Purpose:

This document assists the proper setup of a DSP Module / Radio interface for the ACU-1000 or ACU-T. This includes:

- Use of Radio Template Files provided by JPS
- Setup procedures when no Template is available
- Optimization after application of Template File

Pre-Stored Templates:

The ACU Controller Software Revision 4.0 (or higher) contains a number of Radio Templates. These Templates may be used to quickly set up a DSP Module for best operation with the associated radio models. The Templates contain all DSP Module options settings as optimized by the Raytheon JPS Communications Systems Engineering Department.

NOTE:

The Stored Templates from JPS will work properly only for a DSP/radio set up identically to the system optimized in the Raytheon JPS Systems Engineering Lab.

This means that:

1. The radio must be configured and interfaced exactly as described in the associated Application Notes provided.

2. The radio interface cable must be supplied by JPS or built per the schematic provided.

Application Notes:

Double-click on any DSP module icon to bring up its Settings Screen. Click on the "Open App Notes" button to bring up a list of Application Notes (PDF format). Each is named for the radio model it applies to, and each has an associated Stored Template file. If there are Application Notes for the radio you are interfacing, read them carefully for any special instructions that must be followed for proper operation of the associated Stored Template.

The Application Notes for the radio may describe any or all of the following:

1. Modifications to the radio including:
   - Changes in radio programming to enable desired I/O. These include PTT input or COR output (Unsquelch Indication Signal).
   - Changes in the radio's internal jumpers to enable desired I/O or other features.
   - Internal wiring modifications for the same purpose.
   - Proper radio volume knob settings (when these settings affect RX Audio output to the ACU-1000 or ACU-T).
2. Changes in the DSP Module jumper settings.

The Radio Interface Cables (and therefore the Templates) are designed for use with the radios as set up by the Application Notes. This setup may include any or all of:

1. Signal lines only available if the radio is programmed or modified as described by the Application Notes.
2. Attenuation networks that set the proper audio levels when the radio is set up per the Application Notes.
3. DC blocking capacitors.

Be sure to read the Application Notes thoroughly and be sure that all of its conditions are implemented. If you have any questions, consult Raytheon JPS Customer Service. If the radio programming, modification, and any other directions are not fully implemented, the configuration put into place by the Template may not work with the radio.

Be sure to verify that the cable being used to interface the radio matches the cable specified. If not, the setups put into place by the Template may not work with the radio.

Loading Templates:

1. Review Application Notes
   As described in the previous section, click on the "Open App Notes" button to bring up a list of available Application Notes. Each set of Application Notes has an associated Template file from JPS. Review for changes required and proper interface cable schematic; if the radio and cable are not configured per the Application Notes, the Template can not be used.

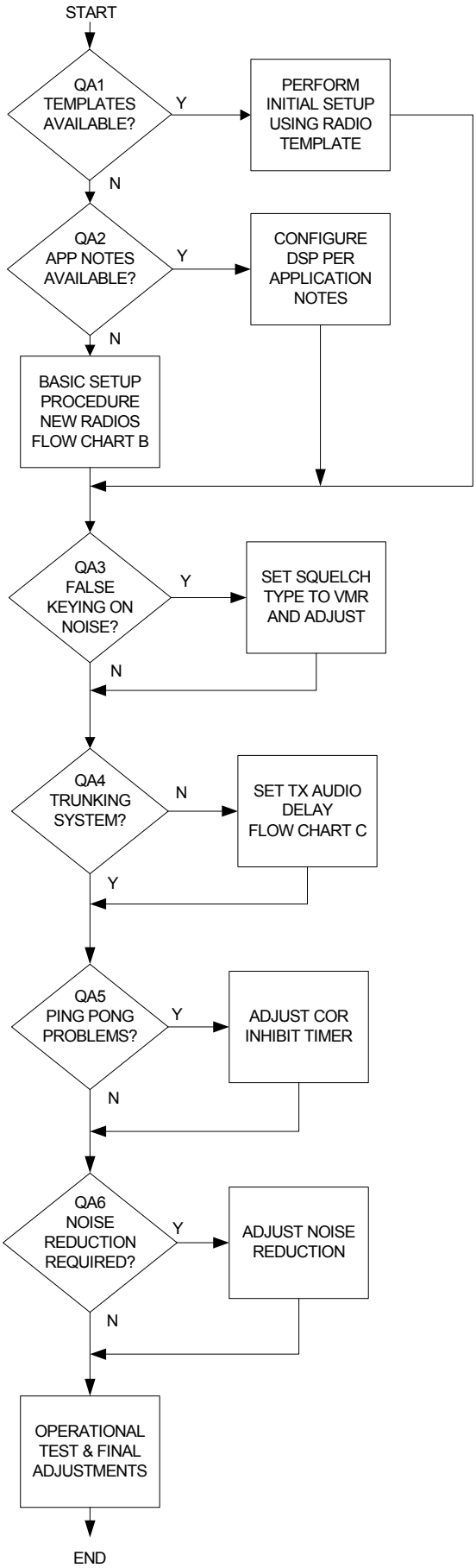
2. Save Current Settings (if desired)
   If you are not sure that you will want to replace the current settings with those of the Stored Template, save the current DSP module settings by clicking on the "Save" button and giving the current settings a new template name. This will allow the DSP Module to be quickly reset to these settings.

3. Load the Selected Template
   Click on the "Load" button on the DSP Module settings screen. Locate the file for the radio model being interfaced (the files are named for the radios). When you click on the selected file, the template settings will be loaded into the DSP module, replacing the current settings.

4. Complete Optimization of Interface
   These settings can then be further modified (for example, to fine-tune RX or TX level settings). Click on the "DSP Help" button and follow the setup Flow Chart

NOTES:

- On earlier versions of the ACU Controller, the "TX Audio Delay" feature is listed as "Radio Type" on the DSP-1 Settings Screen.



FLOW CHART A
Overall Instructions

ACU-1000/ACU-T
DSP MODULE
SETUP PROCEDURE
Rev 1.0 15 March 2004

Raytheon
JPS Communications

Flow Chart A Details

QA1 Are Templates Available?

To determine if there is a Template for the radio model being interfaced, double-click on any DSP module icon to bring up its setting screen. Next click on the 'Load' button to bring up the list of radio templates.

(QA1 Yes) Initial Set Up Using Radio Template

> If you are not sure if the radio and cable are configured per the Raytheon JPS Application Notes, do not click on the Template file to load it. Cancel and click on the 'Open App Notes" button to pull up the proper Applications Note. If the provisions of the Application Notes can't be followed, jump ahead to the Basic Setup Procedure (Flow Chart B).

- Click on the Template file that has the same name as the model of radio being interfaced. All of the DSP settings will change to those listed on the Application Notes. The Last Loaded / Saved field will list the name of the Template File.

Jump to QA3.

(QA1 No) Jump to QA2

QA2 Are Application Notes Available?

Application Notes are provided with radio interface cables purchased from Raytheon JPS Communications or may be obtained from the Customer Service Department. If you do not currently have the proper radio Template file, but do have Application Notes, proceed to step QA2 Yes. Otherwise jump to flowchart B

(QA2 Yes) Application Notes but no Template File

- Ensure that the radio and cable are configured per the Application Notes.
- Set the DSP module to its default settings:
  If each ACU Controller setting is marked [default], no action is necessary. Otherwise, use the ACU Controller to set all to the Default position. Alternatively, all settings can be quickly set to their default settings by loading the DSP Default Template.
- Use the ACU Controller to change all DSP settings to those listed on the Application Notes.
- Click "Apply" to save the settings and stay in the Settings Mode.

Jump to Q3

(QA2 No) Jump to Flow Chart B

QA3 False Keying on Noise?

If the radio Squelch Type is either COR or VOX, and the channel is noisy, the radio may unsquelch inappropriately due to this RF noise. When the radio is cross-connected to another radio via the ACU-1000 or ACU-T, the cross-connected radio will transmit every time the noisy radio unsquelches.
If a radio has a tendency to key on noise, change the Squelch Type to VMR (Voice Modulation Recognition). The DSP Module will unsquelch only when human speech is detected in the receive signal. [Inappropriate unsquelch of the radio can't be resolved by changing the VOX Threshold of the DSP Module]

(QA3 Yes) Set Squelch Type To VMR Mode

- On the DSP Module Settings Screen, select VMR from the Squelch Type options.
- Next determine the proper threshold. Listen while the radio receives a speech signal. The default setting is Med1. If the radio does not break squelch for all received speech, the threshold is too high; adjust to Low. If the radio breaks squelch on all speech signals and also on some noise input, increase the threshold to the Med 2 setting, and if necessary to High. (Note, for extremely noisy signals it may not be possible to find a threshold setting that will unsquelch for all speech signals and also always stay squelched during periods of high noise).

- Now adjust the hang time. The intent of VMR hang time is to keep the system unsquelched during pauses in speech. The default (and minimum) setting is 775 milliseconds. If the radio squelches inappropriately during the reception of speech, raise the hang time in one step increments until proper operation is reached.
- Click "Apply" to save the settings.

Jump to QA4

(QA3 No) Jump to QA4

QA4 Is The Radio Part of a Trunking System?

Trunked radio systems allow efficient use of multiple channel systems. When a user requests access, the system automatically switches the user's radio to a free (unused) channel. Trunked systems users, when keying their radios, must wait for a tone that signals that a free channel has been acquired before beginning a conversation, while conventional (non-trunked) system users can begin talking as soon as they key their radios.

The "Channel Acquired Tone" that signals trunked radio users that they may begin speaking is not available to system users on cross-connected radios, so the trunked radio's TX audio must be delayed, following assertion of PTT, until the normal channel acquisition time has passed.

(QA4 Yes) Jump to Flow Chart C

(QA4 No) Jump to QA5

QA5 Ping-Pong Problems?

Some radios have a tendency to unsquelch momentarily at the end of each transmission. In an ACU system, when two radios are cross-connected, whenever one radio is unsquelched, the other is keyed. If a cross-connected radio exhibits the momentary unsquelch after TX behavior, the cross-connected radio will inappropriately transmit. If both radios unsquelch at the end of each transmission, the system will "ping-pong", with first one radio keyed momentarily and then the other. This effect can be experienced with the DSP module set to either the COR or VOX Squelch Types.

To ensure that a radio being interfaced will not create a "ping-pong" behavior, key the radio and check for signs of a momentary unsquelch at the end of the transmission. This can be done by cross-connecting the HSP module with the radio. Key the HSP handset and see if the COR and/or SIGNAL LEDs of the DSP module associated with the radio light momentarily after the transmission is ended. If either lights up, the ACU should be set to ignore this inappropriate COR signal by enabling the COR Inhibit After PTT feature.

> NOTE: While the COR Inhibit Timer will prevent ping-pong and inappropriate keying of cross-connected radios; it will also prevent the radio from receiving a legitimate signal until the timer expires. This is not usually a problem because the radio is normally producing a burst of noise during this time. If system performance with the COR Inhibit Timer enabled is unsatisfactory, switch to VMR mode.
>
> See "(QA3 Yes) Set Squelch Type to VMR Mode".

(QA5 Yes) Adjust COR Inhibit Timer

- The default setting for the COR Inhibit Time After PTT is 100 ms.. If this does not prevent the DSP front panel COR indicator from lighting momentarily at the end of a transmission, set to the next highest time and repeat the test. (Note: The Signal LED may still light.)
- Continue to raise the time setting one step higher than the time required to prevent the inappropriate COR indication.
- It may be necessary to check system performance with two radios cross-connected (rather than using the HSP) to ensure the optimum COR Inhibit Timer Setting.
- Click "Apply" to save the setting.

(QA5 No) Jump to QA6

QA6 Is Noise Reduction Required? [Affects RX Audio Only]

The DSP module has a Digital Noise Reduction Mode that can be used to clean up noisy received signal input. This affects noise that is mixed with the speech signals, not RF noise that unsquelches a radio, creating a loud noise burst. The only method to find the correct amount of Noise Reduction to apply is to listen to the received signal as the level is changed; this is best done using the HSP Handset so that you can be sure that all noise heard is from the radio's received signal. Do not use the HSP speaker or a cross-connected radio. A little Noise Reduction goes a long way, and too much will give the received signal a fuzzy, artificial sound. It may be advantageous to attempt to improve the signal quality by other means (such as improving antenna placement) before adding Noise Reduction.

(QA6 Yes) Adjust Noise Reduction

- The default setting for Noise Reduction is Off (no reduction). While listening to the received signal, increase the Noise Reduction setting one step at a time until the best signal quality is reached.
- If possible, listen to the receive signal from several different sources and determine the Noise Reduction setting that works for most.
- If the signal quality is later improved, revisit the Noise Reduction setting.
- Click "Apply" to save the setting.

Jump to "Operational Test & Final Adjustments".

(QA6 No) Jump to "Operational Test & Final Adjustments"

Operational Test and Final Adjustment

This procedure accounts for radio-to radio variations and verifies proper cross-connection operation of the system. It will be necessary to create separate cross-connections of the radio being interfaced with every other radio in the ACU-1000 or ACU-T system, and perform each of the following checks. The associated DSP settings can be varied during the operational test to check for the optimum level. Use the ACU Controller to move the setting up or down by one level while communicating to check whether overall operation is degraded or improved, except for correcting TX & RX levels. If these settings need modification, jump back to QB1 and perform the entire settings procedure..

If necessary, refer to relevant sections of the flow charts for more information regarding these quick checks.

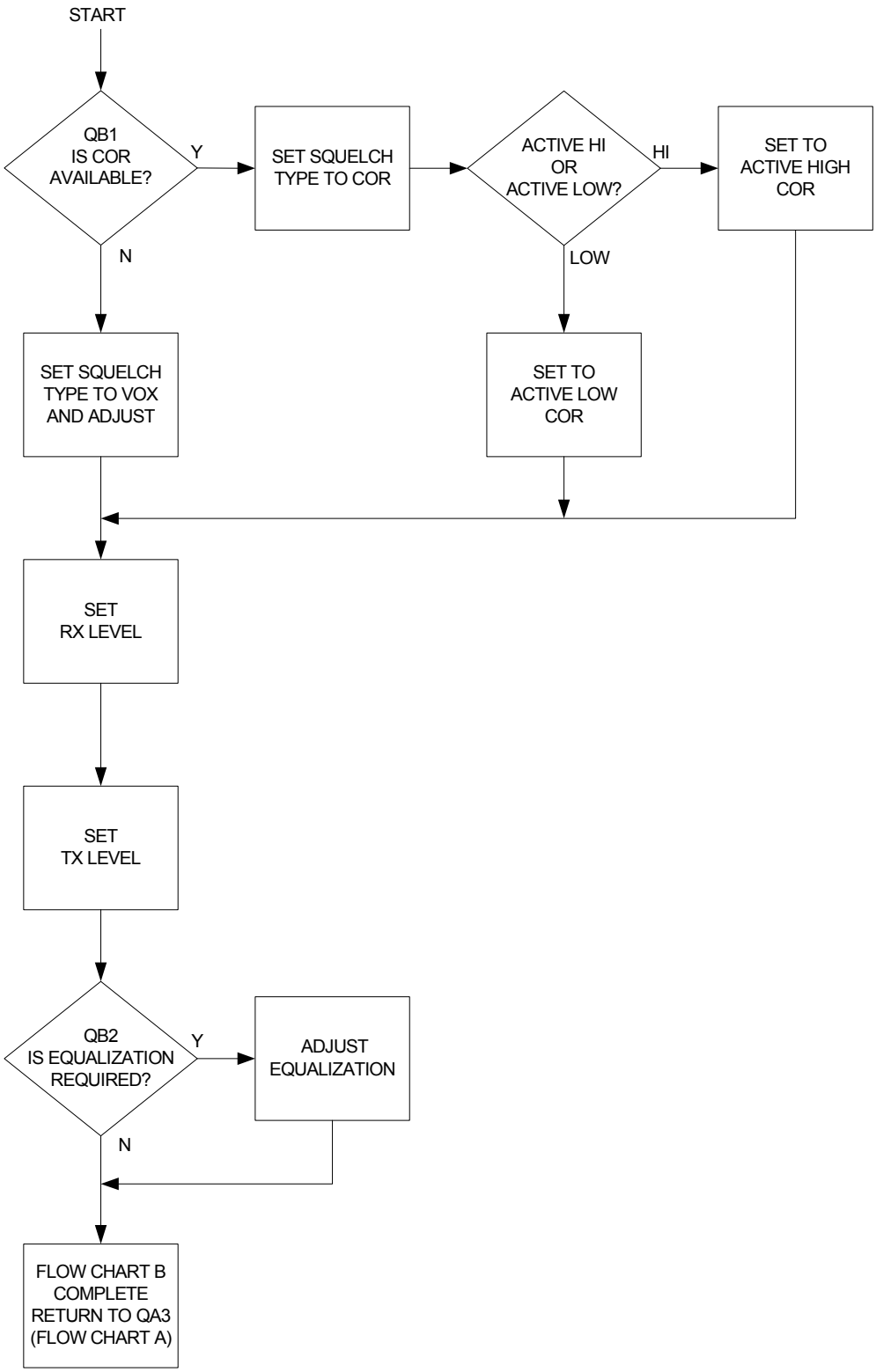
- Verify proper TX and RX levels. If problems are noted jump back to QB1. Do not modify individual module levels, or you may raise an RX level when what is really needed is a lower TX level.
- Check for ping-pong problems.
- Listen for noise problems.
- Listen to RX signal quality to determine if equalization is required.
- Verify that the proper Squelch Type has been set.
- For Trunked radios, listen for audio delay issues (missed first syllables or too much delay before first syllable is heard).
- Repeat the above steps as necessary.

When completed, there are two options:

If a template already exists for the radio being interfaced, click "OK" to save the settings and exit the DSP settings screen.

If you are interfacing a radio that does not already have a stored template and you want to create one to apply to other radios in the system (or to save these exact settings for later recall), click "Save" and store the settings under the Template name of your choice.

FLOW CHART B
Basic Setup For New Radios When No Template or Application Notes Are Available



Flow Chart B Details

Basic Setup

DSP Setup With No Templates & No Application Notes

QB1 Is a COR Signal Available?

The default Squelch Type is VOX because it will function with all radios. However, if a COR (unsquelched) signal line is available, this is usually a better choice. Determine if the radio has an output that will go either high when the radio unsquelches (Active High COR), or low (Active Low COR). It may be necessary to change the radio programming to enable the COR output signal.

(QB1 Yes) Set COR Squelch Type & COR Polarity

- On the DSP Settings Screen, change the Squelch Type To COR.
- The default COR Polarity is Active Low. If the COR signal is actually Active High, change the COR Polarity setting to Active High. [Note: A radio with active high COR, when connected to a DSP Module set for Active Low, will keep the DSP's COR LED on except when the radio unsquelches.]
- Click "Apply" to save the settings.

Jump to Set RX Level

(QB1 No) Jump to Set RX Level

Set RX Level

The RX (Receive) level must be optimized to allow best system operation. First of all, conversations, especially conference calls, will be more intelligible if all voices are at the same volume level. Second, VOX and VMR work best at the proper RX level.

- Monitor the front panel of the DSP module while the radio is receiving a voice signal at a normal speaking volume level.
- Watch the DSP front panel SIGNAL light. It should flicker with the incoming speech. If the level is too high, the LED will be on constantly during received speech. If too low, the LED will never come on, or will flicker only occasionally.
- Adjust the RX Level until the Signal LED flickers with incoming speech.
- Click "Apply" to save the setting.

[Note: If the interface is using speaker audio from the radio, the level will vary depending on the radio's volume control setting. Set the RX level in the DSP to 0 dBm, and then vary the radio volume level until the proper Signal LED indication is achieved. Note the setting, and keep the volume control at this setting.]

Set TX Level

The proper TX level is required to fully modulate the transmitter, but not over modulate it. Most radios have an audio limiter prior to the transmitter to prevent over modulation. Even with the limiter, some radios will still over modulate and some even shut off the TX signal when the input is too high. When the level is set too low the audio of the radio receiving the signal will be lower than normal, requiring that its volume control be turned up to an abnormal position. When the audio is too hot the audio will sound squashed or forced, and if the radio does not have a TX audio limiter the audio will sound distorted and over modulated.

- Cross-connect the HSP Module to the DSP Module being adjusted, and use the HSP Handset to key the radio while speaking at a normal volume level.
- Monitor to the TX audio of the interfaced radio on a receiver set to the radio's TX frequency.
- The quickest way to set the TX audio level is to use the ACU Controller to set the DSP Module's TX level to its lowest setting. Increase the TX level until the audio in the monitoring radio stops increasing in level. This is the threshold point where the limiter is preventing the TX level from going any higher. Leave the DSP Module's TX level at this threshold value.
- You may also follow the radio's recommended TX input audio setting procedure.
- Click "Apply" to save the TX Level setting.

QB2 Is Equalization Required?

High Frequency Equalization either boosts or rolls off the high end of the RX audio spectrum. This adjustment compensates for poor RX audio quality. The best way to determine the proper High Frequency Equalization Setting is to listen to the received audio in the HSP handset (not the HSP speaker, unless a high-quality external speaker is connected).

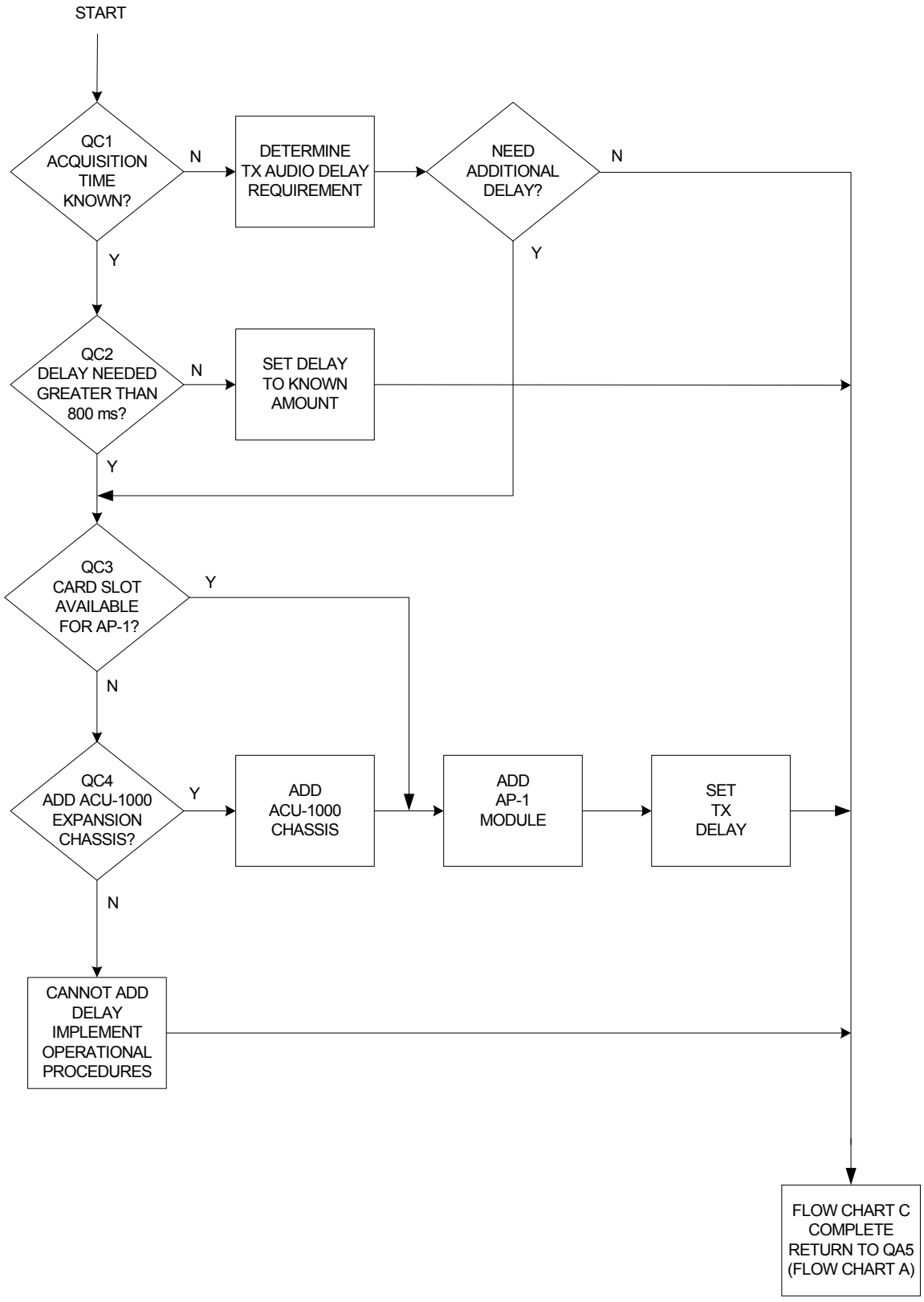
(QB2 Yes) Adjust Equalization

- Monitor the RX Audio in the HSP handset.
- If the audio sounds like it is lacking treble the high frequencies can be increased (boost).
- If the signal sounds too bright or harsh the high frequencies can be attenuated (cut).
- When the best-sounding audio is attained, click "Apply" to save the setting.

Note: Most Motorola mobiles and portables sound best with a boost of at least 3.5 dB.

(QB2 No) Flow Chart B Complete - Jump to QA3

FLOW CHART C
Trunked Radio TX Audio
Delay Adjustment



Flow Chart C Details
Trunked Radio TX Audio Delay Adjustment Procedure

QC1 Is Acquisition Time Known?

Trunked Systems require TX audio delay that matches the normal channel acquisition time. This delay holds up the RX audio from cross-connected radios until the trunked radio is ready to begin transmitting. If the Channel Acquisition Time is known, the task is simply to add this amount of TX audio delay. If it is not known, a procedure must be followed to determine the proper TX Audio Delay Setting.

(QC1 No) Determine TX Audio Delay Requirement

- Set the TX Audio Delay to its maximum setting of 800 ms.
- Cross-connect the HSP Module to the DSP associated with the trunked radio.
- Transmit via the HSP while monitoring the signal via a receiver that is part of the trunked system.
- If the first syllable of the transmissions is being cut, more than 800 ms delay is needed. Jump to QC3.
- If the first syllable is not being cut, lower the delay setting until it is, then raise the setting up one step.
- Click "Apply" to save the TX Audio Delay setting.

Jump to QA5. Flow Chart C Complete.

> The TX Audio Delay Setting may be a compromise between comfortable conversation and safety. When it is imperative that absolutely no first syllables are ever lost, the TX audio delay must be at least as long as the longest channel acquisition time (normally longest during times of heaviest system use). This may result in longer than needed delays during periods of low or normal system traffic. If not sure, leave at max TX Audio Delay.

(QC1 Yes) Jump to QC2

QC2 More Than 800 ms Delay Needed?

The DSP-1 module can provide up to 800ms TX audio delay. Additional delay requires an AP-1 Module.

(QC2 No) Set Known Delay

- Set the TX Audio Delay to the setting equal to (or just above) the known channel acquisition time.
- Click on "Apply" to save the TX Audio Delay setting.

Jump to QA5. Flow Chart C Complete.

(QC2 Yes) Jump to QC3

QC3 Is There an Empty Card Slot in the ACU-1000 Chassis?

An AP-1 TX option can be used to provide additional audio delay if 800 ms is insufficient. This option consists of an AP-1 plug in board and a "Y" cable for easily incorporation into the ACU-1000 chassis. The AP-1 can provide up to 1530 ms TX Audio Delay, for a combined total of 2.33 seconds.

(QC3 Yes) Install AP-1 Module and Set TX Audio Delay

- Acquire the AP-1 Module - TX Option (JPS P/N 5961-294002).
- Remove power from the ACU-1000.
- The AP-1 module should reside alongside the DSP Module that it is going to add delay to. If necessary, move another modules to make room.
- Install the ACU Extender Card (JPS P/N 5951-707000, from the ACU-1000's Accessory Kit) in the slot where the AP-1 is to reside.
- Plug the AP-1 Module into the Extender Card
- Install the included 'Y' cable (JPS P/N 5961-291117, part of the AP-1 TX Option) into the rear panel of the new ACU chassis.

- Connect the radio interface cable (that had been connected to the DSP Module's rear panel D15 connector) to the "Y" cable.
- Make sure that the TX Audio Delay of the DSP module is set to 800mS.
- Using the tables to set the AP-1's TX Audio Delay. SW 4-1 must be on to enable audio delay. The total delay is 800 ms plus the delay as configured by AP-1 SW-1 to SW3-8.

SW-3	Delay Settings
SW3-1	6 milliseconds
SW3-2	12 milliseconds
SW3-3	24 milliseconds
SW3-4	48 milliseconds
SW3-5	96 milliseconds
SW3-6	192 milliseconds
SW3-7	384 milliseconds
SW3-8	768 milliseconds

The total AP-1 delay is the sum of the delays of the individual switches (1530 ms maximum)

SW-4	DSP Function
SW4-1	Digital Delay Enable
SW4-2	2175 Hz Tone Generator Enable
SW4-3	1950 Hz Tone Generator Enable
SW4-4	2175 Hz Tone Detector Enable
SW4-5	1950 Hz Tone Detector Enable
SW4-6	Unused – keep in the off position
SW4-7	Unused – keep in the off position
SW4-8	Unused – keep in the off position

NOTE: SW4-1 **MUST BE ON** to enable audio delay

- With the AP-1 on the "EXTENDER CARD", adjust the delay value and test with audio (as previously described) until the proper delay is reached.
- Once the delay value is set, remove the AP-1 from the Extender Card, replace in the ACU-1000 Chassis.

Jump to QA5. Flow Chart C is Complete.

(QC3 No) Jump to QC4

QC4 Can an Expansion Chassis Be Added?

If there is no slot available for the AP-1 module, an ACU-1000 Expansion Chassis can be added. No similar provisions are available for the ACU-T. See the ACU-1000 manual for instructions.
Jump to QA5. Flow Chart C is Complete.

(QC4 Yes) Add Expansion Chassis

Connect an Expansion Chassis to the existing chassis with the Master/Expansion cable. Again, organize DSP Modules so that the AP-1 Module can be installed along side the trunked radio's DSP Module. Determine the proper TX Audio Delay as listed above "Determine TX Audio Delay Requirement".

(QC4 No) Implement Operational Procedures

When long channel acquisition times can not be completely compensated by adding TX Audio Delay, system users must follow proper procedures to ensure that the entire message is being heard. This can mean simply waiting for the necessary time after keying their microphones before beginning to speak, repeating important communications, or getting a response from the listener.

Flow Chart C Complete - Jump to QA5