

**CACTUS Radio Club, Inc.**

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## **Technical Application Note #1**

In an attempt to optimize the operation of the Palomar Telecom RBC-700 Series Controller, we have made some tests and developed some modifications to improve the performance of the controller. Modifications to the following cards are described individually:

Squelch card

Audio Filter card

Audio Mixer card

Touch-Tone® card

The various modifications in this Technical Application Note improve the audio frequency response of the system from input to output and enhance the noise immunity and the decode performance of the Touch-Tone® decoder in noisy receive conditions. A missing trace on the Squelch card has also been identified in this Tech Note.

We would like to thank the following individuals for their assistance in developing these modifications:

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Robin Critchell	WA6CDR
Ben Vickers	WB6FRM
Denny Chase	W6HDC
Ken Robbins	WA6PYJ
Mike Bucciarelli	N7CK

This Technical Application Note #1 is available in electronic form, in its entirety including the diagrams and pictures, that can be read with the Adobe Acrobat Reader application. To obtain an electronic copy of this document, send an e-mail message to Ken Robbins, WA6PYJ, at [ken@cactus-intertie.org](mailto:ken@cactus-intertie.org) and request an electronic copy of **Technical Application Note #1 - Modifications to the Palomar Telecom RBC-700 Series Controller.**

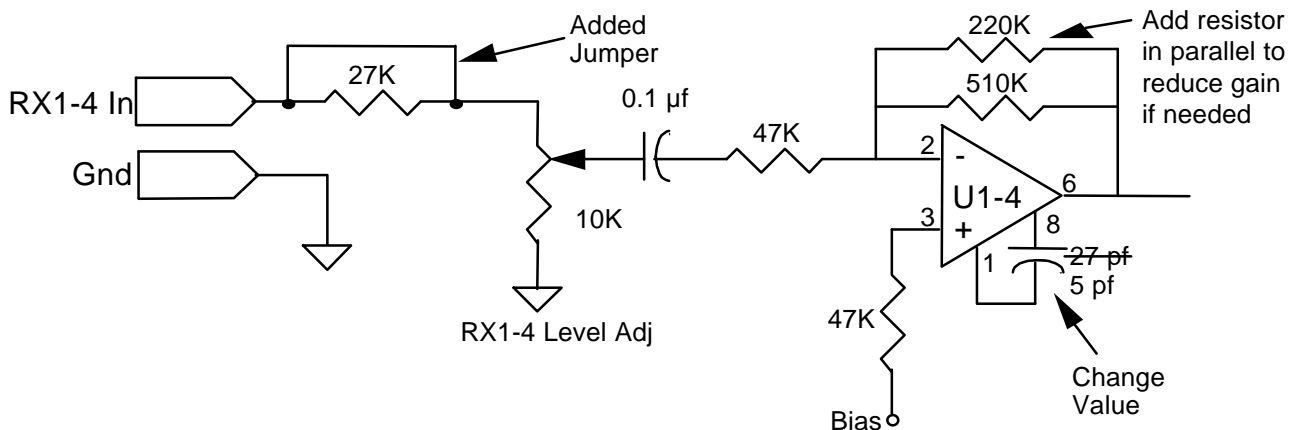
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## SQUELCH - M - CARD

The 27KΩ resistor in series with the input of each circuit "RX1 In" through "RX4 In" is jumpered out.

In some instances it may be necessary to lower the circuit gain by changing the value of the 510KΩ feedback resistor of some of the input Op Amps, U1 to U4. A 220KΩ resistor can be soldered in parallel with the 510KΩ resistor which will result in a combined value of 154KΩ.

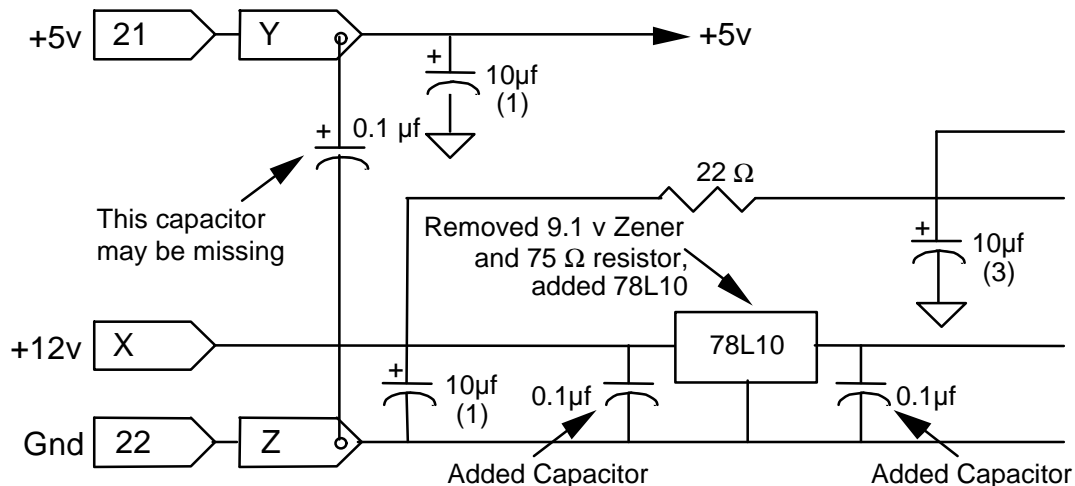
Replace the 27 pf compensation capacitors between pins 1 and 8 of the input Op Amps, U1 through U4, with 5 pF capacitors.



Some circuit cards may be missing the 0.1µF capacitor between pins Y and Z for filtering of the +5 volt input. The mounting holes for this capacitor are placed in the gold plated card edge pins. Be very careful to use the least amount of solder when installing this capacitor.

The 9.1 volt zener diode is removed and replaced with a 78L10 +10 volt DC regulator. Two (2) 0.1 µF capacitors are added with the 78L10 regulator, one on the input lead of the regulator to ground and one on the output lead of the regulator to ground.

To install the 78L10 regulator circuitry, the 75 Ω series current limiting resistor is removed and a hole is drilled (#55 drill) half way between the two (2) solder pads that the resistor was installed in. The 78L10 is installed in this position. The 78L10 regulator input and output leads should be soldered into the existing two (2) solder pads that the resistor was installed in and the ground lead should go through the hole that was drilled on the card and solder to the ground trace on the back of the board. Ensure the ground lead does not short the input or output to ground by touching the trace on the component side of the board.



## SQUELCH - M - CARD (CONT.)

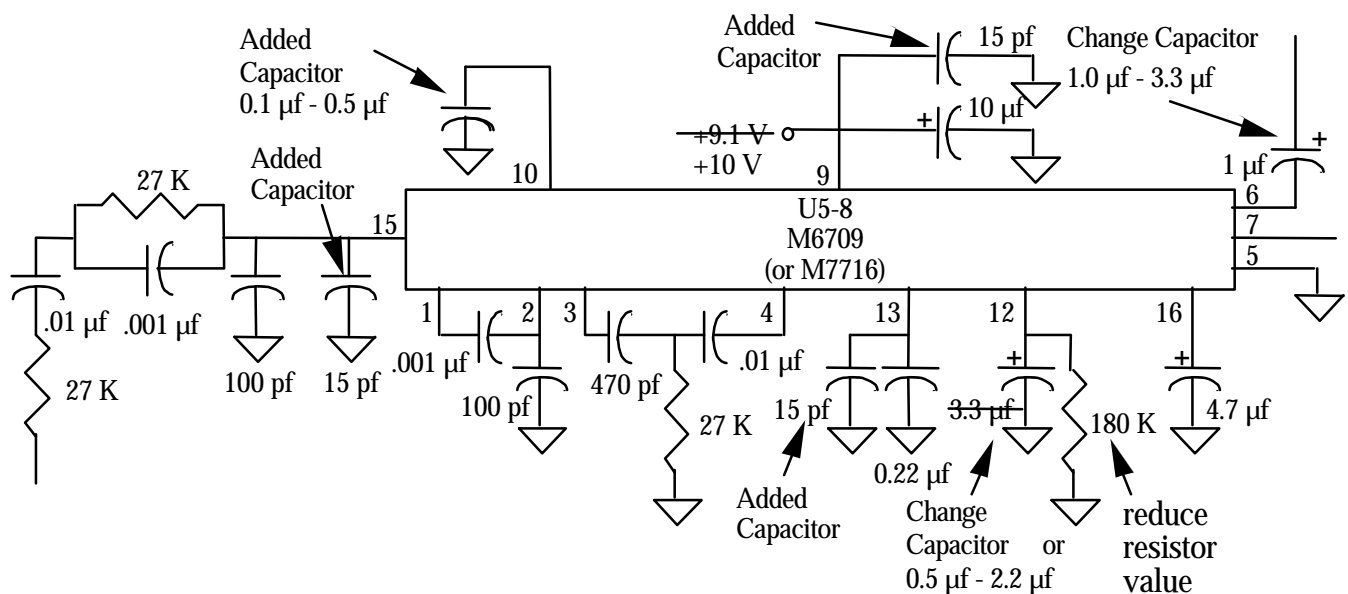
Install 15 pf capacitors on each Motorola squelch chip, M6709 or M7716, between pin 9 and ground, between pin 13 and ground and between pin 15 and ground. This will help the squelch chip's immunity to RF. The squelch chip part number may be M6709, the old number, or M7716, the new number.

### Optional Modifications

The length of the "Long Squelch" tail can be reduced, if desired. This change may create an **UNACCEPTABLE** "sputtering" in the squelch tail. To change the length of the long squelch tail, change either the capacitor **OR** resistor connected to pin 12 of the Motorola squelch chip. Do not change both the capacitor and the resistor. This modification is **NOT** recommended for the Motorola squelch chips that are connected to a mobile radio input, i.e. the 440 or 2 Meter receiver. The 3.3µf capacitor at pin 12 can be changed to a lower value between 0.5 µf and 2.2 µf. The smaller the value the shorter the "Long Squelch" tail time. The minimum safe value of capacitor is 0.5 µf. The 180KΩ resistor can be lowered to a value as low as 32KΩ. A 39KΩ resistor can be soldered in parallel with the 180KΩ resistor which will result in a combined value of 32KΩ. The minimum safe value of resistor is 32KΩ.

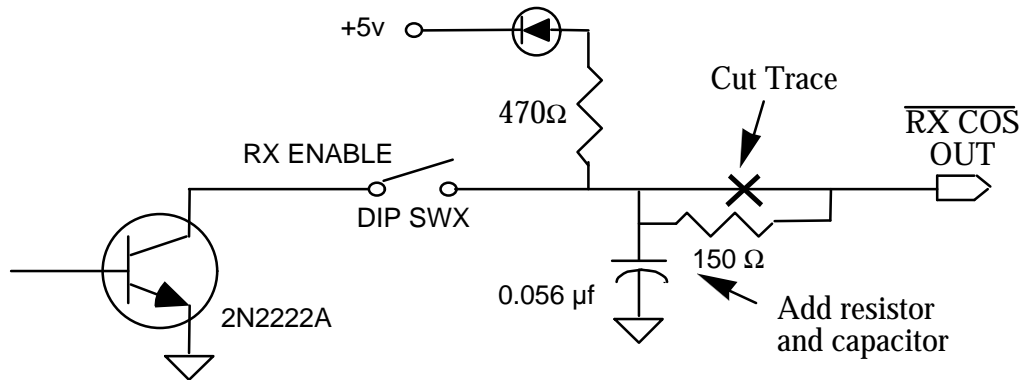
A capacitor between the values of 0.1 µf to 0.5 µf can be added from pin 10 to ground. This will generate a small amount of turn on delay. A 0.1 µf capacitor will provide approximately a 3 ms turn on delay and a 0.5 µf capacitor will provide approximately a 15 ms turn on delay.

In some cases using the local controller Touch-Tone® key pad to perform functioning may result in the function not being decoded. This is due to a "audio rumble" from the Squelch muting circuitry. The 1.0 µf capacitor at pin 6 of the Motorola squelch chip may be changed to value of no larger than 3.3 µf.

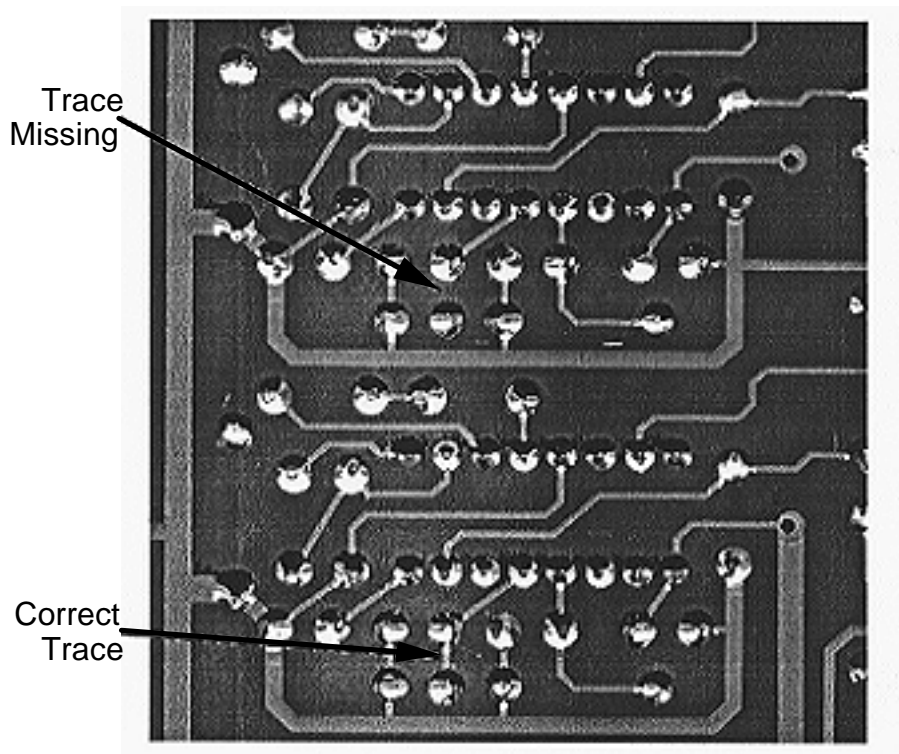


## SQUELCH - M - CARD (CONT.)

Add a noise filter to each of the four (4) RX COS OUT lines. Cut the circuit card trace near the card edge pin (as close as possible to each output pin 17, U, V and W) and install a 100  $\Omega$  to 150  $\Omega$  resistor in series with the output and a 0.047  $\mu\text{f}$  to 0.068  $\mu\text{f}$  capacitor at the input side of the resistor (the side of the resistor that connects to the dip switch) to ground. The noise filter components should be placed as close as possible to the card edge connector to minimize any coupling. The noise filter components for RX2 COS OUT, RX3 COS OUT and RX4 COS OUT should be placed on the solder side of the board and the noise filter components for RX1 COS OUT should be placed on the component side of the board.



A trace is missing on the solder side of the squelch board at U7. The trace should be part of a connection to U7 pin 13. A jumper wire needs to be soldered between the two pads to correct the problem.



## SQUELCH - M - CARD (CONT.)

### Squelch Threshold Adjustment

Setting the squelch threshold too tight will introduce a "Long Squelch Tail" into a normally quieting signal. Adjust the squelch threshold as follows:

Turn the squelch pot that corresponds to the receiver being adjusted CCW until the squelch is fully open. Inject an unmodulated signal into the receiver and set the input level for 20 dB of quieting. Remove the signal from the receiver. Adjust the squelch pot two (2) turns tighter than threshold for WIDEBAND receivers and up to four (4) turns tighter than threshold for NARROWBAND receivers. Insert the 20 dB quieting signal back into the receiver. The squelch should open quick and sharp without sputtering. If the squelch does not open quickly, turn the squelch pot CCW in ½ turn increments and repeat the test until the squelch opening is quick.

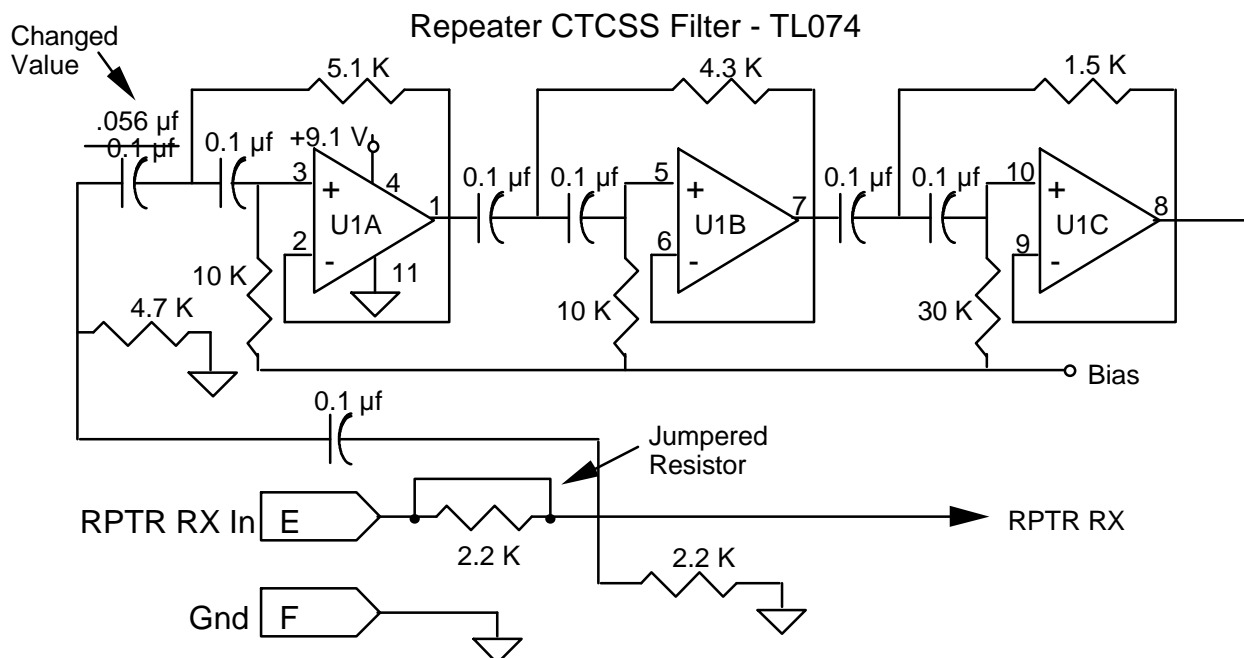
Increase the signal input to 40 dB of quieting. Step the RF frequency away from the receiver center frequency by one (1) megahertz and listen to the squelch tail generated by the loss of the received signal. Slowly reduce the RF signal input level and listen for the change from the short squelch tail to the long squelch tail. This should occur at NO MORE than 30 to 35 dB of quieting.

For best weak signal performance, the threshold for the user input receivers (440 or 2 Meters) should be set at about 6 to 10 dB quieting, or ¾ to 1 ½ turns tighter than threshold.

## AUDIO FILTER - A - CARD

There is a 2.2 KΩ resistor that is connected to Pin E, RPTR RX IN, that is jumpered thus removing it from the circuit. This connects the input of the CTCSS filter and the input of the RPTR RX OP Amp, U9A, directly to card Pin E. Jumper the 2.2 KΩ on the RPTR RX IN **ONLY**. Do **NOT** jumper any of the other 2.2 KΩ input resistors. After this modification verify there is no clipping of the signal to the input of the tone decoder chip used for the 440 input on the Touch-Tone® Decoder - A - Card TD1. See Touch-Tone® Decoder - A - Card modification instructions.

The 0.1 μf capacitor that connects the input to the first stage of the CTCSS filter, U1A, is replaced with a .056μf capacitor.

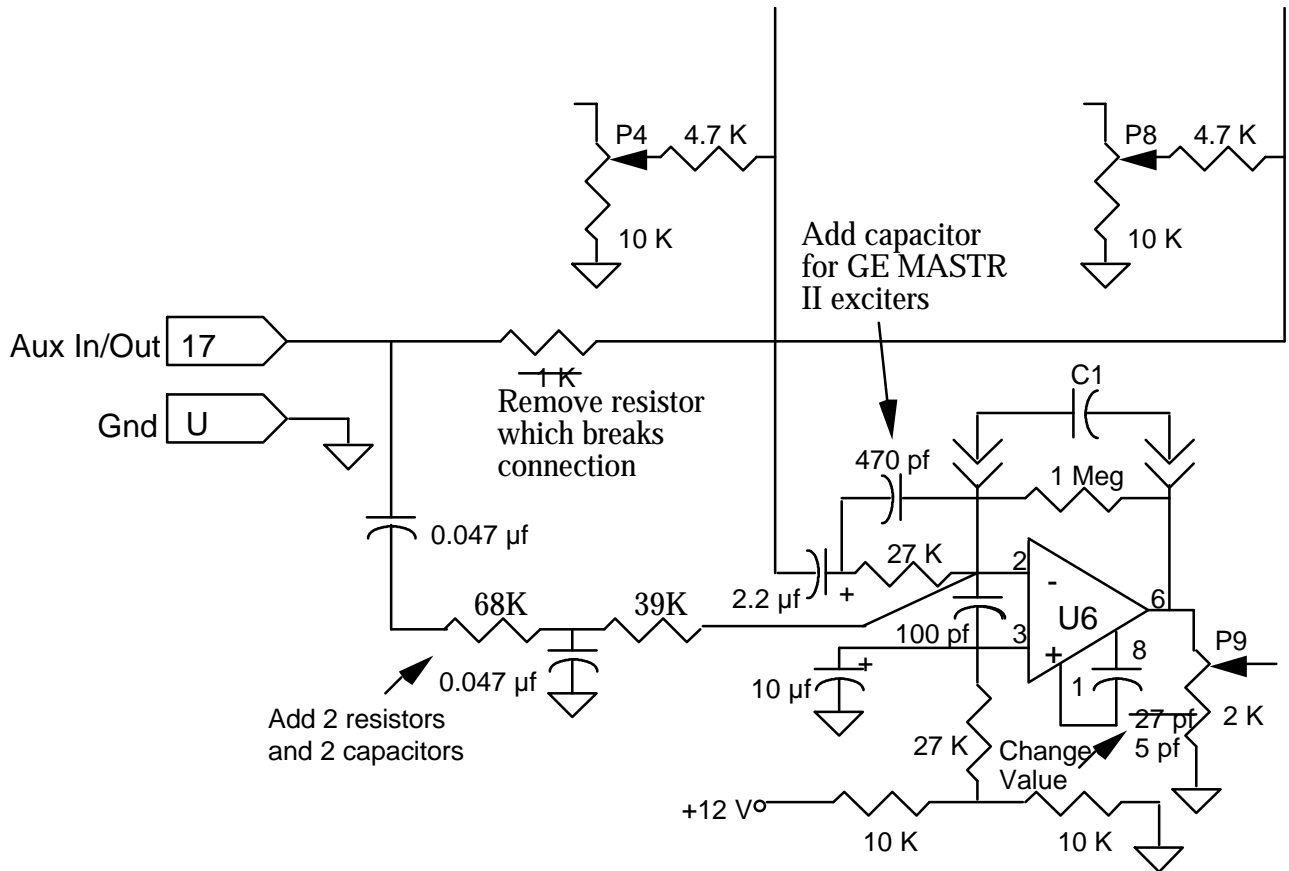


## AUDIO MIXER - A - CARD

Remove the 1 K $\Omega$  resistor (this resistor may have been changed to a 10K $\Omega$  value on some boards) from the AUX IN/OUT, edge card Pin 17, to the 2.2 $\mu$ f input capacitor of OUTPUT BUFFER/SUMMING amplifier, U6. Add a capacitor and two (2) resistors in series, 0.047 $\mu$ f first 68K second and 39K third, from the AUX IN/OUT, edge card Pin 17, to the pin 2 input of the OUTPUT BUFFER/SUMMING amplifier, U6. Between the two (2) resistors add a capacitor to ground with a value between 0.047  $\mu$ f and 0.068  $\mu$ f.

The 27 pf compensation capacitor between pins 1 and 8 of the OUTPUT BUFFER/SUMMING amplifier, U6, should be replaced with a 5 pf capacitor if the feedback resistor is greater than 510 K $\Omega$ , or replaced with an 8 - 10 pf capacitor if the feedback resistor is 510 K $\Omega$  or smaller.

To emphasize the higher frequencies for certain transmitters such as the GE MASTR II series (MASTR II, MASTR EXEC II, MVP) exciters, add a 470 pf capacitor in parallel to the 27K $\Omega$  resistor at the input of U6 pin 2.



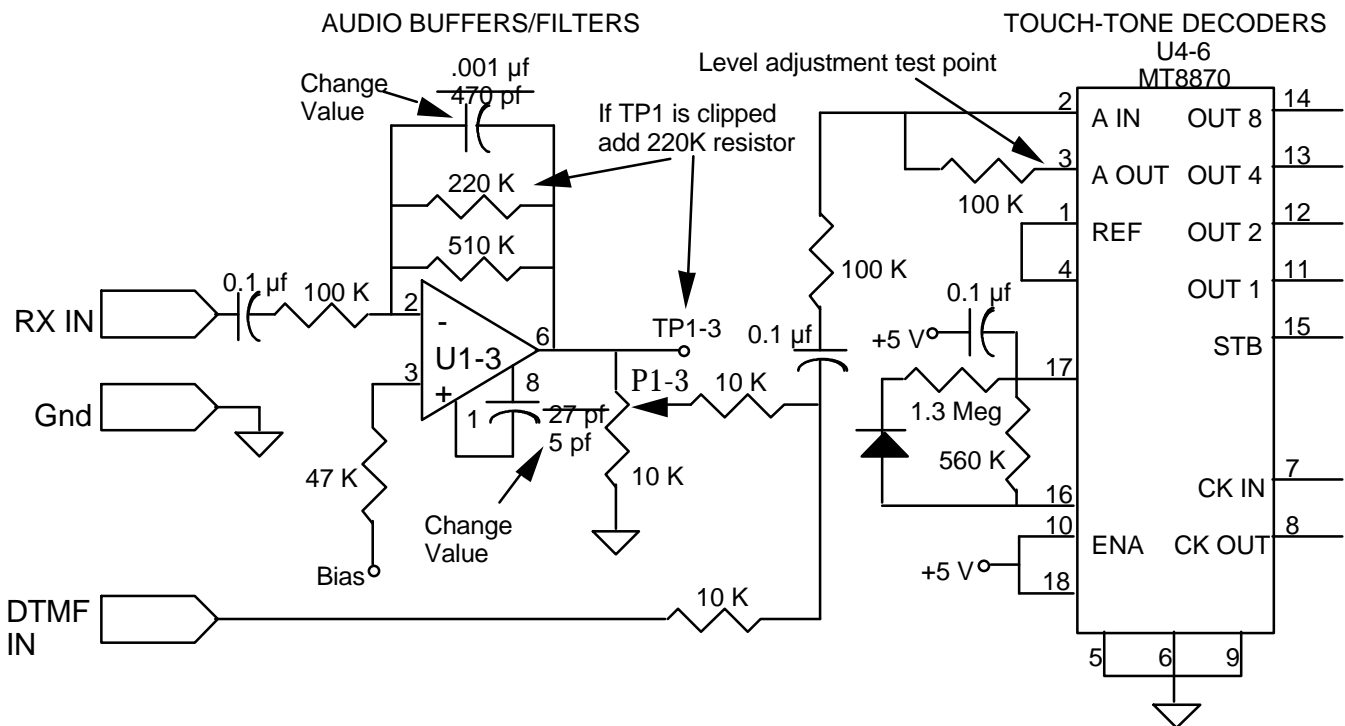
## TOUCH-TONE® DECODER - A - CARD

The input Op Amps, U1 through U3, may have a 470 pf capacitor in parallel with the 510KΩ feedback resistor. If this capacitor value is 470 pf it should be replaced with a .001 μf capacitor.

The 27 pf compensation capacitor connected between pin 1 and 8 of the input Op Amps, U1 through U3, should be replaced with a capacitor between 5 pf to 27 pf. Use as low a value as possible ensuring the Op Amp does not oscillate.

The modification of jumpering the 2.2KΩ resistor on the Audio Filter - A - Card for 440 audio may cause the Tone Decoder 1 (TD1) card TP1 output to be clipped. If the audio at TP1 is clipped, reduce the gain of the U1 Op Amp by adding a 220KΩ in parallel to the 510KΩ feedback resistor.

The front panel switch of the controller should be left in the RPTR position or an unused LINK position. The switch determines which input, RPTR or LINK, to send the Touch-Tones® from the front panel. The Touch-Tone® encoder adds sufficient capacitive loading to cause some response problems. Keeping the switch in the RPTR position causes the loading only on the RPTR input and not on the Links which could have more difficulty during decoding.



## **TOUCH-TONE<sup>®</sup> DECODER - A - CARD (CONT.)**

### **Level Adjustment Procedure for Touch-Tone<sup>®</sup> Decoder -A- Card.**

1. With the Touch-Tone<sup>®</sup> Decoder card on an extender card, connect an oscilloscope to pin 3 of the tone decoder chip that is connected to the receive path that is to be adjusted.
2. Inject a 430 Hz full deviation tone into the desired receiver. Use 4 kHz of deviation for a 4 kHz narrow band receiver, 5 kHz of deviation for a 5 kHz narrow band receiver and 10 kHz deviation for a wide band receiver.
3. If you have a variable audio generator, manually sweep the audio tone between 300 Hz and 600 Hz to find the audio tone frequency that has the highest amplitude level as shown on the oscilloscope. Typically the peak frequency will be approximately 430 Hz.
4. Adjust the input level to the tone decoder, using the level control pot (P1, P2 or P3) until the signal is clipped.
5. Slowly decrease the input level to the tone decoder, using the level control pot, until the signal just comes out of clipping.
6. Decrease the input level to the tone decoder using the level control pot another one (1) turn.
7. Check to ensure that functioning using the local controller Touch-Tone<sup>®</sup> key pad performs reliably for the receive path. If functioning is not reliable, decrease the input level to the tone decoder using the level control pot one (1) more turn. If functioning is still not reliable, change the shunt muting capacitor at pin 6 of the Motorola squelch chip. See Optional Modifications on page 3.
8. Repeat this procedure for each receive path connected to a tone decoder.