



Technical Support

TECHNICAL NOTE

Technical Note TN-914 Tait Orca Scanning & Voting Operation and Performance

8 October 2004

Applicability

This Technical Note applies to all Tait Orca 5000 series conventional radios. It discusses the general principles of how the Tait Orca 5000 series scans and votes. It is not a definitive statement of all the options included in the Tait Orca 5000 scanning and voting algorithms.

Note: This is a Tait Only Technical Note. It should not be distributed to Dealers.

1. Introduction

Background

General Use for Scanning

This allows the user to monitor a number of channels for traffic of interest.

General Use for Priority Scanning

This allows the user to monitor a number of channels for traffic of interest, but also continuously monitor a "priority" channel, regardless of activity on the other channels.

General Use for Voting

This allows wide area communication with the radio unit selecting the "best" channel for communication.

To operate as a mobile voting network it is important that all base stations in the network transmit the same information at approximately the same time. In addition, for the vote to be effective it is important that all the base stations transmitters are at full power and stable. The faster the network design is able to accomplish this, the faster the vote in the radio unit can be initiated.

Operation – Scanning

Receiving (Scanning)

1. Member channels of the scan group are sampled sequentially and continuously.
2. If the conditions below are both satisfied, the radio will capture that particular channel.
 - The radio detects activity on the channel.
 - The sub-audible signalling (if any) detected on the channel meets that programmed into the radio for the channel.
3. When a channel is captured, scanning is suspended causing the radio to “lock” onto that channel.
4. The ‘Group Hold Time’ activates when the captured channel conditions become invalid. (eg. there is no activity detected on the channel).

The ‘Group Hold Time’ resets if:

 - Valid activity is received
 - The radio is PTTed
 - The radio is alerting an incoming call.
5. The radio will resume scanning when the ‘Group Hold Time’ expires. The group hold time is programmable from 0 to 25 seconds in steps of 100ms.

Note: If ‘Economy Mode’ operation is enabled and a voting group is selected, then ‘Economy Mode’ operation is deactivated. However the radio will still appear to be in economy mode via the slow flashing green LED.

Transmissions

- If a channel is captured and the PTT is pressed, then the radio will attempt to transmit on the captured channel.
- If the radio is scanning and the PTT is pressed, scanning is suspended and the ‘home’ channel selected. The ‘home’ channel is the first channel defined in the group membership list at time of programming.

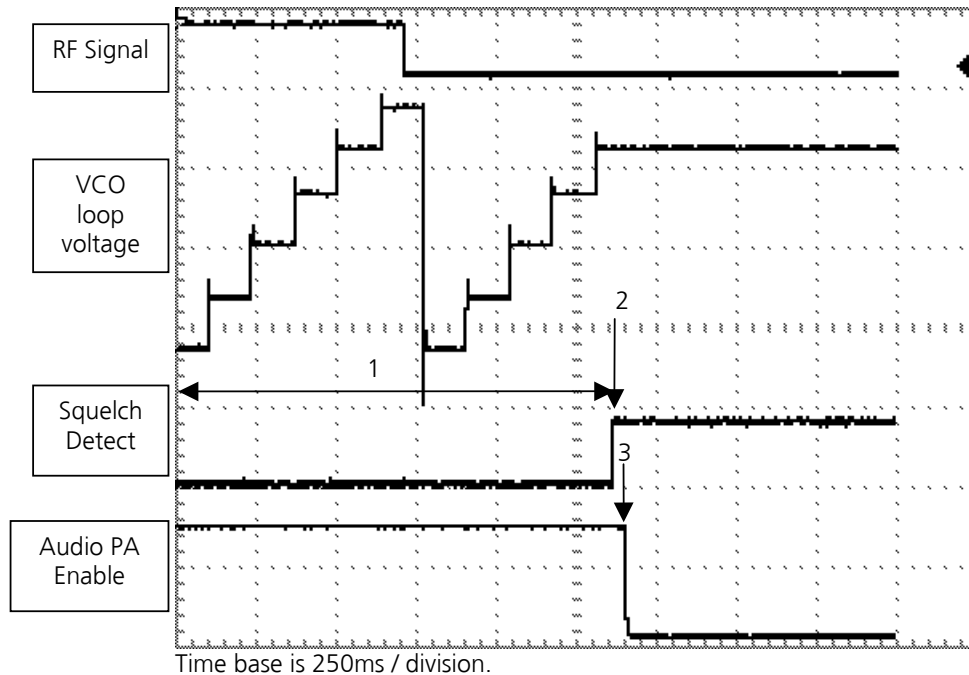
In the above cases any programmed TX Inhibit conditions apply when the PTT is pressed.

Timing Information – Scanning

Below is a diagram that demonstrates the scanning operation on a Tait Orca 5010 using firmware v2.12 scanning 6 channels, spaced 10MHz apart.

- On the **RF Signal** trace, the transition from high to low indicates when the RF signal is presented to the radio antenna.
- On the **VCO loop voltage** trace, each incremental step represents the VCO having switched to a new frequency.
- On the **Squelch Detect** trace, the transition from low to high indicates that the squelch circuitry has detected activity on the current channel.
- On the **Audio PA** trace, the transition from high to low indicates the audio power amplifier is enabled and audio is heard from the speaker.

Note: This description applies to all traces from this point on.

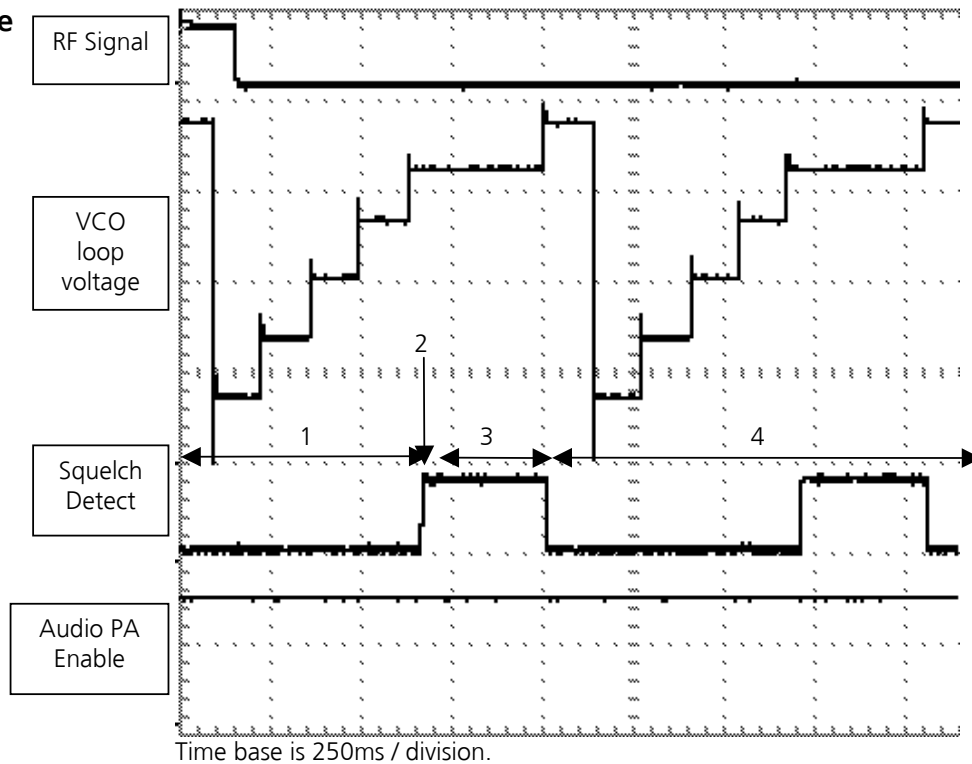


1. The radio begins scanning for channel activity. Approximate time per channel step is 130ms. This 130ms is made up of:
 - Approximately 30ms to allow the VCO to lock onto frequency.
 - Approximately 100ms to sample the channel for activity.
2. Activity is detected on channel – through the Squelch Detect line going high. This takes place approximately 50ms after stepping to this frequency and is made up of:
 - Approximately 30ms to allow the VCO to lock onto frequency.
 - Approximately 20ms period to detect activity.
3. Approximately 50ms later the audio circuitry completes power up, and the Audio PA line is enabled resulting in audio being heard from the speaker.
4. [Not shown] Once the RF signal is removed, the channel is held until the 'Group Hold Time' expires and the radio resumes scanning.

In this situation of scanning 6 channels, the worst-case scenario will be where the RF signal is applied directly after the channel is scanned. There would be approximately 760ms between application of the RF signal until audio is heard from the speaker.

Timing Information – Scanning with invalid Sub-audible

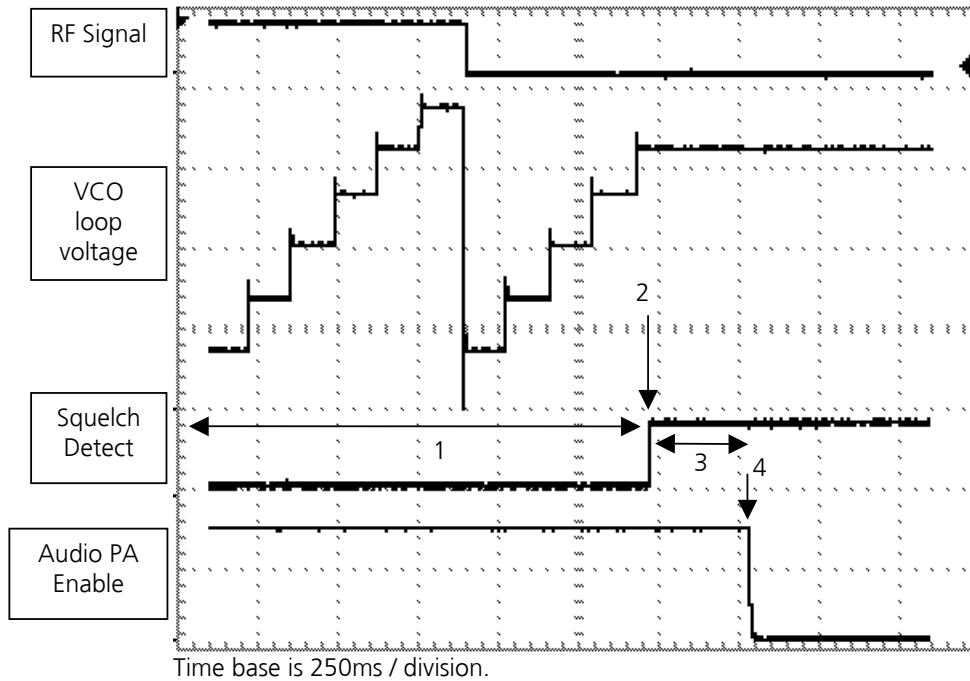
Below is a diagram that demonstrates the scanning operation with invalid sub-audible signalling on a Tait Orca 5010 using firmware v2.12 scanning 6 channels, spaced 10MHz apart.



1. The radio begins scanning for channel activity. Approximate time per channel step is 130ms. This 130ms is made up of:
 - Approximately 30ms to allow the VCO to lock onto frequency
 - Approximately 100ms to sample the channel for activity.
2. Activity is detected on channel – through the Squelch Detect line going high. This takes place approximately 50ms after stepping to this frequency and is made up of:
 - Approximately 30ms to allow the VCO to lock onto frequency.
 - Approximately 20ms period to detect activity.
3. The radio spends 330ms validating the CTCSS frequency. This sub-audible validation takes a maximum of 330ms and is dependent upon the sub-audible frequency programmed.
4. The sub-audible is not validated, thus the Audio PA is never enabled and the radio continues scanning, and repeats steps 1 to 3 above.

Timing Information – Scanning with valid Sub-audible

Below is a diagram that demonstrates the scanning operation with valid sub-audible signalling on a Tait Orca 5010 using firmware v2.12 scanning 6 channels, spaced 10MHz apart.



1. The radio begins scanning for channel activity. Approximate time per channel step is 130ms. This 130ms is made up of:
 - Approximately 30ms to allow the VCO to lock onto frequency
 - Approximately 100ms to sample the channel for activity.
2. Activity is detected on channel – through the Squelch Detect line going high. This takes place approximately 50ms after stepping to this frequency and is made up of:
 - Approximately 30ms to allow the VCO to lock onto frequency.
 - Approximately 20ms period to detect activity.
3. The radio spends 330ms validating the CTCSS frequency. This sub-audible validation takes a maximum of 330ms and is dependent upon the sub-audible frequency programmed. The sub-audible is validated as correct.
4. The Audio PA line is enabled, and audio is heard from the speaker.
5. [Not shown] Once the RF signal is removed, the channel is held until the 'Group Hold Time' expires and the radio resumes scanning.

In this situation of scanning 6 channels, the worst-case scenario will be where the RF signal is applied directly after the channel is scanned. There would be approximately 1000ms between application of the RF signal to audio being heard from the speaker.

Operation – Priority Scanning

Receiving (Priority Scanning)

1. Member channels of the scan group are sampled sequentially and continuously.
2. If the conditions below are both satisfied the radio will capture that particular channel.
 - The radio detects activity on the channel.
 - The sub-audible signalling (if any) detected on the channel meets that programmed into the radio for the channel.
3. The programming software offers two 'Priority Sample Timers'. These are:
 - 'Non-Captured Sample Timer' – which dictates the time between samples of the priority channel when no other channel is currently captured. Programmable from 500 to 5000ms, in steps of 100ms, or set to 0 to disable extra sampling of priority channels.
 - 'Captured Sample Timer' – which dictates the time between samples of the priority channel when a non-priority channel has been captured. Programmable from 500 to 5000ms, in steps of 100ms, or set to 0 to disable extra sampling of priority channels.
4. If the captured channel is the priority channel then no priority sampling is performed.
5. If no channel is captured or the captured channel IS NOT the priority channel, then the priority channel will be sampled according to the following:
 - If no channel is captured then a priority sample occurs every time the 'Non-Captured Sample Timer' expires. Note: The priority sample occurs after the current channel sample has completed.
 - If a channel is captured that is not the priority channel, then a priority sample occurs as soon as the 'Captured Sample Timer' expires. The radios mute is closed as the sample of the priority channel is taken.
6. If the priority channel has no activity and is therefore not captured then the radio will either:
 - Return to the place in the channel list where it previously was and continue sampling; or
 - Return to the previously captured channel, where the radios mute is reopened as soon as possible.
7. The 'Group Hold Time' activates when the captured channel conditions become invalid. (eg.there is no activity detected on the channel). The 'Group Hold Time' resets if:
 - Valid activity is received
 - The radio is PTTed
 - The radio is alerting an incoming call
8. The radio will resume scanning when the 'Group Hold Time' expires. The group hold time is programmable from 0 to 25 seconds in steps of 100ms.

Note: If 'Economy Mode' operation is enabled and a voting group is selected, then 'Economy Mode' operation is deactivated. However the radio will still appear to be in economy mode via the slow flashing green LED.

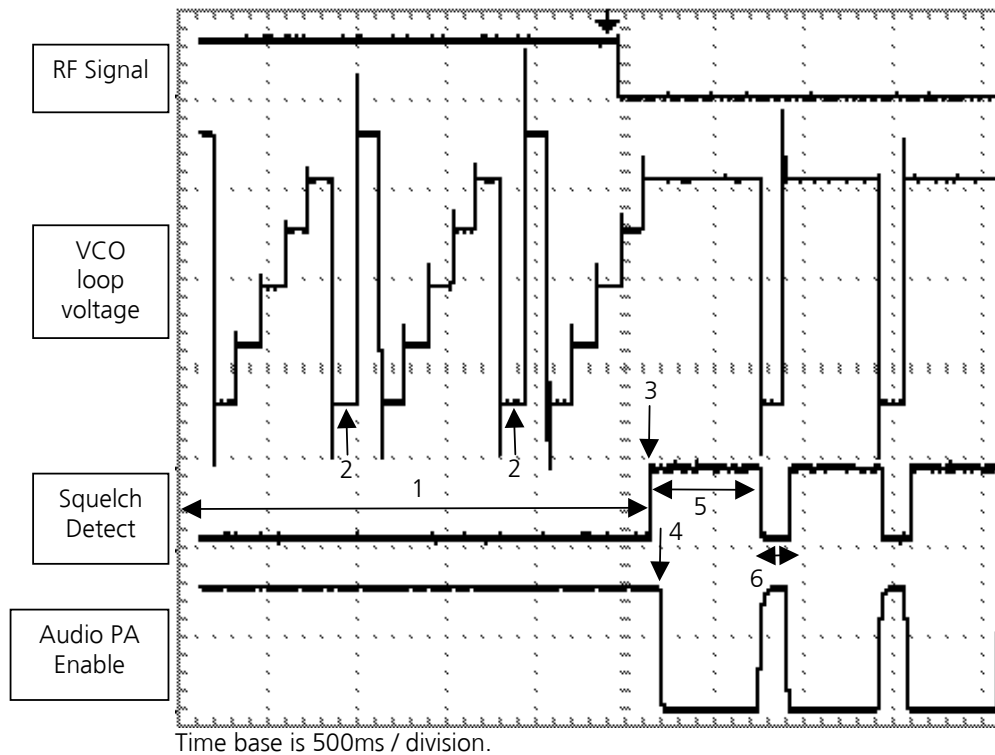
Transmissions

- If a channel is captured and the PTT is pressed, then the radio will attempt to transmit on the captured channel.
- If the radio is scanning and the PTT is pressed, scanning is suspended and the 'home' channel selected. The 'home' channel is the first channel in the group membership list at time of programming.

In the above cases any programmed TX Inhibit conditions apply when the PTT is pressed.

Timing Information – Priority Scanning

Below is a diagram that demonstrates the priority scanning operation on a Tait Orca 5010 using firmware v2.12 scanning 6 channels, spaced 10MHz apart. **NB The 'Non-Captured Sample Timer' was programmed to 500ms. The 'Captured Sample Timer' was set to 500ms.**

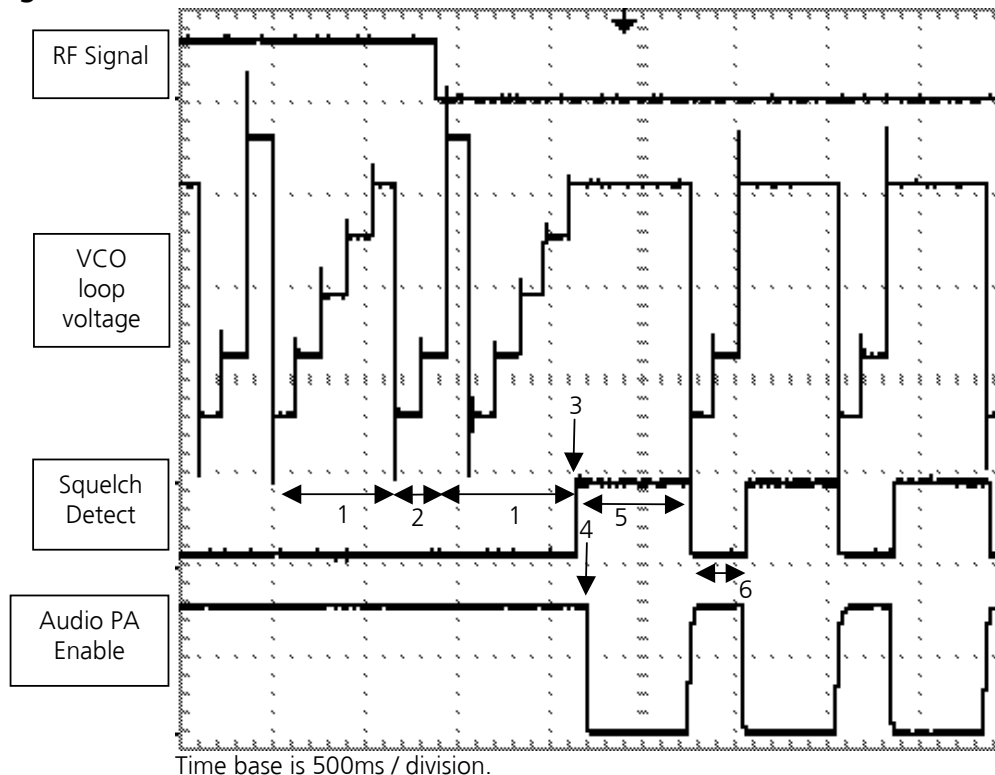


1. The radio begins scanning for channel activity. Approximate time per channel step is 130ms. This 130ms is made up of:
 - Approximately 30ms to allow the VCO to lock onto frequency
 - Approximately 100ms to sample the channel for activity.
2. Every 500ms the 'Non-Captured Sample Timer' expires and the priority channel is sampled for activity.
3. Activity is detected on channel – through the Squelch Detect line going high. This takes place approximately 50ms after stepping to this frequency and is made up of:
 - Approximately 30ms to allow the VCO to lock onto frequency.
 - Approximately 20ms period to detect activity.
4. Approximately 50ms after the squelch detect line goes high, the Audio PA line is enabled and audio is heard from the speaker.
5. As the captured channel is not the priority channel, the non-captured sample timer starts and when this timer expires the radio samples the priority channel. The Audio PA line is disabled as the sample is taken.
6. Sampling the priority channel takes approximately 130ms and as no activity is detected on the priority channel. The radio returns to the previously captured channel with the Audio PA enabled again.

[Not shown] Once the RF signal is removed, the channel is held until the 'Group Hold Time' expires and the radio resumes scanning.

Timing Information – Dual Priority Scanning

Below is a diagram that demonstrates the dual priority scanning operation on a Tait Orca 5010 using firmware v2.12 scanning 6 channels, spaced 10MHz apart. **NB The 'Non-Captured Sample Timer' was programmed to 500ms. The 'Captured Sample Timer' was set to 500ms.**



1. The radio begins scanning for channel activity. Approximate time per channel step is 130ms. This 130ms is made up of:
 - Approximately 30ms to allow the VCO to lock onto frequency
 - Approximately 100ms to sample the channel for activity.
2. Every 500ms the 'Non-Captured Sample Timer' expires and the priority channels are sampled for activity.
3. Activity is detected on channel – through the Squelch Detect line going high. This takes place approximately 50ms after stepping to this frequency and is made up of:
 - Approximately 30ms to allow the VCO to lock onto frequency.
 - Approximately 20ms period to detect activity.
4. Approximately 50ms after the squelch detect line goes high, the Audio PA line is enabled and audio is heard from the speaker.
5. As the captured channel is not one of the priority channels, the non-captured sample timer starts and when this timer expires, the radio samples the priority channels. The Audio PA line is disabled as the sample is taken.
6. Sampling the priority channel takes approximately 130ms per channel and as no activity is detected on the priority channels the radio returns to the previously captured channel with the Audio PA enabled again.
7. [Not shown] Once the RF signal is removed, the channel is held until the 'Group Hold Time' expires and the radio resumes scanning.

Operation – Voting

Receiving (Voting)

1. Member channels of the scan group are sampled sequentially and continuously.
2. Upon detection of activity on the channel, the radio commences the voting sequence.
3. The voting procedure is as follows:
 - If a 'Lead In Delay' is programmed, then the radio takes no action for the lead in interval. The 'Lead In Delay' is programmable from 0 to 2550ms, in steps of 10ms.
 - All member channels (commencing with the current channel) are then selected sequentially and a single signal strength (RSSI) measurement taken.
 - The channel with the highest measured signal strength (RSSI) from all samples taken is selected and recorded as the home channel.
 - The channel capture criterion is then applied to the home channel. (ie confirmation of valid activity on the channel).
4. If the voting group is defined as 'Double Voting' then the above step is repeated.
5. The 'Group Hold Time' activates when the captured channel conditions become invalid. (eg. there is no activity detected on the channel). The 'Group Hold Time' resets if:
 - Valid activity is received
 - The radio is PTTed
 - The radio is alerting an incoming call
6. The radio will resume scanning when the 'Group Hold Time' expires. The group hold time is programmable from 0 to 25 seconds in steps of 100ms

Note: If 'Economy Mode' operation is enabled and a voting group is selected, then 'Economy Mode' operation is deactivated. However the radio will still appear to be in economy mode via the slow flashing green LED.

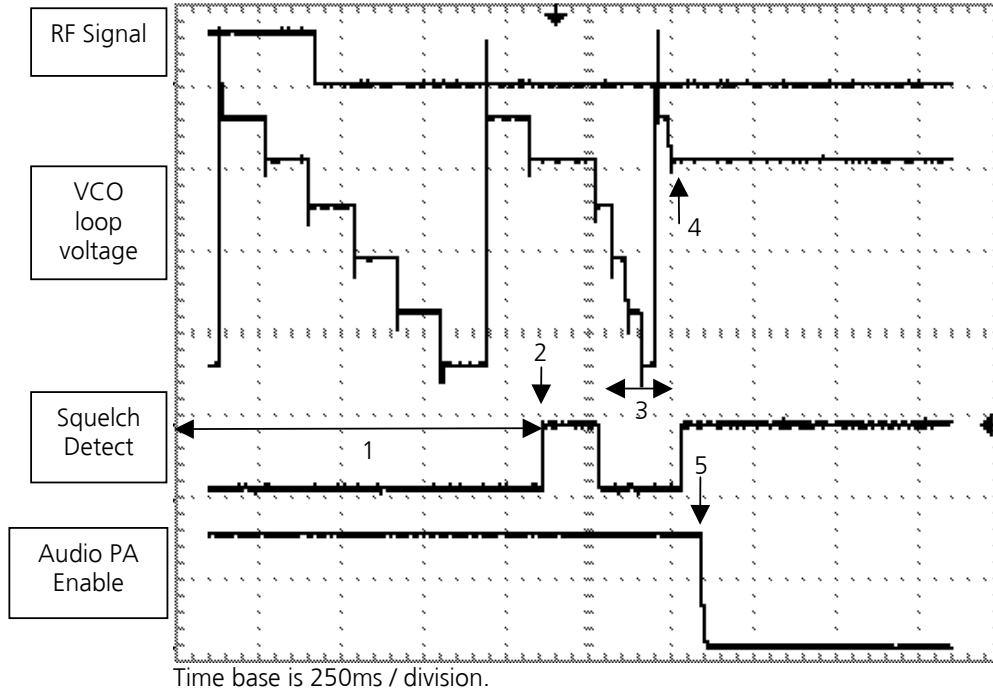
Transmissions

- If a channel is captured and the PTT is pressed, then the radio will attempt to transmit on the captured channel.
- If the radio is voting and the PTT is pressed, scanning is suspended and the 'home' channel selected. The 'home' channel is the first channel in the group membership list at time of programming, or if a vote has occurred, then the previously voted channel is the 'home' channel.

In the above cases any programmed TX Inhibit conditions apply when the PTT is pressed.

Timing Information – Voting

Below is a diagram that demonstrates the voting operation on a Tait Orca 5010 using firmware v2.12 scanning 6 channels, spaced 10MHz apart.

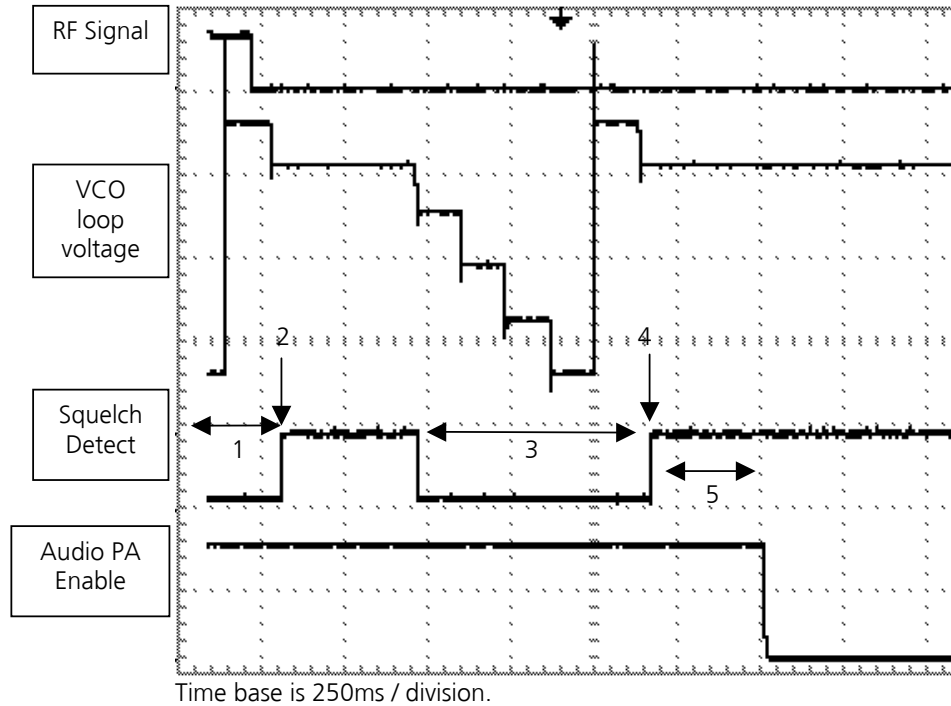


1. The radio begins scanning for channel activity. Approximate time per channel step is 130ms. This 130ms is made up of:
 - Approximately 30ms to allow the VCO to lock onto frequency
 - Approximately 100ms to sample the channel for activity.
2. Activity is detected on channel – through the Squelch Detect line going high. This takes place approximately 50ms after stepping to this frequency and is made up of:
 - Approximately 30ms to allow the VCO to lock onto frequency.
 - Approximately 20ms period to detect activity.
 - The radio now waits for the 'Voting Lead in Delay', which is programmed in this instance to 60ms.
 - The radio then monitors activity for 80ms.
 - An RSSI check is performed on the channel this takes approximately 10ms.
3. Then a signal strength measurement (RSSI) is performed on all channels. This takes approximately 40ms per channel and comprises of:
 - Approximately 30ms to allow the VCO to lock onto frequency
 - Approximately 10ms to sample the channels signal strength (RSSI).
4. The vote completes and the channel with highest measured signal strength measurement (RSSI) is captured and marked as the home channel.
5. Approximately 60ms after the switching to the channel with highest measured signal strength measurement (RSSI) the Audio PA line is enabled, and audio is heard from the speaker.
6. [Not shown] Once the RF signal is removed, the channel is held until the 'Group Hold Time' expires and the radio resumes voting scan.

In this situation of a voting scan group with 6 channels, the worst-case scenario will be where the RF signal is applied directly after the channel is scanned. There would be approximately 1200ms between application of the RF signal to audio being heard from the speaker.

Timing Information – Voting with Sub-audible

Below is a diagram that demonstrates the voting with sub-audible operation on a Tait Orca 5010 using firmware v2.12 scanning 6 channels, spaced 10MHz apart.



1. The radio begins scanning for channel activity. Approximate time per channel step is 130ms. This 130ms is made up of:
 - Approximately 30ms to allow the VCO to lock onto frequency
 - Approximately 100ms to sample the channel for activity.
2. Activity is detected on channel. On this channel there is an approximate 440ms sample. This represents:
 - Approximately 30ms to allow the VCO to lock onto frequency
 - Approximately 20ms to detect activity.
 - Approximately 330ms to validate the sub-audible frequency.
 - The 'Voting Lead in Delay', which is programmed in this instance to 60ms.
3. Then a signal strength measurement (RSSI) along with a sub-audible validation is performed on all channels. This takes approximately 130ms per channel and comprises of:
 - Approximately 30ms to allow the VCO to lock onto frequency
 - Approximately 100ms, to sample the channel waiting for valid activity. If valid activity is detected a validation of the channels sub-audible will occur. Sub-audible validation time varies with the sub-audible frequency, with a maximum of 250ms to validate the sub-audible signal.
4. The vote completes and the channel with highest measured signal strength measurement (RSSI) AND valid sub-audible signalling is captured and marked as the home channel.
5. The sub-audible is again validated this takes approximately 330ms. Approximately 50ms later the Audio PA line is enabled, and audio is heard from the speaker.

6. [Not shown] Once the RF signal is removed, the channel is held until the 'Group Hold Time' expires and the radio resumes voting scan.

In this situation of a voting with signalling scan group with 6 channels, the worst-case scenario will be where the RF signal is applied directly after the channel is scanned. There would be approximately 1650ms between application of the RF signal to audio being heard from the speaker.

Double Voting

Double voting functions in exactly the same way as standard voting except that the voting sequence is conducted twice. The channel with the highest measured signal strength measurement (RSSI) on the second vote sequence will be captured and marked as the home channel.

Double Voting without Sub-audible Signalling

In this situation of double voting without signalling with 6 channels, the worst-case scenario will be where the RF signal is applied directly after the channel is scanned. There would be approximately 1440ms between application of the RF signal to audio being heard from the speaker.

Double Voting with Sub-audible Signalling

In this situation of double voting with signalling with 6 channel, the worst-case scenario will be where the RF signal is applied directly after the channel is scanned. There would be approximately 2860ms between application of the RF signal to audio being heard from the speaker.

Compliance Issues

None

CSO Instruction

Please inform all Technical Staff of this information. **This should not be distributed to Dealers.**

3. Issuing Authority

Name and Position of Issuing Officer

Tim Lummis
Technical Support Engineer

Confidentiality

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Distribution Level

Tait Only

Document History

Original Release	8 October 2004	TPL
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