



# QCII/ 2-Tone Over P25 Configuration

## Configuring G-Series Voice Pagers for QCII over P25 Operation

### 1. Overview

QCII over P25 offers a number of advantages for implementing a paging solution on a P25 System. They are:

- Minimizes use of TGIDs
- Minimal Dispatching process change
- Pager behavior closely matches that of the Minitor/G1 Analog pagers
- Works over Motorola, Kenwood, Harris and Airbus ABME+2 Capable RF
- Uses the identical QCII Tone set as Motorola
- Works with Wireless and IP connected Console AMBE+2 capable environments

In the following sections a detailed review of QCII coding, Tone Sets and ways to configure the G4 or G5 to support various behaviors are provided.

### 2. How Does QCII over P25 Work?

QCII over P25 uses a Talk Group ID (TGID) and it is over this TGID's assigned Talk Channel that the QCII, 2-Tone, ID is sent. Many Dispatch Centers will patch analog VHF/UHF Channel traffic to a P25 TGID so Portable and Mobile users can hear these transmissions. In such applications adopting to QCII over P25 paging should be straightforward.

There are differences between a standard analog 2-Tone frequency set and the set used for QCII over P25 paging. Refer to *Figures 1 and 2 on the following pages*.

**Figure 1** is an example of a Motorola analog 2-Tone set and one can see the tone frequencies are defined and their spacing runs 3-6%.

In **Figure 2**, QCII over P25 defines frequency range of 31.25 to 62.5Hz for each of its 72 groups. Any frequency that falls into a specific range is decoded the same. So, for example, if an analog tone of 349Hz is patched to a P25 TGID, it will get decoded as Index 3. And, an analog tone of 330.5Hz will also get decoded as Index 3.

The significance of these differences and how one programs a G4/5 for QCII over P25 will be explained in a later section.

Figure 1:

**Signaling Setting Motorola** [X]

Group 1	Group 2	Group 3	Group 4
<input type="radio"/> 330.5	<input type="radio"/> 569.1	<input type="radio"/> 288.5	<input type="radio"/> 321.7
<input type="radio"/> 349.0	<input type="radio"/> 600.9	<input type="radio"/> 296.5	<input type="radio"/> 339.6
<input type="radio"/> 368.5	<input type="radio"/> 634.5	<input type="radio"/> 304.7	<input type="radio"/> 358.6
<input type="radio"/> 389.0	<input type="radio"/> 669.9	<input type="radio"/> 313.0	<input type="radio"/> 378.6
<input type="radio"/> 410.8	<input type="radio"/> 707.3	<input type="radio"/> 953.7	<input type="radio"/> 399.8
<input type="radio"/> 433.7	<input type="radio"/> 746.8	<input type="radio"/> 979.9	<input type="radio"/> 422.1
<input type="radio"/> 457.9	<input type="radio"/> 788.5	<input type="radio"/> 1006.9	<input type="radio"/> 445.7
<input type="radio"/> 483.5	<input type="radio"/> 832.5	<input type="radio"/> 1034.7	<input type="radio"/> 470.5
<input type="radio"/> 510.5	<input type="radio"/> 879.0	<input type="radio"/> 1063.2	<input type="radio"/> 496.8
<input type="radio"/> 539.0	<input type="radio"/> 928.1	<input type="radio"/> 1092.4	<input type="radio"/> 524.6

Group 5	Group 6	Group 10	Group 11
<input type="radio"/> 553.9	<input type="radio"/> 1122.5	<input type="radio"/> 1472.9	<input type="radio"/> 1930.2
<input type="radio"/> 584.8	<input type="radio"/> 1153.4	<input type="radio"/> 1513.5	<input type="radio"/> 1989.0
<input type="radio"/> 617.4	<input type="radio"/> 1185.2	<input type="radio"/> 1555.2	<input type="radio"/> 2043.8
<input type="radio"/> 651.9	<input type="radio"/> 1217.8	<input type="radio"/> 1598.0	<input type="radio"/> 2094.5
<input type="radio"/> 688.3	<input type="radio"/> 1251.4	<input type="radio"/> 1642.0	<input type="radio"/> 2155.6
<input type="radio"/> 726.8	<input type="radio"/> 1285.8	<input type="radio"/> 1687.2	<input type="radio"/> 2212.2
<input type="radio"/> 767.4	<input type="radio"/> 1321.2	<input type="radio"/> 1733.7	<input type="radio"/> 2271.7
<input type="radio"/> 810.2	<input type="radio"/> 1357.6	<input type="radio"/> 1781.5	<input type="radio"/> 2334.6
<input type="radio"/> 855.5	<input type="radio"/> 1395.0	<input type="radio"/> 1830.5	<input type="radio"/> 2401.0
<input type="radio"/> 903.2	<input type="radio"/> 1433.4	<input type="radio"/> 1881.0	<input type="radio"/> 2468.2

OK Cancel

**Figure 2:**

For FDMA channels, there are 72 groups of frequencies, where some groups cover a 31.25 Hz, and some groups cover a 62.5 Hz range (marked in **red text** below). The following table lists the standard frequency, and the corresponding minimum and maximum frequency, for each group:

Index	Freq Range (Hz)	Decoded Freq (Hz)	Index	Freq Range (Hz)	Decoded Freq (Hz)	Index	Freq Range (Hz)	Decoded Freq (Hz)
1	265.7 - 296.8	283	25	1015.7 - 1046.8	1032.5	49	1828.2 - 1859.3	1838.25
2	296.9 - 328.1	310.75	26	1046.9 - 1078.1	1055	50	1859.4 - 1890.6	1881.25
3	328.2 - 359.3	344.25	27	1078.2 - 1109.3	1103	51	<b>1890.7 - 1953.1</b>	1926.5
4	359.4 - 390.6	376.25	28	1109.4 - 1140.6	1128.75	52	<b>1953.2 - 2015.6</b>	1974
5	390.7 - 421.8	407.5	29	1140.7 - 1171.8	1155.75	53	2015.7 - 2046.8	2021.75
6	421.9 - 453.1	435.25	30	1171.9 - 1203.1	1184.5	54	2046.9 - 2078.1	2065
7	453.2 - 484.3	467.25	31	1203.2 - 1234.3	1219	55	<b>2078.2 - 2140.6</b>	2110
8	484.4 - 515.6	496.25	32	1234.4 - 1265.6	1242.75	56	2140.7 - 2171.8	2156.75
9	515.7 - 546.8	528.5	33	1265.7 - 1296.8	1293.25	57	<b>2171.9 - 2234.3</b>	2205.75
10	546.9 - 578.1	566	34	1296.9 - 1328.1	1320	58	<b>2234.4 - 2296.8</b>	2257.5
11	578.2 - 609.3	598	35	1328.2 - 1359.3	1347.75	59	2296.9 - 2328.1	2311.75
12	609.4 - 640.6	621.5	36	1359.4 - 1390.6	1376.75	60	<b>2328.2 - 2390.6</b>	2369
13	640.7 - 671.8	660	37	1390.7 - 1421.8	1406.5	61	2390.7 - 2421.8	2409.25
14	671.9 - 703.1	688.25	38	1421.9 - 1453.1	1437.75	62	<b>2421.9 - 2484.3</b>	2461.5
15	703.2 - 734.3	719	39	1453.2 - 1484.3	1470.5	63	<b>2484.4 - 2546.8</b>	2516.25
16	734.4 - 765.6	752.5	40	1484.4 - 1515.6	1505	64	<b>2546.9 - 2609.3</b>	2573.5
17	765.7 - 796.8	789.75	41	1515.7 - 1546.8	1541.25	65	<b>2609.4 - 2671.8</b>	2633.75
18	796.9 - 828.1	806.25	42	<b>1546.9 - 1609.3</b>	1579.25	66	<b>2671.9 - 2734.3</b>	2697
19	828.2 - 859.3	849	43	1609.4 - 1640.6	1616.75	67	<b>2734.4 - 2796.8</b>	2763.75
20	859.4 - 890.6	880.5	44	1640.7 - 1671.8	1650	68	<b>2796.9 - 2859.3</b>	2813.25
21	890.7 - 921.8	914.25	45	1671.9 - 1703.1	1684.75	69	<b>2859.4 - 2921.8</b>	2875.5
22	921.9 - 953.1	932	46	1703.2 - 1734.3	1721	70	<b>2921.9 - 2984.3</b>	2941.25
23	953.2 - 984.3	970	47	1734.4 - 1765.6	1758.25	71	<b>2984.4 - 3046.8</b>	3010
24	984.4 - 1015.6	1011	48	<b>1765.7 - 1828.1</b>	1797.25	72	<b>3046.9 - 3109.3</b>	3082.25

### 3. What Steps are Required in Preparation for Implementing QCII Over P25?

In preparation for implementing the QCII Over P25 paging solution the following must be taken into consideration.

- a. Does your system use AMBE+2 capable Base Stations?

The G4/5 solution makes use of the Motorola QCII Tone Set and testing on AMBE+2 capable Base Stations allows for a high degree of reliably decoding the QCII tone. The P25 System Administrator or Group responsible for the maintenance of the Dispatch Center and RF Base Stations can assist with this information.

- b. Do you have an assigned TGID over which the QCII Tones are transmitted over?

This can be a dedicated TGID used just for Dispatched paging messages or it can be a currently used TGID over which the QCII tones are to be transmitted over. Take into consideration, if there is too much traffic on a currently used TGID it may delay the sending of a QCII page.

- c. What 2-Tone Coding Plan is going to be used?

The answer to the above question depends on if current analog 2-Tone VHF/UHF traffic is going to “patched” over P25 or if a new coding plan is to be developed.

If the plan is for current analog 2-Tones to be used to page a G4/5 pager then as mentioned earlier, care must be taken in the assignments to ensure there is a “one to one” relationship.

- i. Review existing 2-Tone coding plan
- ii. Match 2-Tone IDs with the QCII Tone Index Ranges
- iii. There may be existing 2-Tone IDs that will not have a unique QCII ID
- iv. Options are:
  - 1. Change a 2-Tone ID
  - 2. Create a new one for QCII

Figure 3 below shows an example where a current 2-Tone Plan has a conflict. There are two 2-Tone IDs (CCII Code 9460 and 9960) whose Tone B frequencies fall into QCII Index 3 (refer to Figure 2) so the G4/5 would treat these as the same page and not two different ones.

**Figure 3:**

AGENCY	CCII CODE	A TONE	B TONE
Ada 821	9973	716.0	473.1
Adell	9818	412.0	851.0
Airprt Manager	9460	645.7	358.9
All Call Fire	9926	426.5	645.7
Batavia	9160	668.2	371.5
Beechwood 867	9960	645.7	346.7
Cascade	9110	398.0	371.5
Cascade 813	9113	398.0	507.0
Cedar Grov 829	9912	384.5	426.5
Cedar Grove	9922	426.5	426.5
CitySFalls 814	9955	582.0	582.0
CShebFalls 851	9905	346.7	582.0
Elk Lake 816	9181	822.1	412.0
Elk Lk Hazmat	9822	457.0	457.0
Elkhart Lake	9112	398.0	457.0
Franklin 833	9970	716.0	346.7
Glenbeulah	9180	822.1	371.5

- d. If there is no existing 2-Tone coding plan this allows one the opportunity to create one that may be more efficient and straightforward than a legacy plan that has evolved over time. To begin creating a plan;
  - v. List all the entities that need to be paged.
  - vi. Once this is identified one may want to assign a common Tone B to specific entity for ease of determining different whose ID it is.
  - vii. If there are different entities that would be paged out for an incident one may want to assign that combination of entities to one ID (instead of “stacking” 2-Tone IDs which adds to the time to dispatch).
  - viii. A suggestion is one use the standard Motorola 2-Tone Groups to create the above IDs keeping in mind the “one to one” relationship described in paragraph 3.c.
- e. Once the above steps are completed and reviewed with the System Administrator and Director of the Dispatching Center the process of programming the pager can begin.

## 4. Programming the G4/5

### A. Assigning the TGID(s) and the QCII over P25 Codes

With the G4/5 Programming Software select Tab D.4 to assign the TGID(s) and the QCII over P25 Codes. Refer to Figure 4 below, where an example is provided. Refer to the bottom three rows where the P25 Sub-Group ID are set. In this example standard 2-Tone ID are set and from these it is easy to select the corresponding QCII over P25 Index in the P25 Sub-Group ID column.

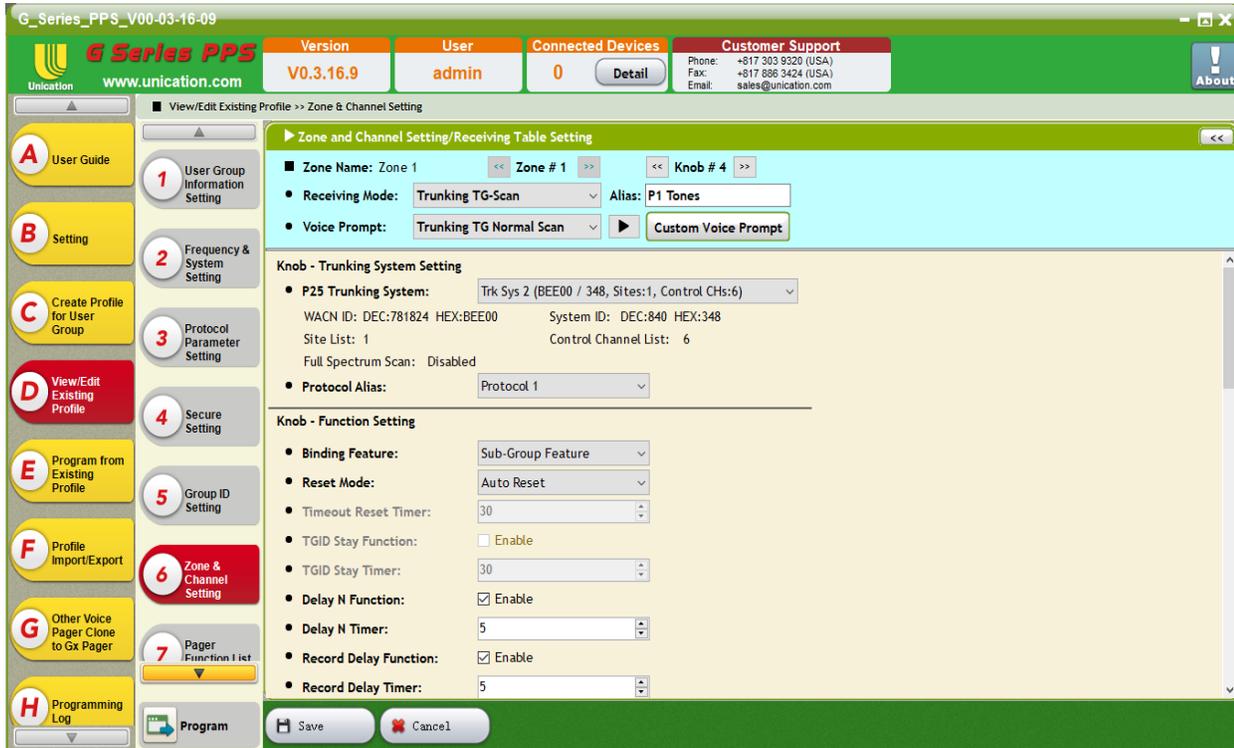
Figure 4:

No.	Group Alias	Alert Mode	Alert Tone	Voice Storage	Relay Control	Background Color	Key Alias	2-Tone	P25C TGID	P25C Sub-Group (2-Tone Phase 1)	P25
1	TGID	Tone	Default Tone	<input checked="" type="checkbox"/>	Off	Off	Key 1	No Setting	1 (DEC) 1 (HEX)	No Setting	5478 D605
2	P1 2 Tone	Tone	Default Tone	<input checked="" type="checkbox"/>	Off	Off	Key 1	No Setting	No Setting	No Setting	No S
3	P2 2 Tone	Tone	Default Tone	<input checked="" type="checkbox"/>	Off	Off	Key 1	No Setting	No Setting	No Setting	No S
4	Uni Sub	Tone	Default Tone	<input checked="" type="checkbox"/>	Off	Off	Key 1	No Setting	No Setting	No Setting	No S
5	Group 1	Tone	None	<input checked="" type="checkbox"/>	Off	Off	Key 1	No Setting	No Setting	No Setting	No S
6	Group 2	Tone	Default Tone	<input checked="" type="checkbox"/>	Off	Off	Key 1	T1. 330.5 Hz T2. 539 Hz	No Setting	No Setting	No S

## B. Setting the Zone and Channel Setting

In Tab D.5 there are several new settings and a new Talk Group List. Figures 5-9 represent one Selector Knob setting and each new setting and the Talk Group List will be explained in detail.

**Figure 5:**



**Figure 6:**

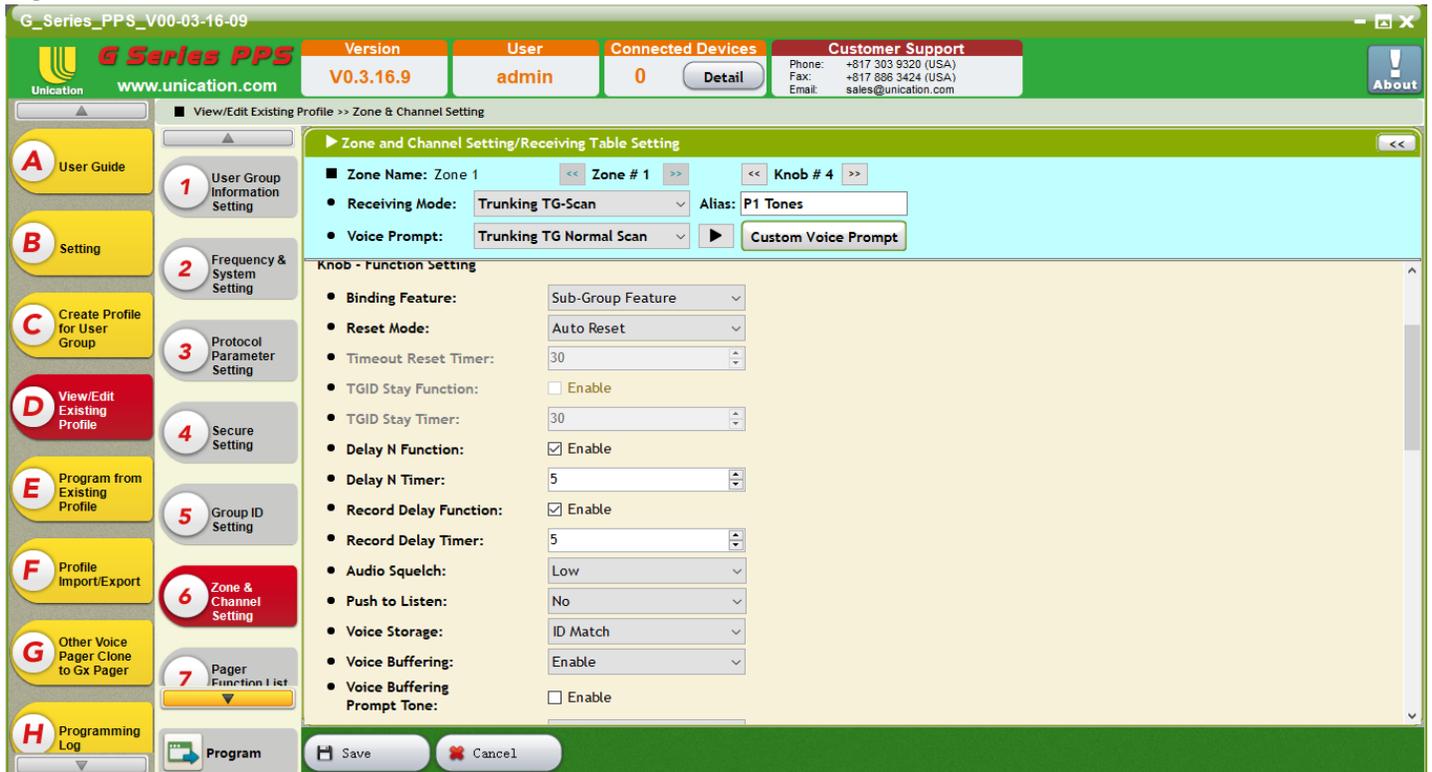


Figure 7:

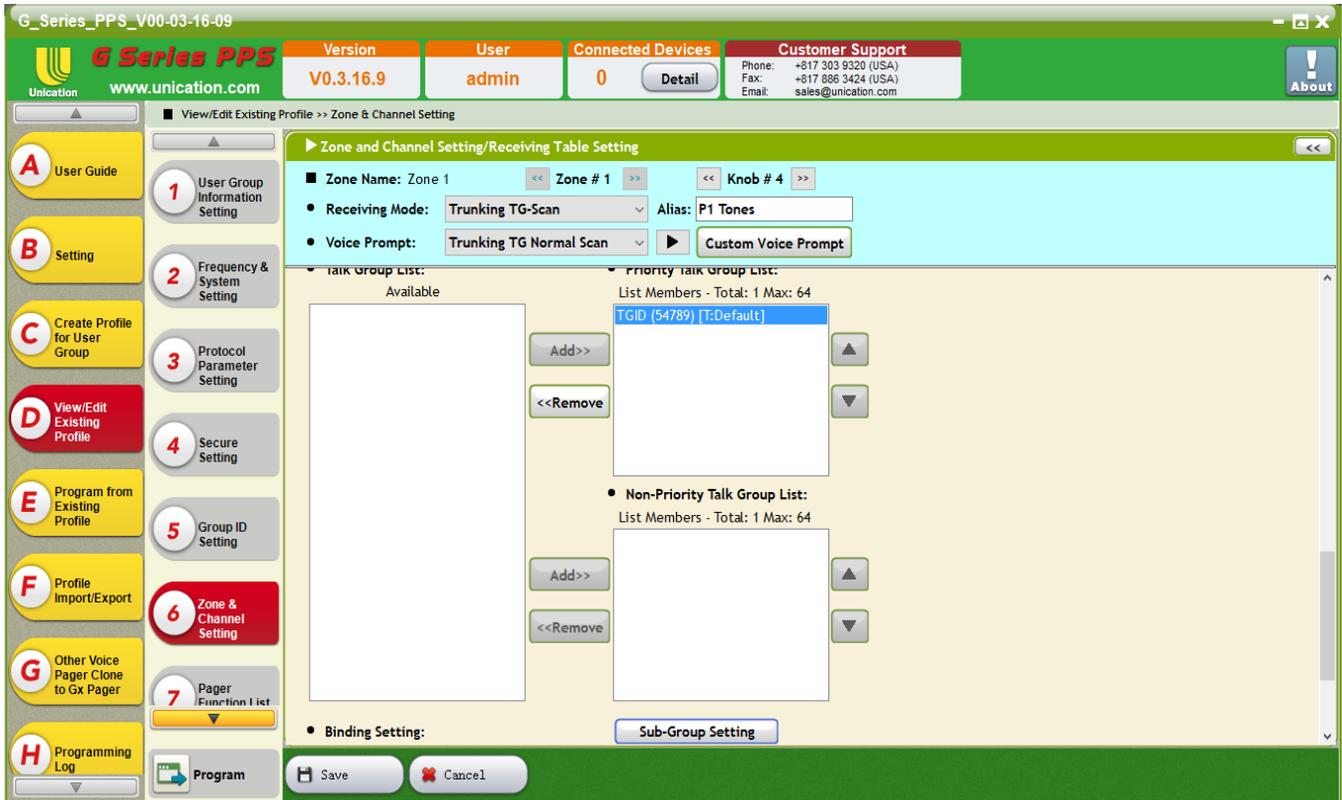


Figure 8:

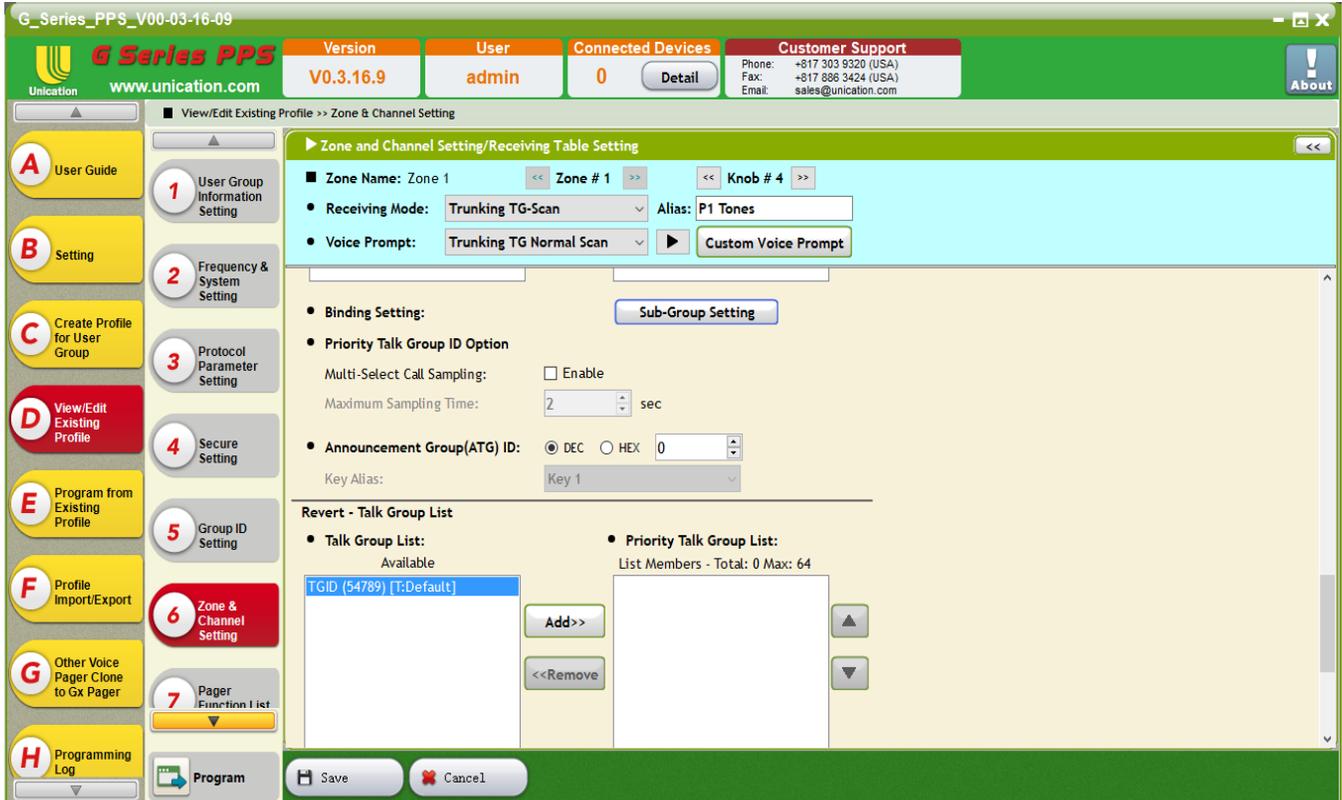
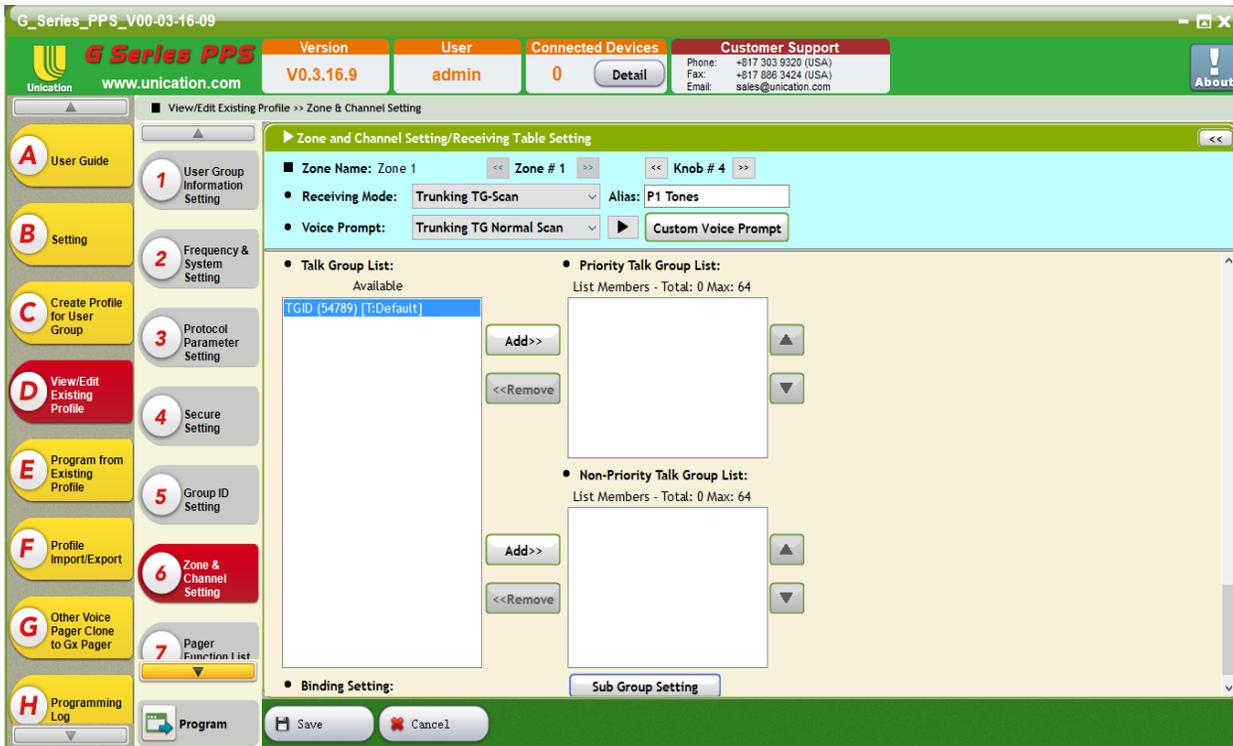


Figure 9:

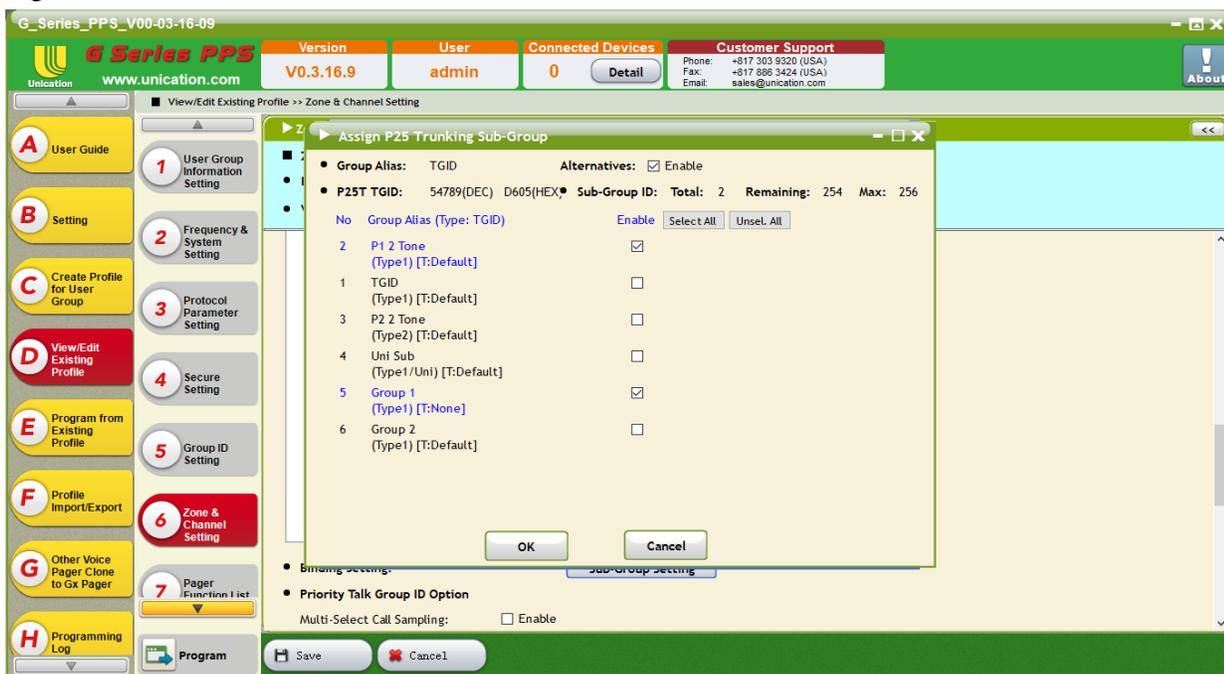


**C. The following is detailed explanation of the new settings for QCII over P25.**

1. **Binding Feature-** There are three settings; None, Sub-Group Feature and Call Alert Feature. For TGID paging “None” is selected, for QCII over P25 paging “Sub-Group Feature” is selected and for Call Alert paging “Call Alert Feature” is selected.
2. **Reset Mode-** If the **Binding Feature** is set for “Sub-Group Feature” there are five selections.
  - a. **Auto Reset-** At the end of the page’s voice message the G4/5 goes back to Stand-By mode awaiting another QCII page.
  - b. **Selective Timeout Reset-** This is similar to an analog pager’s Selective Call with Revert mode. In this case, after the pager receives the QCII page’s message it will continue to monitor TGIDs programmed in the **Revert- Talk Group List** until the **Timeout Reset Timer** value expires. The pager will then go back to stand-by mode awaiting a QCII page.
  - c. **Selective Manual Reset-** Same as the above except one must depress the pager’s Reset Key Button to cause the pager to return to the stand-by mode.
  - d. **Monitor Timeout Reset-**Monitors all TGIDs active on the **P25 site** until the **Timeout Reset Timer** value expires. If a TGID with QCII IDs is programmed in this list then upon detection of a valid QCII ID the pager will monitor all TGIDs affiliated to the Site for the duration of the **Timeout Reset Timer**.
  - e. **Monitor Manual Reset-** Same as the above except one must depress the pager’s Reset Key Button to cause the pager to return to the stand-by mode.
3. **Timeout Reset Timer-** Works in conjunctions with the Timeout Reset Modes described above.
4. **Delay N Function-** During the Delay N time only the TGID on which the tones were received will be heard for the duration. This ensures the message is heard.
5. **Delay N Timer-** Works in conjunction with the Delay N Function setting to make sure the message is stored.

6. **Talk Group List**- This table lists the TGIDs to be listened to before the alert. How the pager behaves is explained in Figure 11.
7. **Priority Talk Group List**- TGID list that determines which TGID's are held in the highest priority. To setup the unit to work how it did prior to adding this feature put all TGID's in this list.
8. **Non-Priority Talk Group List**- TGID List for non-priority TGID's
9. **Revert- Talk Group List**- This list is only available when Selective Reset modes are chosen. It determines how the pager behaves after the alert. How it behaves is explained in Figure 11.
10. **Sub-Group Setting**- This is a setting associated with the Talk Group Lists and it allows the assignment of QCII IDs to specific TGIDs. In Figure 10 the Sub-Group is selected and, for this example, a TGID assigned multiple QCII IDs is shown. Another important setting is **Alternatives** and its function is explained in Figure 11.

**Figure 10**



## 5. Configuring the G4/5 for Different Behaviors

*Figure 11 provides different Use Case Scenarios and the associated settings.*

- A. **Scenario 1**- is identical to the analog Selective Call operation. In this case the pager is mute until it detects a programmed QCII ID and stores the paging voice message. After the voice message, the pager goes to stand-by mode awaiting a new page. However, if a TGID is assigned to either Table that is not associated with a QCII ID then the pager will unmute if there is traffic. NOTE: only consider programming a non-paging TGID to a Table if the System supports TGID Priority.
  - Scenario 2**- This is similar to the analog Monitor Mode where the pager is monitoring traffic on one or more TGIDs. However, if a TGID is assigned to either Table that is not associated with a QCII ID then the pager will unmute if there is traffic. NOTE: only consider programming a non-paging TGID to a Table if the System supports TGID Priority.
  - Scenario 5**- This is similar to Selective Call with Revert analog mode. Multiple TGIDs can be programmed in the Revert- Talk Group List however, if a TGID that is not associated with a QCII ID or has its Alternate Setting enabled is programmed then the pager will unmute if there is traffic on these

TGIDs. NOTE: only consider programming multiple TGIDs if the System supports TGID Priority to ensure an incoming page is not missed.

B. **Scenarios 3 and 4** are special cases and may not apply to paging applications.

**Figure 11**

Scenario	Binding Feature	Reset Mode	TGIDs In Talk Group List	TGIDS in Revert Talk Group List	Behavior
1	Sub-Group	Selective Manual	Alternative Setting= Disabled	Alternative Setting= Disabled	No traffic on the QCII TGID is heard unless a QCII Id is detected. If there is a non paging TGID assigned to either Talk Group list all its related traffic will be heard.
2	Sub-Group	Selective Manual	Alternative Setting= Enabled	Alternative Setting= Enabled	The pager plays all traffic from TGID's assigned to the <b>Talk Group List</b> . After receiving a QCII page it then follows the <b>Revert- Talk Group List</b> and hears traffic on all TGIDs programmed in this list. <b>This behavior is similar to the Minitor Monitor Mode, but in a P25 environment.</b> Multiple TGID's (i.e. the QCII and the Traffic TGIDs) must be in both lists for the pager to behave like the Minitor Pager's Monitor Mode, <b>but only if the system supports TGID priority.</b> If the system does not support TGID Priority only the QCII associated TGID should be assigned to both lists. Once in Revert, the pager will continue to check TGID transmissions for its assigned QCII IDs and , if detected, will alert and store the message.
3	Sub-Group	Monitor Manual	Alternative Setting= Disabled	N/A	No traffic on the QCII associated TGID is heard unless QCII ID is detected. If a non paging TGID is assigned to the <b>Talk Group List</b> , all its traffic will be heard. Upon detecting a QCII ID the pager will, alert ,store the message and then begin to monitor <b>ANY</b> TGID traffic affiliated on that Site, regardless if programmed into the unit.
4	Sub-Group	Monitor Manual	Alternative Setting= Enabled	N/A	Unit hears all traffic on the QCII TGID and other Non Paging TGIDs assigned to the <b>Talk Group List</b> Upon detecting a QCII ID the pager will, alert ,store the message and then begin to monitor <b>ANY</b> TGID traffic affiliated on that Site, regardless if programmed into the unit.
5	Sub-Group	Selective Manual	Alternative Setting= Disabled	Alternative Setting= Enabled	To configure for <b>Selective Call with Revert mode</b> the QCII TGID should be the only TGID assigned to the <b>Talk Group List</b> . Upon page detection the pager will alert, store the message and then monitor traffic on the TGIDs assigned to the <b>Revert-Talk Group List. It will continue to check for QCII IDs on the associated TGID and upon detection, alert, store the message and go back to the Revert Mode.</b>

In conclusion, if **Alternates** is enabled then you will hear all traffic on that TGID. When **Alternatives** is disabled only traffic accompanied by the correct QCII tone pair is heard. All TGID's with no QCII assigned operate as though **Alternatives** is enabled regardless of which list they are in.

# APPENDIX

In the following several examples will be provided to help understand the settings for different behaviors.

## 1. Selective Call Mode

In this mode, the pager is mute until a programmed QCII ID is decoded. Once decoded the pager will generate the alert assigned to the QCII ID and after the alert cycle the voice message is played. After the message is heard the pager will go mute awaiting any traffic on the TGID assigned the QCII IDs.

Key programming settings to configure the G4/5 for Selective Call Mode are shown in Figures 1A-5A below. Below, several of the Key settings are reviewed.

- a. **Voice Prompt-** This is not a key setting, but may be useful for the User. In in this a prompt labelled Selective Call using the Custom Voice Prompt button was created.
- b. **Binding Feature-** Sub-Group Feature must be selected.
- c. **Reset Mode-** Selective Manual Reset must be selected.
- d. **Delay N Function-** To ensure the received voice message is stored this must be enabled.
- e. **Delay N Timer-** This setting works in tandem with the Delay N Function. The value selected is to cover any gap in a voice transmission after the QCII ID is sent and ensure the voice message is stored.
- f. **Talk Group List-** (Figure 2A) Select the TGID to be used for QCII transmissions.
- g. **Binding Setting-** Located at the bottom of the Talk Group List, click on Sub-Group Setting and a list showing the TGID is displayed. Click on Edit and Figure 3A will be displayed. It is here where one selects the QCII IDs to decode.  
**NOTE: The Alternatives setting cannot be selected.**
- h. **Revert Talk Group List-** Select the TGID to be used for QCII transmissions (Figure 4A). Located at the bottom of the Revert Talk Group List, click on Sub-Group Setting and a list showing the TGID is displayed. Click on Edit and Figure 5A will be displayed. Selects the same QCII IDs to decode that were selected in the Talk Group List. **NOTE: The Alternatives setting should always be selected in the Revert Talk Group list to ensure the message is heard.**

Figure 1A

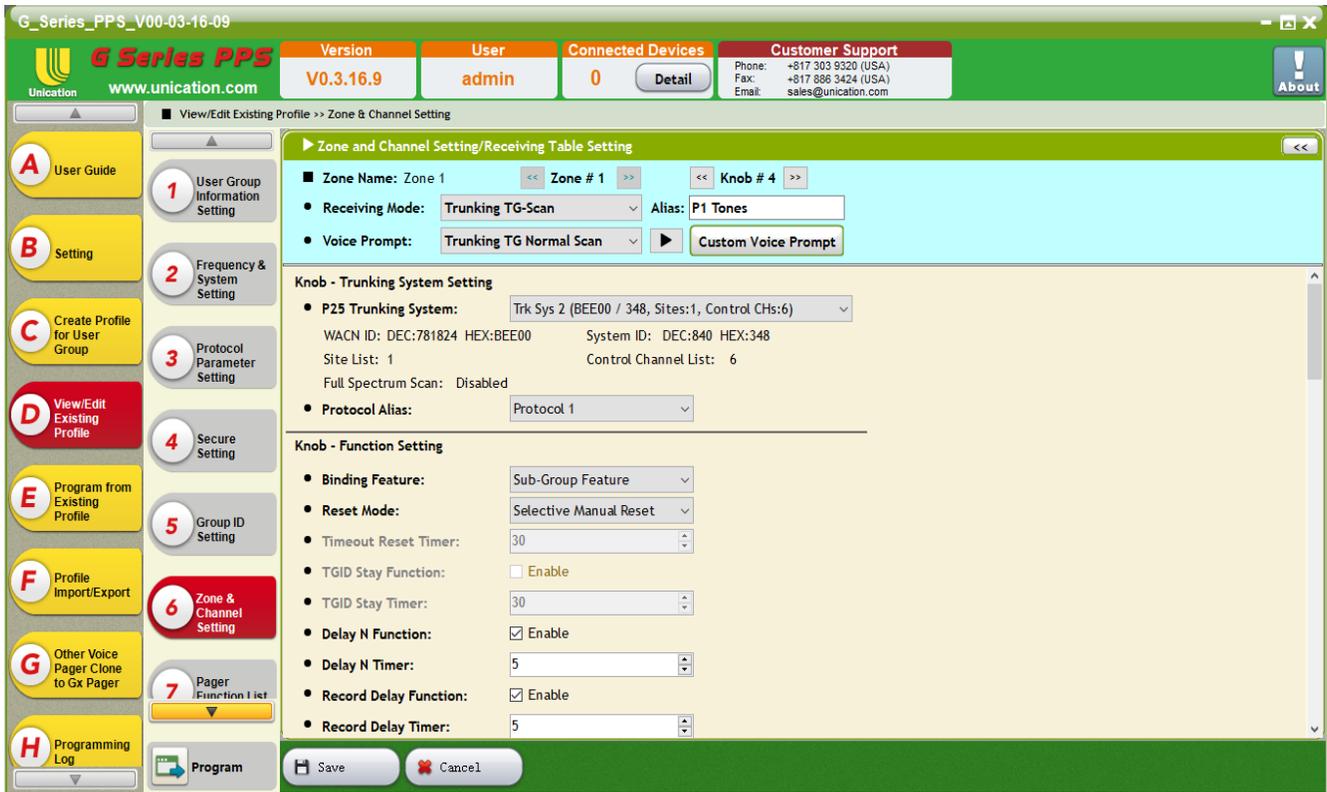


Figure 2A

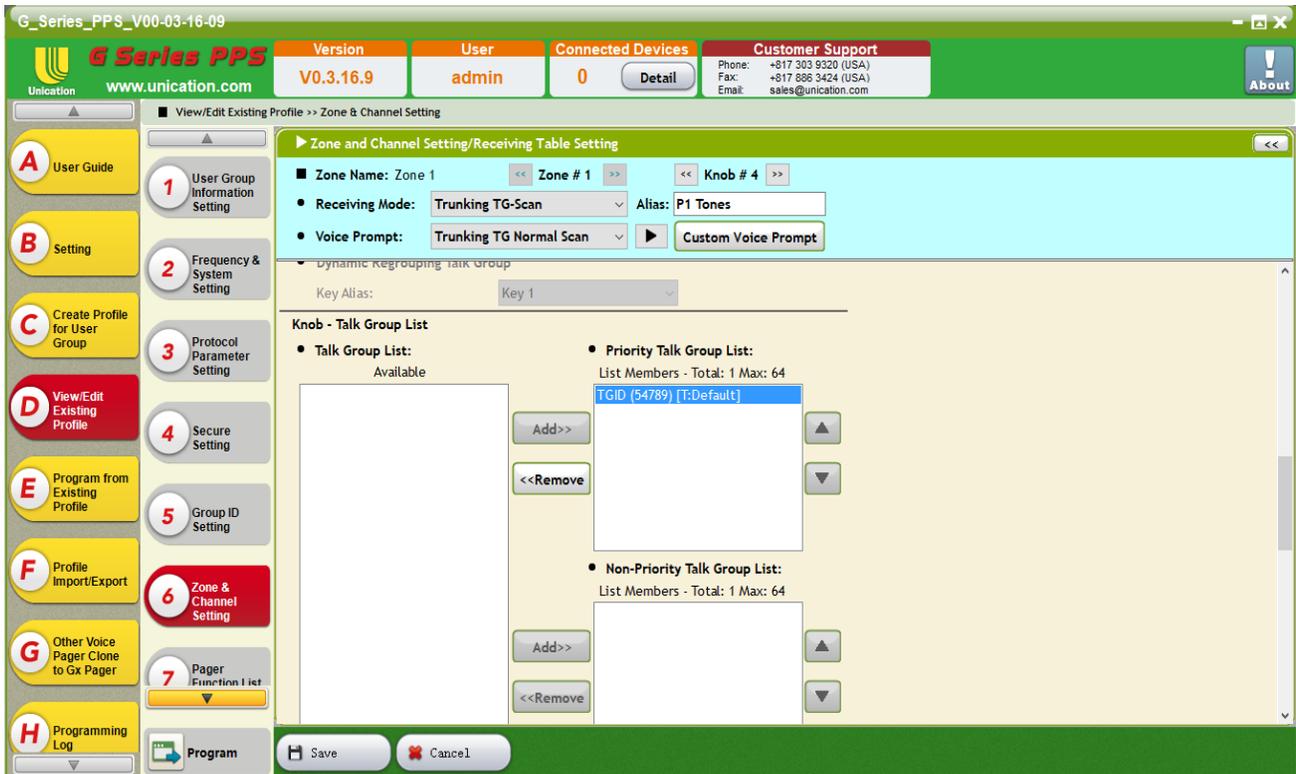


Figure 3A

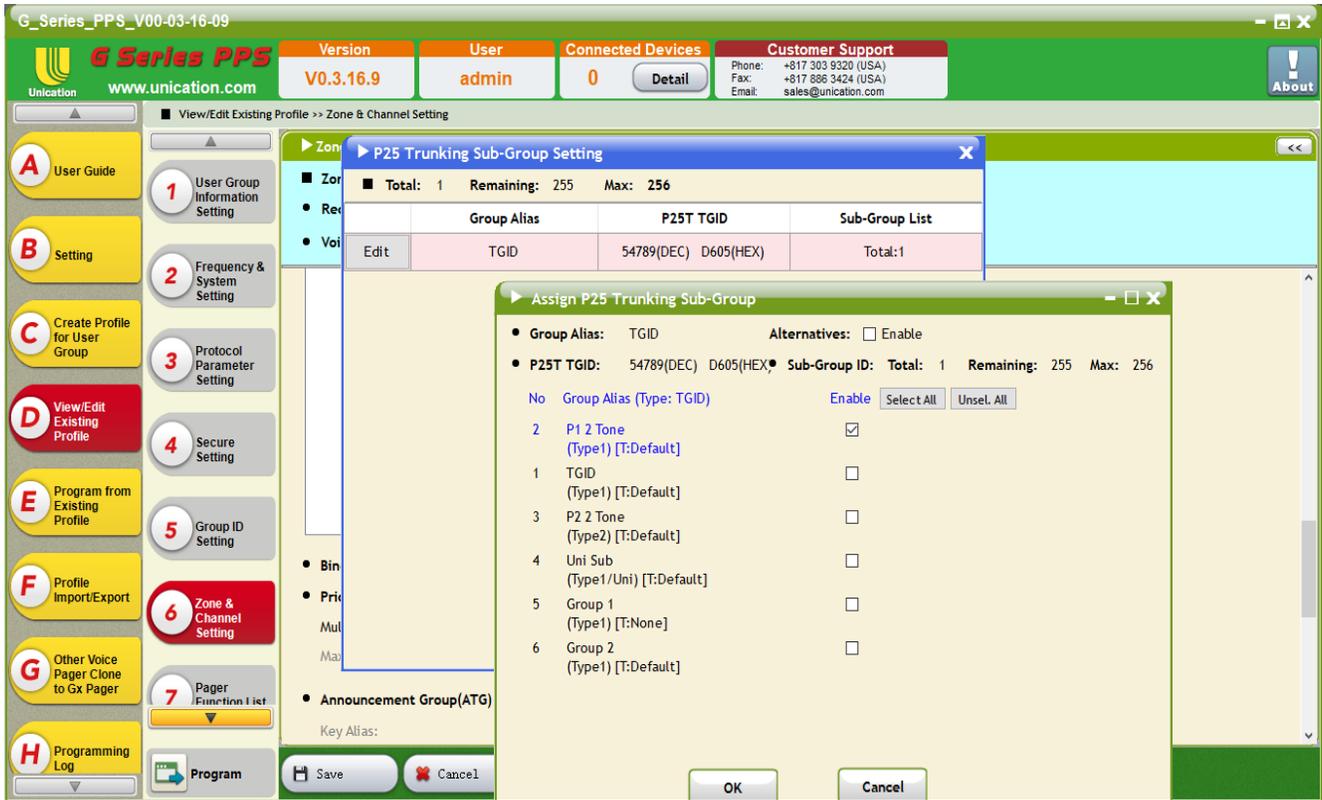


Figure 4A

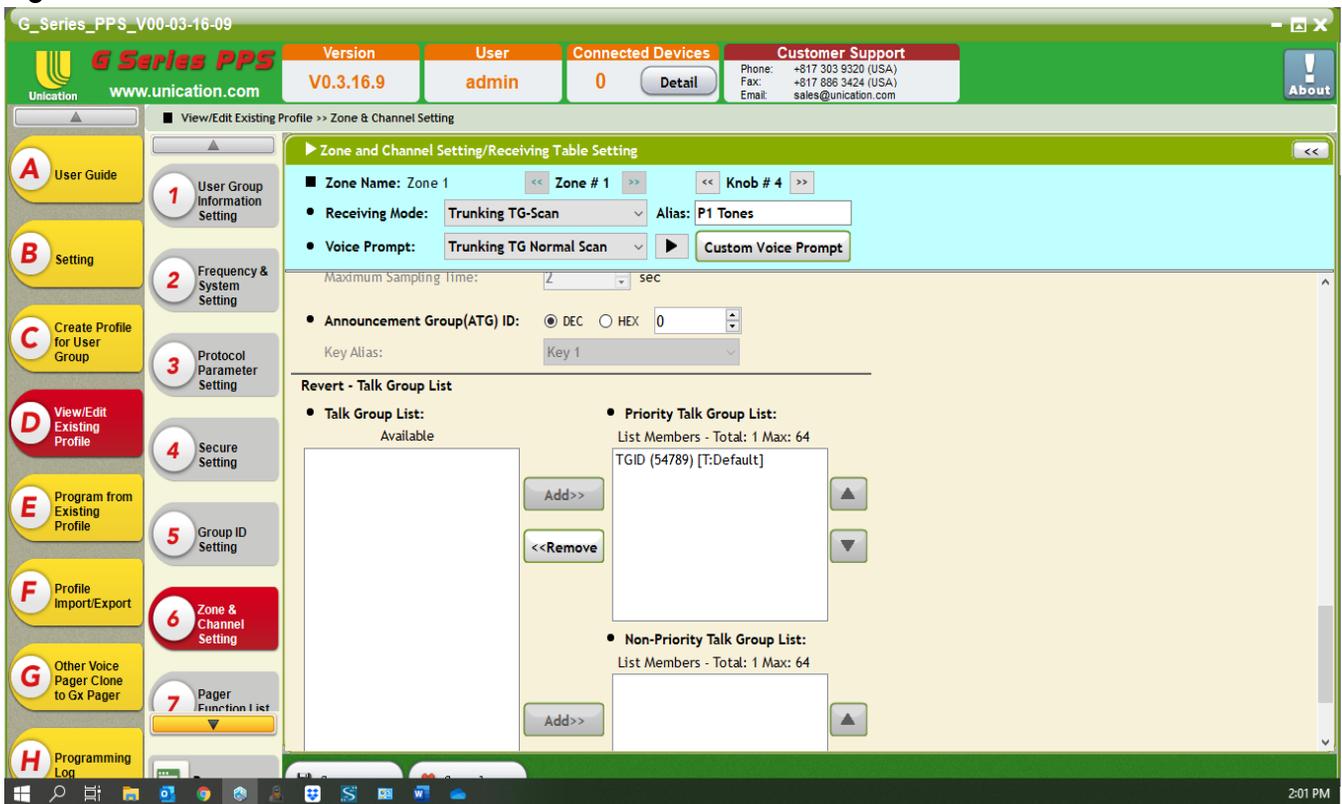
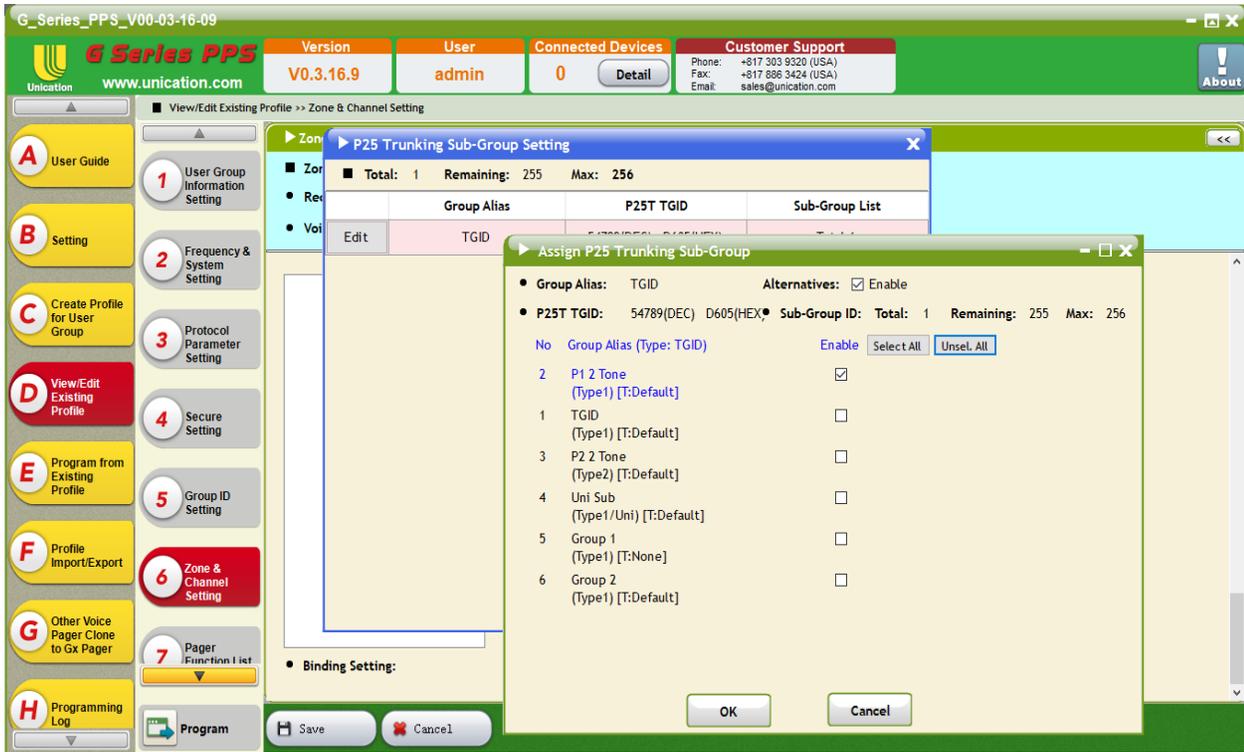


Figure 5A



## 2. Selective Call with Revert Mode

In this mode, the pager is mute until a QCII ID is decoded. When decoded, the pager alerts, the voice message is heard and stored. Since it is in Revert Mode the pager will unmute, but not store, any non-QCII transmissions on the selected TGID. If a valid QCII ID is decoded the pager will alert, play/store the message and revert back to listening all transmissions on the TGID.

To configure the G4/5 for this behavior follow the same procedure for Selective Call Mode except in Figure 1A **ENABLE** the Selective Manual Reset.

## 3. Monitor Mode

In this mode, the pager unmutes on all transmissions to the selected TGID. If a valid QCII ID is detected the pager will alert, play/store the message and then continue to monitor all transmissions to the selected TGID. Any non-QCII transmissions on the selected TGID are not stored.

To configure the G4/5 for this behavior follow the same procedure for Selective Call with Revert Mode in addition:

- a. **Voice Prompt**- Create a prompt for monitor to differentiate this selector knob position from that of the Selective Call.
- b. In Figure 3A, **ENABLE** the Alternatives setting.

## 4. Multiple TGIDs to be Listened to when in Revert and/or Monitor Modes

If one wants to listen to TGID traffic other than the TGID that the QCII IDs are transmitted over this is possible if the P25 System supports TGID Priority. In this case the TGID with the QCII IDs would be assigned the highest priority to ensure the page is not missed. The **Priority Talk Group ID Option** setting must be enabled.

**NOTE:** If the P25 System does not support TGID Priority one can still listen to multiple TGIDs, but it is possible a page will be missed.