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### **Technical Application Note #3**

This Technical Application Note describes alignment procedure for a Palomar Telecom RBC-700 series controller. The following instructions are individually described:

Initial Setup Parameters

Repeater Setup Procedure

Link Setup Procedure

Receive Audio to Transmit Audio Setup Procedure

Remote Base Setup Procedure

Touch-Tone® Decoder Setup Procedure

Squelch Threshold Adjustment Procedure

This alignment procedure assumes that the controller needs a complete audio alignment.

This Technical Application Note #3 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 #3 - Alignment Procedure for the Palomar Telecom RBC-700 Series Controller.**

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## ***Initial Setup Parameters***

This initial setup procedure must be performed prior to adjustments of any audio levels. This setup determines the overall gain setting. This is necessary because the Tone Buss is a non-adjustable fixed level audio buss.

This procedure assumes that the receiver and transmitter have been properly compensated for flat audio response. (A resistor - capacitor network is often required in a receiver to obtain a flat response with the proper decoupling)

This procedure also assumes the Auxiliary Tone Buss modifications have been made to the Audio Mixer Card.

Set the following software audio levels:

- Program Identifier to level 10 (CW Identifier)**
- Program CW TM to level 14 (CW Telemetry)**
- Program Alert Tone to level 08 (Link Alert)**
- Program CSY 1 Tone to level 10 (Interface)**
- Program CSY 2 Tone to level 10 (Carrier Delay)**
- Program L-Dial 1 Tone to level 06 (Dialtone Low)**
- Program L-Dial 2 Tone to level 06 (Dialtone High)**

See the last page of this Technical Application Note for a complete listing of the software default volume levels and for the one change in the default frequency value.

Perform the following setup procedures in the order that they are listed. Changing the order may result in the final audio levels not being set to the proper deviation.

## ***Repeater Setup Procedure***

Function the Interface Normal command and trip the Interface Telemetry by momentarily providing a signal to the Repeater receiver input. This provides the normal audio load to the CW ID audio.

Function Start Test Tone 1 or CW ID to Repeater Only and adjust the tone deviation to 750 Hz peak using the Master Gain pot, P8 on Audio Mixer Card 1 (AM1). This is the bottom pot on the card.

If this deviation level cannot be reached, DO NOT increase the software volume level. Either change the way the transmitter is fed or increase the value of the 1 megohm feedback resistor on the U6 summing Op Amp on the Audio Mixer card. The value should not be any higher than necessary, but in no case should it be higher than 3.6 megohms. If the transmitter is unusually sensitive, reduce the value of the 1 megohm feedback resistor or attenuate the level at the transmitter.

NOTE: After a power on reset or a software reboot, the CW ID will sound loud and clicky. The deviation will be approximately 1.3 KHz to 1.5 KHz until the Interface Telemetry is tripped. The CW ID will return to the normal level after the Interface Telemetry has been tripped.

Function the CW ID to Interfaced Links and adjust the interfaced CW ID to 4 KHz peak deviation using the Tone Buss pot, P7 on Audio Mixer Card 1 (AM1). This is the second pot up from the bottom of the card. Expect this pot to be close to its maximum gain value. If you desire the level to be lower, adjust the level using the CW Telemetry software volume adjustment after all the levels have been set.

NOTE: The "A" series Audio Mixer Cards may not be able to obtain the proper CW Telemetry level. If this happens, leave the pot in the maximum gain value and continue with the adjustment setup.

## *Link Setup Procedure*

NOTE: The Link Alert tone significantly loads down the dialtone at any software volume setting. Use the software volume level set identified in the “Initial Setup Parameters” section.

Before setting the Dialtone, the Link Alert telemetry must be tripped to load down the Dialtone. This needs to be done one link at a time because the tone generator chips are also used for other outputs, which may disturb the setup.

Set the local DTMF tone pad control switch to the link that is to be adjusted. Using the local DTMF tone pad, send the Site Prefix and the Link Normal command. Immediately send the Site Prefix again and note the Alert Tone over the Dialtone. Function Interface Normal during the Alert Tone over the Dialtone time period. Send the Site Prefix again and note the smooth Dialtone. Adjust this Dialtone for 50% peak deviation for each link at the site using the Master Gain pot, P8 on each Link Audio Mixer Card 2 -5 (AM2 - AM5). This is the bottom pot on the card. For wideband links (10 KHz), set the deviation to 5 KHz and for narrowband links, (5 KHz) set the deviation to 2.5 KHz, or for narrowband links, (4 KHz) set the deviation to 2.0 KHz.

If this deviation level cannot be reached, DO NOT increase the software volume level. Either change the way the transmitter is fed or increase the value of the 1 megohm feedback resistor on the U6 summing Op Amp on the Audio Mixer card. The value should not be any higher than necessary, but in no case should it be higher than 3.6 megohms. If the transmitter is unusually sensitive, reduce the value of the 1 megohm feedback resistor or attenuate the level at the transmitter.

NOTE: After a power on reset or a software reboot, the Dialtone will sound loud. The deviation will be approximately 60% of full system deviation until the Link Alert Telemetry is tripped. The Dialtone will return to the normal level after the Link Alert Telemetry has been tripped.

Set the local DTMF tone pad control switch to the link that is to be adjusted. Using the local DTMF tone pad, send the Site Prefix and the CW Telemetry command. Adjust this CW Telemetry for 80% peak deviation for each link at the site using the Tone Buss pot, P7 on each Link Audio Mixer Card 2 -5 (AM2 - AM5). This is the second pot up from the bottom of the card. For wideband links (10 KHz), set the deviation to 8 KHz, for narrowband links, (5 KHz) set the deviation to 4 KHz, or for narrowband links, (4 KHz) set the deviation to 3.2 KHz.

NOTE: After a power on reset or a software reboot, the CW Telemetry will sound loud. The deviation will be approximately full system deviation until the Link Alert Telemetry is tripped. The CW Telemetry will return to the normal level after the Interface Telemetry has been tripped.

The “A” series Audio Mixer Cards may not be able to obtain the proper CW Telemetry level. If this happens, leave the pot in the maximum gain value and continue with the adjustment setup.

If the Auxiliary Tone Buss modifications have been made to the Audio Mixer Card, the telemetry audio loading will not affect the normal voice audio in any way. If the Auxiliary Tone Buss modifications have NOT been made to the Audio Mixer Card, the telemetry audio loading WILL affect the normal voice audio.

## ***Receive Audio to Transmit Audio Setup Procedure***

This setup must be performed after the “Repeater Setup Parameters” and the “Link Setup Parameters” procedures have been performed.

All levels are set using a 900 Hz tone. DO NOT use a 1.0 KHz tone. The notch filters in the controller will slightly attenuate the 1.0 KHz tone audio level as it passes through the controller.

Take any receiver using CTCSS out of decode mode and set all levels without the CTCSS tone.

Take any transmitter using CTCSS out of encode mode. If this is not possible, carefully measure the CTCSS peak deviation and add the deviation value to the target deviation levels specified in this procedure. Example: if the CTCSS peak deviation is 600 Hz and the audio target deviation specified is 2.5 KHz, the corrected deviation will be 3.1 KHz ( $0.6 + 2.5 = 3.1$ ).

Set the controller Power Switch to Off. Remove the first Squelch Card (SQ1) and put it on an extender card. Plug the extender card back into the controller SQ1 slot. Set the controller Power Switch to On and wait for the controller to boot itself. Ensure all CTCSS circuitry is off. It is not necessary to function the telemetry audio. The telemetry audio will not affect the receiver audio adjustments.

Inject a full quieting, on channel signal into the Repeater receiver. Set the deviation of the 900 Hz tone to half system deviation, 2.5 KHz. Using an oscilloscope, monitor TP1 on the Squelch card and adjust the Level Adjust 1 pot for a 0.5 Volt peak (1.0 VP-P) level.

Repeat this procedure for each receiver in the system, monitoring the appropriate Squelch Card test point and adjusting the appropriate Level Adjust Pot for a 0.5 Volt peak (1.0 VP-P) level. For narrowband receivers use 2.5 KHz input deviation and for wideband receivers use 5.0 KHz input deviation. For narrowband 4.0 KHz links, make the Squelch Card audio adjustments using 2.0 KHz input deviation.

After the Squelch Card level adjustments have been made, remove the extender card and insert the Squelch Cards back into the controller. After the controller reboots from power-up, all links should be interfaced. All links need to be interfaced for the remainder of the audio repeat level adjustments.

With the instrument(s) that will be used for the deviation level setting, connect the generator output to the monitor input and set the deviation of the 900 Hz tone to 50% of full system deviation, 2.5 KHz for a narrowband receiver (5.0 KHz), 2.0 KHz for a narrowband receiver (4.0KHz) and, 5.0 KHz for a wideband receiver (10.0 KHz). Make sure both agree on the deviation level. If they do not agree, the monitor is the most critical and should be the most accurate measurement. Adjust the generator such that the monitor reads the proper system deviation level to be measured. Ensure the monitor bandwidth filter is properly set for the deviation being measured, ie: do not use a narrowband filter when measuring a wideband signal.

Inject a full quieting, on channel signal into the Repeater receiver. Adjust the monitor’s frequency to measure the Repeater transmitter. Turn Off the 900 Hz tone deviation at the generator and accurately measure the deviation of noise generated by the transmitter. Turn on the 900 Hz tone deviation at the generator and adjust the transmitter deviation, using the P1 adjustment on Audio Mixer Card 1 (AM1) to the proper deviation level. This is the top pot on the card. The proper deviation level is 50% of full system deviation level plus the transmitter noise level measured plus the CTCSS level.

***Receive Audio to Transmit Audio Setup Procedure*** (cont.)

Adjust the monitor's frequency to measure the Link 1 transmitter. Turn Off the 900 Hz tone deviation at the generator and accurately measure the deviation of noise generated by the transmitter. Turn On the 900 Hz tone deviation at the generator and adjust the transmitter deviation, using the P2 adjustment on Audio Mixer Card 1 (AM1) to the proper deviation level. This is the second pot down from the top of the card. The proper deviation level is 50% of full system deviation level plus the transmitter noise level measured plus the CTCSS level.

Repeat the above paragraph procedure for the remaining link transmitters.

Disconnect the generator from the Repeater receiver and, using the local DTMF pad, function Link 1 Looparound ON.

Inject a full quieting, on channel signal into the Link 1 receiver. Adjust the monitor's frequency to measure the Repeater transmitter. Turn Off the 900 Hz tone deviation at the generator and accurately measure the deviation of noise generated by the transmitter. Turn on the 900 Hz tone deviation at the generator and adjust the transmitter deviation, using the P1 adjustment on Audio Mixer Card 2 (AM2) to the proper deviation level. This is the top pot on the card.

Adjust the monitor's frequency to measure the Link 1 transmitter. Turn Off the 900 Hz tone deviation at the generator and accurately measure the deviation of noise generated by the transmitter. Turn on the 900 Hz tone deviation at the generator and adjust the transmitter deviation, using the P2 adjustment on Audio Mixer Card 1 (AM1) to the proper deviation level. This is the second pot down from the top pot on the card.

Repeat the above paragraph procedure for the remaining link transmitters.

Repeat the above procedures for each of the Audio Mixer Cards in the controller.

There is a slight interaction of loading with each of the gain level adjustment pots on the Audio Mixer Cards. If there is a large adjustment in the position of one of the transmitter deviation pots, the adjustment procedure should be performed twice to ensure accurate deviation levels.

## ***Remote Base Setup Procedure***

This same level setting procedure can be used to set the deviation levels of any Remote Bases that are a part of the site where the transmit audio is applied to the microphone input to utilize the clipper and bandwidth filtering of the microphone circuits. If the transmit audio is applied to the microphone input, ensure the Audio Mixer card supplying the transmit audio has been modified for de-emphasized audio output by adding the proper value of the C1 capacitor in parallel to the 1 megohm feedback resistor of the U6 output Op Amp.

The maximum transmitter deviation in the Remote Base radio must be set prior to setting the normal transmitter deviation level.

Using the local DTMF pad, function the Remote Base ON, select the desired frequency and enable the transmitter.

Adjust the Master Gain pot, P8 on the Audio Mixer Card that supplies the transmit audio to the Remote Base (usually AM7 first) to mid range. This is the bottom pot on the card. There is no need to perform the telemetry audio adjustments since telemetry is not sent to any Remote Base transmitters.

Inject a full quieting, on channel signal into the Repeater receiver. Adjust the monitor's frequency to measure the Remote Base transmitter. Turn on the 900 Hz tone deviation at the generator and adjust 900 Hz tone deviation level at the generator for full or slightly above full system deviation. Using the P1 adjustment on the Audio Mixer Card that supplies the transmit audio to the Remote Base to be adjusted (usually AM7 first) adjust the pot clockwise until the Remote Base transmitter deviation is well into clipping. Set the deviation limiting adjustment inside the Remote Base radio for the desired maximum deviation level, usually 5.0 KHz.

Adjust 900 Hz tone deviation level at the generator back to the previous level used (the 50% of full system deviation level).

Turn Off the 900 Hz tone deviation at the generator and accurately measure the deviation of noise generated by the transmitter. Turn on the 900 Hz tone deviation at the generator and adjust the transmitter deviation, using the P1 adjustment on Audio Mixer Card to the proper deviation level. This is the top pot on the card.

Inject a full quieting, on channel signal into the Link 1 receiver. Adjust the transmitter deviation, using the P2 adjustment on Audio Mixer Card to the proper deviation level. This is the second pot down from the top pot on the card. The proper deviation level is 50% of full system deviation level plus the transmitter noise level measured.

Repeat this procedure for the remaining link receivers in the system.

Remember to set the Remote Base receiver to all other transmitters deviation level according to the Receive Audio to Transmit Audio Setup Procedure section above.

## ***Touch-Tone® Decoder Setup Procedure***

1. With the Touch-Tone® 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 sinewave tone into the desired receiver. Use 4 KHz deviation for a narrowband (4 KHz) receiver, use 5 KHz deviation for a narrowband (5 KHz) receiver and 10 KHz deviation for a wideband 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® 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 Technical Application Note #1, Modifications to the Palomar Telecom RBC-700 Series Controller, Optional Modifications on page 3.
8. Repeat this procedure for each receive path connected to a tone decoder.

## ***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.