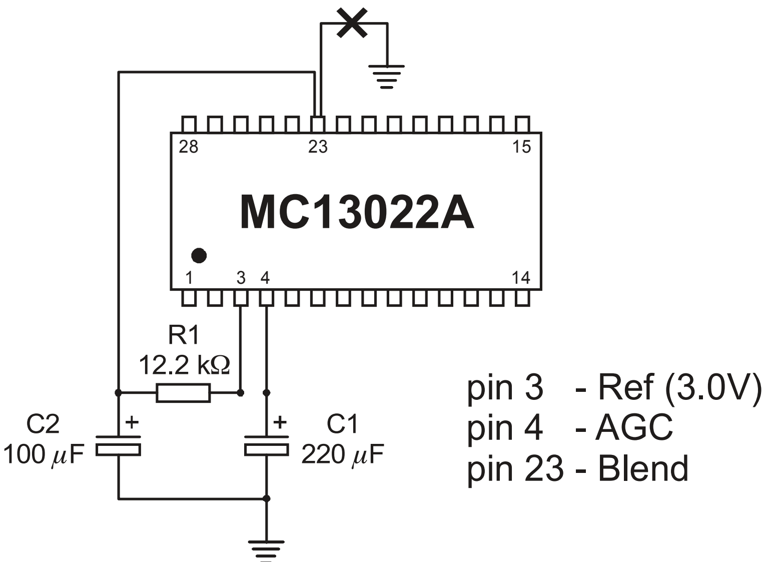
IC-R75 AM & S-AM mod
Ver. 1.1

WARNING! The operations described below are not as easy to perform as they may seem. There is a real danger of seriously damaging your radio! Only persons with experience in such procedures should try to perform the modifications. It is better to have a radio with reduced performance than a not working one!

DISCLAIMER: The information in this document is provided as is. The author is not responsible for any damage or malfunction of the receiver caused by or during the application of the modifications described below.

1. Introduction

This modification addresses the not-so-good AM performance and the "not working" synchronous AM detector of the IC-R75. The modification consists of three parts – AGC, synchronous detector and PLL lock/de-lock speed. The modification could be performed partially according to your tastes (for example only AGC or AGC + synch. detector). Below is a schematic of the modification.



AGC: For the detection in both AM and S-AM modes a stereo-AM IC is used (Motorola MC13022A – IC2001 in the R75 schematic). This IC has its own AGC system, which goes on top of the receiver's AGC. As implemented the AGC of the IC is very fast thus defeating the slow AGC of the receiver. The result is very unpleasant sound in AM mode – especially for rapidly fading stations. The fix provided here increases the time constant of the IC's AGC making it VERY slow thus leaving only the receiver's AGC in charge. In parallel to the capacitor connected to pin 4(AGC) of IC2001 (10 uF) an external capacitor is added (C1 - 220 uF).

Synchronous detector: As implemented the stereo-AM IC is put into "tuning" mode (pin 23(BLEND) connected to ground). This puts the internal PLL in FAST lock mode practically meaning that the output signals from the quasi-synchronous AM detector (used for AM) and the in-phase synchronous detector (used for S-AM) will be identical. In order to make the S-AM mode work as it should some hysteresis has to be added to the PLL. This is done by connecting a capacitor (C2) between pin 23(BLEND) and ground (as illustrated in the Motorola's IC datasheet). For the purpose of synchronous AM detection my experimentation showed that larger value of the capacitor makes for more stable operation. A value of 100 uF worked best (in the datasheet a value of 20 uF is shown but it is for the case when the IC is used for stereo-AM demodulation i.e. with strong stable MW stations).

PLL lock/de-lock speed: My experience showed that the capacitor (C2) alone is not enough to make the synchronous detector stable. In deep fades it still loses lock. In order to improve the stability a small positive bias is added to pin 23(BLEND) through a resistor (R1) from pin 3(REF 3.0V). This makes the synchronous detector rock-stable. It is capable to "fly" over a complete carrier absence of about 2 seconds. The price for this stability however is slower locking speed, which means about 1 or 2 seconds whine after switching to S-AM mode. Also tuning around in S-AM mode is not very pleasant (a lot of whines). I use AM mode while tuning and when I'm on a station of interest I switch to S-AM. If the stability is important to you I recommend you to also perform this part of the mod.

2. Materials and precautions

You will need:

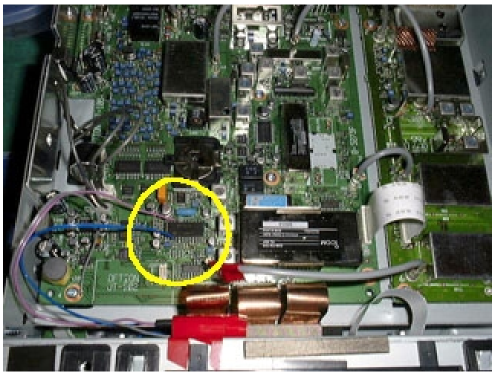
- A low-power soldering iron (≤ 30W).
- Thin insulated wire.
- Two electrolytic capacitors – 100 uF and 220 uF (both 15V or more).
- Some resistors - 10 kΩ, 2.2 kΩ and a 10 kΩ pot if you like to experiment with the PLL lock/de-lock speed.
- A small (-) type screwdriver. (I used one with 1 mm blade width).

Precautions – READ THIS!!!:

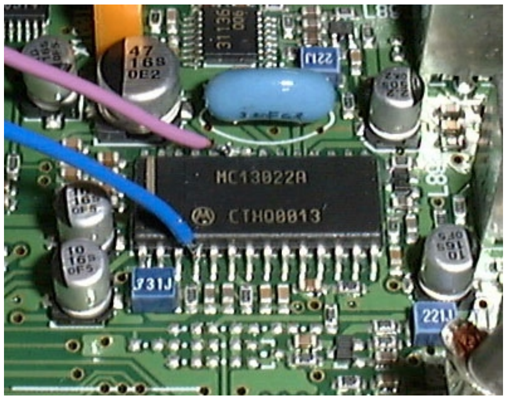
- You'll need some soldering experience – don't try to perform the mod if you don't feel confident with the soldering iron.
- STRONGLY RECOMMENDED!!!
  If you decide to perform the modification do some "training" before working on the R75. Take a PCB from scrapped electronics (VCR, TV, phone etc.) with surface-mount ICs on it. Practice soldering and pin-lifting on the ICs. Only after you feel confident about your skills go to R75.
- In order to avoid static discharge ground yourself and the soldering iron. Wind the bare end of a wire on your wrist (or to a metal bracelet which you'll wear) and connect the other end of the wire through 1 MΩ resistor to ground. Wind one or two times the bare end of a wire on the metal part of the soldering iron close to the handle and ground the other end of the wire (at the same ground as your wrist ground). Ground the R75 as described in the user's manual to the same ground.
- Disconnect all cables except for the grounding from the IC-R75 before opening and working on it.
- Check everything 3 times before going to action. Be careful with the pin numbers on the IC! Check the polarity of the electrolytic capacitors!
- Read the whole procedure before starting the application!

3. Modification instructions

1. Disconnect all cables except for the grounding from the IC-R75 and open the top cover as described in the user's manual. You'll be working in the area encircled with yellow on the picture (the receiver front panel facing you). This is the MC13022A stereo-AM IC.



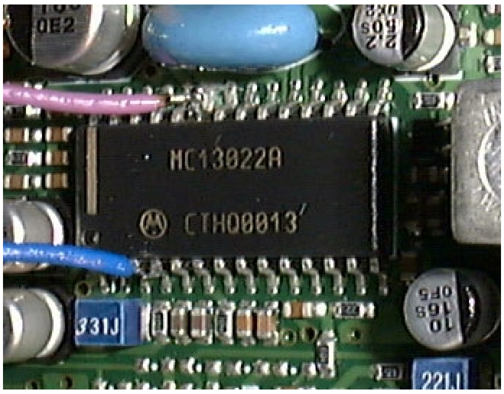
2. The first part of the mod is the AGC mod. It involves soldering a 220 uF capacitor (15V or more) between pin 4 (AGC) and ground (C1). Remove about 2 mm of the insulation from both ends of a thin insulated copper wire (about 15 cm long). Soak the bare copper with solder. Clean the tip of the soldering iron (with wet cotton cloth for example) and take with it very little solder. Put some solder on the upper part of pin 4 (AGC) by touching it with the iron for about 3-4 sec. Pin 4 is the 4^{th} pin from left on the lower side of the IC when the marker hole is in the bottom left corner (see the picture – the blue wire goes to pin 4). If you are not successful wait for about 30 seconds before trying again (in order the IC to cool down). When there is little solder on the pin align the solder soaked end of the wire with it vertically (see picture) and apply the tip of the soldering iron on top of the wire for several seconds. As soon as the solder melts remove the iron. Don't try to make a nice looking solder joint – if there is no solder bridge to neighbor pins and the wire stays connected leave it like this. Be careful not to pull the wire as this may brake the joint.

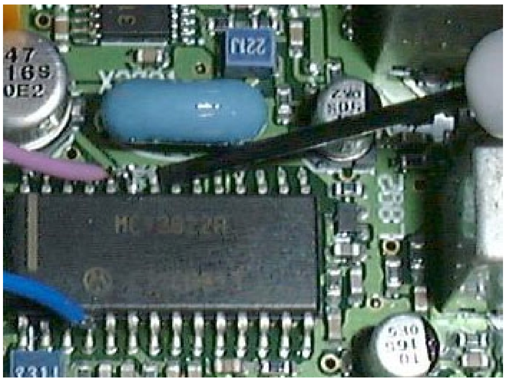


3. Scrap a small patch of the insulation covering of the PCB near the screw in the bottom left corner (see the picture – the gray wire goes there). Solder another wire there – this is ground. Take the 220 uF capacitor and shorten for 1-2 seconds both legs together in order to discharge the cap if there is some charge in it. Cut the legs to about 1 cm length. Thread pieces of heat shrink or pieces of insulation from thick wire on both wires (ground and pin 4). Solder the negative (-) leg of the cap to the wire which goes to ground then the positive leg (+) to the wire which goes to pin 4 of the IC. Be careful with the polarity of the capacitor!

4. That finishes the first part of the mod. If you would like to stop here (no synchronous detector and PLL speed mods) cover the legs of the capacitor with the insulation and go to step 9.

5. The second part of the mod is for the synchronous detector. The most tricky part is the peeling off of the pin 23 (BLEND) of the stereo-AM IC. I've done that with a small screwdriver (-) type with blade width 1 mm. Check the pin number – pin 23 is the 6th pin from left on the top side of the IC when the marker hole is in the lower left corner (see the first picture on the right – the magenta wire goes to pin 23). Take the screwdriver and place it from one side behind and below the pin (see the second picture on the right). By gently pushing and slowly turning the screwdriver the pin comes off easily. Gently lift the pin up (to have about 0.5 mm between it and the PCB). I first tried to cut the trace on the PCB but there is also a trace coming from below the IC so this is not working.





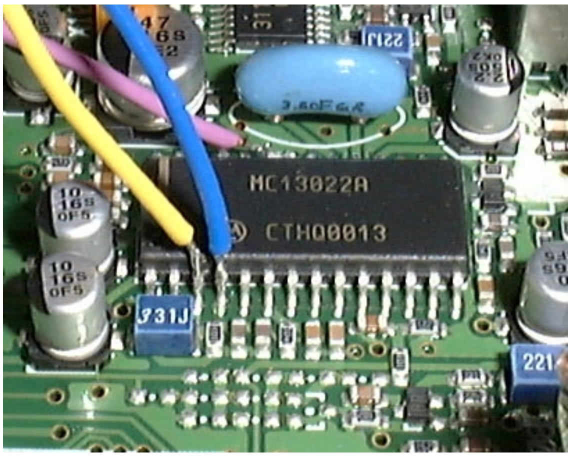
6. Solder one end of a wire to the lifted pin 23 (same soldering procedure as in step 2). Take a 100 uF electrolytic capacitor (15V or more), shorten the legs for a short time to discharge it, cut the legs to 1 cm length. Solder the positive leg (+) to the wire coming from pin 23 (put some insulation piece on the wire before soldering it to the cap). Solder the negative leg (-) together with the negative (-) leg of the 220 uF cap to the ground wire.

7. That finishes the second part of the mod. If you do not like to perform the PLL speed mod go to step 9.

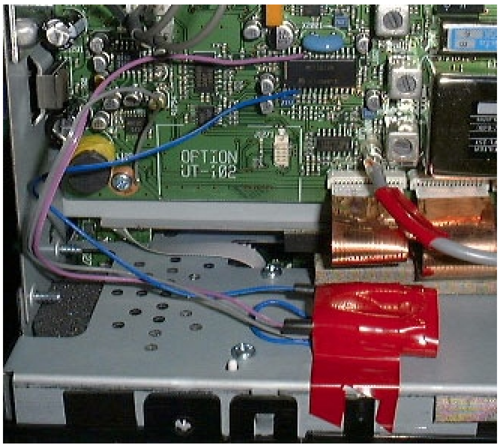
8. The last part of the modification is the PLL speed mod. Solder a wire to pin 3(REF 3.0V) – same procedure as in step 2. See the picture to the right – the yellow wire goes to pin 3. Now there are two options:
   - Use the resistor value I found works best.
   - Experiment and find the value which suits your taste most.

   If you choose to use my value then take a 10 kΩ resistor, solder it in series with 2.2 kΩ one (total 12.2 kΩ). Solder on end of the resistor series to the wire from pin 3. Solder the other end of the resistors to the joint between the wire from pin 23 and the positive leg of the 100 µF capacitor (C2). The joint will then be: wire from pin 23 + resistors from pin 3 + positive leg of 100 µF capacitor (C2).

   If you want to experiment then use a series of 10 kΩ resistor and 10 kΩ pot. Connect the cables to the receiver and turn it on as it is open. Tune around and adjust the pot for the best compromise PLL lock speed/stability. Disconnect the resistor series and measure the resistance – this will be your value for R1.



9. Wrap the capacitors and the resistors with tape and stick them to the back of the front panel shield (see picture). Put back the top cover as described in the user's manual. Reconnect all cables to the radio.



10. Enjoy the new AM and S-AM performance of the R75! If you are not satisfied with the results the mod can be easily reverted by de-soldering the wires from pins 3 and 4 and soldering the wire from pin 23 to ground.

<u>Some thoughts:</u>

- The effect of the synchronous detector is most noticeable on stations with selective fading (i.e. when the audio is distorted during the fade). You can check the audio sample provided separately. Also it is much more obvious with narrow 9 MHz filter (2.4 kHz). I wonder what genius decided to prohibit 455 kHz filter selection for the S-AM mode.
- There is no "LOCK" output on the IC so it is not possible to make the synchronous detector work as in other receivers – the audio to be from the envelope detector until the synch. is locked and after that to switch to synch. audio. This could have eliminated the whines.
- It will be good if one can choose between fast and slow PLL speeds (i.e be able to connect and disconnect R1). Firs I was thinking of using the "LOCK" button on the front panel for

this. This way after tuning in a station one can push the "LOCK" button and switch to slow synch. The button will also lock the tuning knob so no way to de-tune and hear whistle. Unfortunately this is not very easy modification (not to say impossible). Another option is to mount a switch on the back panel of the radio or as a remote switch with cable.

For more information check the R75 mailing list at: http://www.egroups.com/group/icomr75

Questions and suggestions are welcome! E-mail me at: rado@nips.ac.jp

Rado December 1, 2000