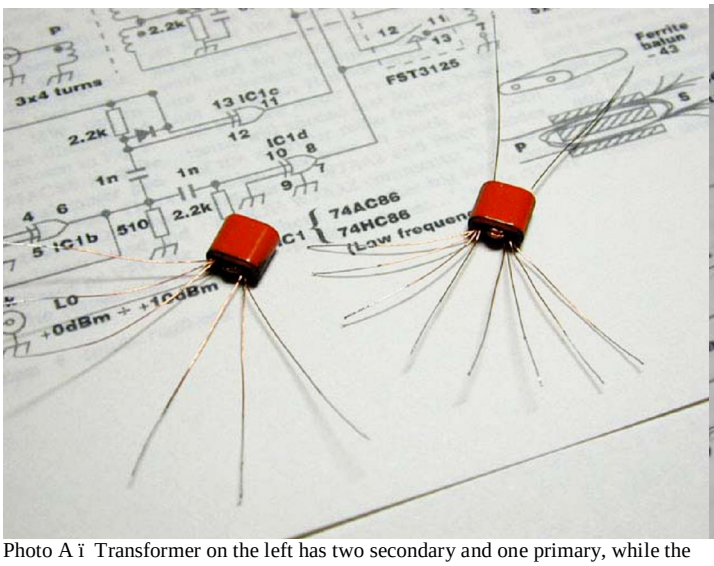


Photo A ï Transformer on the left has two secondary and one primary, while the one on the right has four secondary and one primary.

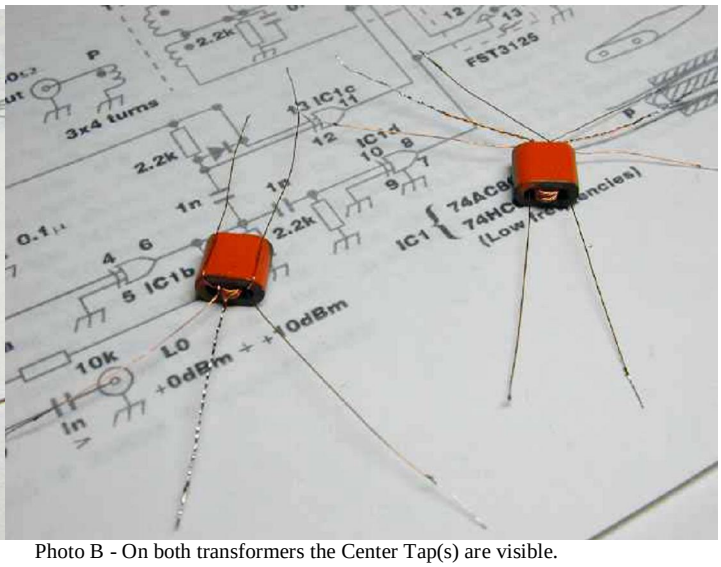


Photo B - On both transformers the Center Tap(s) are visible.

Figura 6 ï Le foto mostrano la costruzione dei trasformatori, ad esempio, come effettuata da Takahiro Kato, JA9TTT.

Figure 6 ï Pictures are showing the transformers assembly, as an example, like done by Takahiro Kato, JA9TTT

La foto A mostra i trasformatori dopo lôavvolgimento delle spire. La foto B mostra i due trasformatori dopo la selezione dei secondari . I nuclei sono del tipo binoculare da#43 o #61 - 2402.

1st IF ROOFING FILTER REPLACEMENT

An interesting mod is the replacement of the original roofing filters with the INRAD filter. The change gives an important difference between the original filters bandwidth (12-15kHz) to the new filter 4-6kHz BW. This solution maybe interesting as to reduce strong signals entering the front-end but outside the Roofing Filter Band Width. The solution presented and to be experimented is different from the INRAD modification. See circuit diagram. The INRAD Roofing filter is inserted after the 1st mixer and the original roofing filters.

The ideal positioning of selectivity is just after the 1st mixer.

The proposed circuit diagrams show a solution without mixer termination and with mixer termination using a diplexer.

Enjoy the proposed modifications and feedbacks are most welcomed.

Best 73.

Gian
I7SWX

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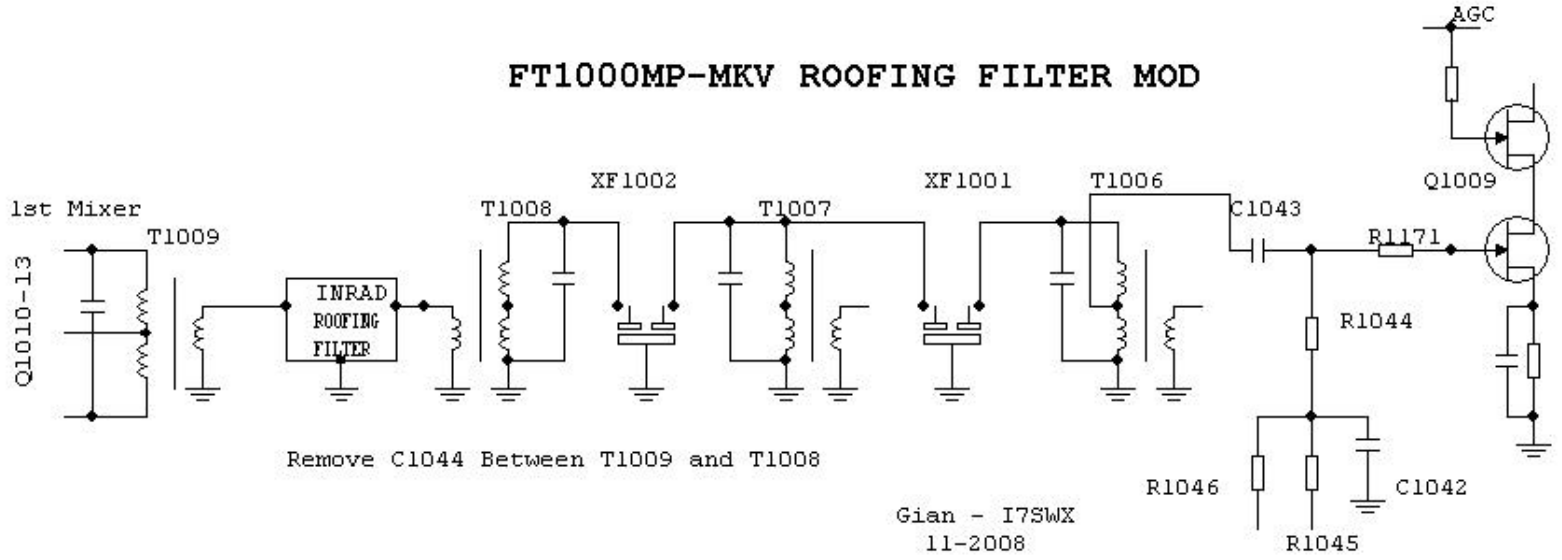
FT1000MP-MKV ROOFING FILTER MOD



FT1000MP-MKV ROOFING FILTER MOD + DIPLEXER