Si468x Release Notes

Revision History

Rev No	Description	Author	Effective Date
001	Original	G. Fidan	02.07.2012
002	Revised for A0B release	G. Fidan	02.27.2012
003	Revised for A10 release	L. Staller	06.27.2012
004	Revised for 120731 release Added errata description of ROM patch 0.0.9	T. Zhao	07.31.2012
005	Revised for 120914 release	T. Zhao	09.14.2012
006	Revised for 121120 release	T. Zhao	11.20.2012
007	Revised for 130215 release	T. Zhao	02.15.2013
008	Revised for 130524 release	T. Zhao	05.24.2013
009	Revised for 130930 release	T.Shah	09.30.2013
010	Revised for 131018 release	T.Shah	10.18.2013
011	Revised for 131209 release	T.Shah	12.09.2013
012	Revised for 140210 release	T.Shah	02.10.2014
013	Revised for 140325 release	T.Shah	03.25.2014
014	Revised for 140508 release	T.Shah	05.08.2014
015	Revised for 140714 release	T.Shah	07.14.2014
016	Revised for 140722 release	T.Shah	07.22.2014
017	Revised for 140814 release	T.Shah	08.14.2014
018	Revised for 150120 release	T.Shah	01.20.2015
019	Revised for 150210 release	T.Shah	02.10.2015
020	Revised for 150313 release	T.Shah	03.13.2015
021	Revised for 150406 release	T.Shah	04.03.2015
022	Revised for 151106 release	A.Moutard	10.30.2015
023	Revised for 151201 release	T.Shah	12.01.2015
024	Revised for 151204 release	T.Shah	12.04.2015
025	Revised for 160107 release (Updated Release Notes for DAB 5.0.2 and updated Errata for FMHD Radio 4.0.12 and AMHD Radio 2.0.11. The updates to these releases are in Italics)	T.Shah	01.07.2016
026	Revised for 160121	T.Shah	01.21.2016

Table of Contents

1. Introduction

2. Overview

This document describes changes in performance and features between releases of the Si46xx Receiver firmware (FW).

This document should be used in conjunction with the Si46xx data sheets and programming guide. Please use the data sheets and application notes for programming support, and this document as an additional reference.

Both engineering releases of the firmware along with production releases are listed in this document. Any firmware version with an alphabet character in the version is an engineering release. For example FW Rev 0C is Firmware 0 engineering version C. Production firmware has numeric characters only in the version numbers.

The AMHD firmware component revision(enumerated in section 3), FMHD firmware component revision (enumerated in section 4) and DAB firmware component revision (enumerated in section 5) are combined to into a AMHD/FMHD/DAB firmware revision (enumerated in section 6).

3. AMHD Firmware

3.1 Revision 1.0.5

- ***Production release***

3.2 Revision 2.0.9

- ***Production release***
- First commercial release featuring support for iBiquity's HD Radio All-Digital Transmission mode
- Added advanced DSQM features
  - Updated AM_RSQ_STATUS command with HD valid bit and filtered version of HD valid and HD level.
  - Added two properties- HD Level time constant & HD level Threshold.
- Implemented advanced blend decision for Hybrid Mode
- Added AMHD bandwidth management properties
- Added support for EZ Blend
- Added "comfort noise" non-hybrid mode blending feature for all-digital mode
- Added audio ramp during service loss
- Added Buzzer sound feature
- Added setting to configure the DAC output in mono mode
- Adjusted default setting for time-alignment between HD and Analog as needed based on new library for All-Digital mode
- HD Radio digital metric DAAI now clears to 0 upon losing the HD signal
- CDNR H/L interrupt repeat functionality restored

3.2.1 Errata

- Radio cannot handle transmit gain of more than 4 dB.
- MA3(Digital Signal) core audio acquisition time exceeds the required specification
- MA3 conductive sensitivity is 2 dB below the required specification
- In-band interference sweep with desired signal 1120KHz fails at four frequencies: 1040, 1510, 1520, and 1560 KHz.
- Static noise is heard instead of silence- when tuning to all digital station.
- MA3 HD-level detect reliability decreases at low rf signal levels

3.3 Revision 2.0.10

- ***Production release***
- Fixed the tune related audio behavior. The receiver can now handle the analog tune command while in hybrid mode with no mute in the audio.

3.3.1 Errata

- Radio cannot handle transmit gain of more than 4 dB.
- MA3(Digital Signal) core audio acquisition time exceeds the required specification
- MA3 conductive sensitivity is 2 dB below the required specification
- In-band interference sweep with desired signal 1120KHz fails at four frequencies: 1040, 1510, 1520, and 1560 KHz.

- Static noise is heard instead of silence- when tuning to all digital station.
- MA3 HD-level detect reliability decreases at low rf signal levels

3.4 Revision 2.0.11

- ***Production release***
- Updated the reporting status of AUDACQINT and AUDACQ bits in HD_DIGRAD_STATUS command. AUDACQINT now reports change in the digital audio acquisition state and AUDACQ reports digital HD audio state.

3.4.1 Errata

- Radio cannot handle transmit gain of more than 4 dB.
- MA3(Digital Signal) core audio acquisition time exceeds the required specification
- MA3 conductive sensitivity is 2 dB below the required specification
- In-band interference sweep with desired signal 1120KHz fails at four frequencies: 1040, 1510, 1520, and 1560 KHz.
- Static noise is heard instead of silence- when tuning to all digital station.
- MA3 HD-level detect reliability decreases at low rf signal levels
- Read Offset command(0x10) is not functioning.
- *The CLK_MODE parameter mode-2(single ended buffer) and mode-3(differential buffer)within the POWER_UP command argument are getting ignored.*

4. FMHD Firmware

4.1 Revision 0.0.5

- ***Engineering release only – not a production release***
- FM Mono/Stereo Demodulation is functional. Performance is not yet optimized for dynamic signal conditions.
- FM AGC is functional but not yet optimized.
- FM AFC is OFF.
- FM Impulse blanker is OFF.
- Blend, Hi-cut and softmute engines are not implemented.
- FM performance meets datasheet specifications.
- RDS is not supported.
- This revision only supports analog audio outputs.
- Tuning varactor is not yet supported for Si4680-97.

4.2 Revision 1.0.3

- ***Engineering release only – not a production release***
- FMHD data service support added. Audio service is not functional.
- Ability to render and select primary service is implemented for FMHD.
- Added RDS support. This release does not include soft decision RDS.
- FM RSQ Status is added.
- AFC is OFF for FM and FMHD.
- Part information and state reporting is available.
- BER test capability is added.
- FM AGC is functional but not yet optimized.
- FM Impulse blanker is OFF. Audio performance near sensitivity level is degraded as a result of this.
- Blend, Hi-cut and softmute engines are OFF by default.
- Tuning varactor is not supported (SI4680-97).
- Unless otherwise noted in 1.0.3 errata, 0.0.5 errata are fixed.

4.2.1 Errata

- ASQ indicator never gets released if signal is lost during playback of FMHD. As a workaround, DAAI indicator from FMHD_DIGRAD_STATUS command can be used. When signal is lost this indicator will be 0.
- FM 200 kHz and 400 kHz and FMHD 1st adjacent selectivity on image side are below the datasheet specifications.
- RDS does not acquire when tuning in wideband analog FM. Acquisition is achieved for tune modes 0 and 3 which are narrow band analog FM and wideband FMHD. However, RDS decode can have intermittent issues with dropped or corrupted data in HD tune mode. For this release, users should choose tune mode 0, narrow band analog FM for RDS performance testing.
- Multipath metric is not accurate. Do not use this metric for signal quality indication.

4.3 Revision 2.0.12

- ***Production release***
- Added the ability to render data from a port without specifying the Service ID (SID) by setting the SID to '0'. See the API command "START_DIGITAL_SERVICE" in the Programming Guide for details.
- Added the ability to specify default data ports with API commands "FMHD_SET_PORTS" and "FMHD_GET_PORTS". See the Programming Guide for details.
- Automatic/Manual FrontEnd Varactor tuning support for point, slope and VHF switch control
- Added STCACK to FM RSQ STATUS command
- FM AGC is Functional and optimized.
- Added ACF status command
- Added support for RDS in FMHD wide band modes
- Added Power Down Command to API
- Improved THD mono to meet spec
- Added I2S audio and properties
- Added Seek command and properties
- Added CTUNE run time settings to POWER UP command
- RSQ Interrupts Added
- Added TEST GET RSSI for calibrating front end
- Added Set\Get port commands
- Blend, Hi-cut and softmute engines are OFF by default.
- Fixed the issue of 5% RDS sync failure after tuning.
- RDS sync time consistency across the FM band is improved.
- Frequency reports as 0 in fm_rsq_status before the first tune command is issued.
- Added the ability to render data from a port without specifying the Service ID (SID) by setting the SID to '0'. See the API command "START_DIGITAL_SERVICE" in the Programming Guide for details.
- Added "FMHD_SET_ENABLED_PORTS" and "FMHD_GET_ENABLED_PORTS" commands to manage default ports the device will receive after HD acquisition. See the Programming Guide for details.
- Added "SRCANAINT" and "SRCDIGINT" flags to the "FMHD_DIGRAD_STATUS" command to indicate changes to the analog and digital audio blend state. See the Programming Guide for details.
- Several FMHD properties have been added. Please see the Programming Guide for a complete list of available FMHD properties.
- Update typical datasheet specification for FM Adjacent Selectivity to 50dB.
- Update typical datasheet specification for FM Alternate Selectivity to 43dB.
- Update typical datasheet specification for FM RDS Sensitivity to 4uV.
- Update typical datasheet specification for FM Audio Sensitivity to 0.7uV.
- Update typical datasheet specification for FM Input IP3 to 93 dBuV.
- Updated typical datasheet specification for FMHD 1st adjacent selectivity to 37dB.
- Update typical datasheet specification of FMHD IP3 to 91dBuV.
- Unless noted in the 2.0.12 errata, all 1.0.3 errata have been corrected.

4.3.1 Errata

- Occasionally, the receiver will halt operation after an FM_TUNE_FREQ or FM_SEEK_START in mode 2 and mode 3 after command is issued. The workaround is: device must be reset to recover from this condition. This occurs in <1% of tune and seek operations.
- Digital Audio Output: Only I2S mode with sample rates of 48kHz and 44.1kHz are supported.
- Multipath metric reports higher that 100%.
- FM Stereo Blend reports in dB instead of %.
- FM stereo Blend is greater than 48dB .

4.4 Revision 3.0.11

- ***Production release***

- Improved FM RDS sensitivity to line up with the 4706D standard.
- Improved RDS acquisition with ARI present.
- Improved RF AGC decision algorithm for increasing gain/decreasing attenuation.
- Improved channel bandwidth filter coefficient.
- Improvement on multipath metric behavior.
- Added automatically restart service functionality in an reacquisition event.
- FM_SEEK_START update with TUNE_MODE and ANTCAP settings.
- Rename ALL FMHD_* commands to to generic HD_* commands. Just a naming change. No hex command changes.
- Improved the stability of clocking scheme during boot up process.
- Stereo seperation now report the value in % instead of dB.
- All analog FM mitigation engines is enabled.
- HDDET feature is now enabled.
- FMHD tune time is improved.
- FMHD service and event interrupts are enabled: PSD_INTEN, ALERT_INTEN.
- Bug fix: RSQ interrupts now waits for STC to complete before running.
- Bug fix: Addressed the issue where a potential interrupt from a previous tune to appear in the current tune.
- Bug fix: Addressed the issue where the digital interrupts are not being cleared at tune time.
- Bug fix: Addressed the issue where It takes 2 correct commands to clear out the CMD_ERR interrupt on INTB.
- Bug fix: Addressed the issue where FMHD firmware stops responding potentially during seek.
- Bug fix: Reset AGC IF gain to max on tune.
- Bug fix: Fixed an AGC chattering issue to improve selectivity when part is pulled to a strong blocker and released.
- Bug fix: When data packet overflows, improve data buffer fashion to FIFO to maintain the latest data packets.
- Bug fix: Addressed the issue where channel filter bandwidth chatter on a weak stable RF level.
- Bug fix: Transmitter gain setting information is considered when DSP auto-adjust the audio volume.
- Bug_fix: Fixed a system crashing issue when attempting to start an FMHD service before the system is tuned.
- Bug fix: Addressed the issue where the receiver will halt operation after an FM_TUNE_FREQ or FM_SEEK_START in mode 2 and mode 3 after command is issued.
- Bug fix: Digital audio outputs interface now accomodates 32K sampling rate correctly.

- Bug fix: In HD only tuning mode, if SPS is not available due to RF reason, the audio will now correctly mute instead of blending back to analog programs.
- Bug fix: All PSD channels are now fully functional.
- Bug fix: Resolve the issue that the blend transition time (Analog to Digital and vice versa) were not accurate.
- Bug fix: addressed the issue: SIS interrupt fires before SIS data is ready.
- Bug fix: 4680 FMHD image now is EN55020 compliant.
- Bug fix: FM_RSQ_STATUS now report injection side correctly.
- Bug fix: Resolved the issue that during BER testing, FMHD image crashes issues when tuning to a non BER testing vector.
- Bug fix: Resolved the issue that during BER testing, CTS can be long when reading BER info.
- Bug fix: Resolved the issue that PSD interrupt did not function properly.
- Bug fix: Resolved the issue that HD signal acquisition loss in blend mode.
- API update: FM_RSQ_STATUS with READANTCAP.
- API update: Add HD CODEC mode indication. This was added to the HD_DIGRAD_STATUS command.
- API update: Update description regarding tune cancel for both FM and DAB. Cancel never has done anything to TUNE on any part ever. It only aborted SEEK.
- API update: update description regarding the HD_SET_ENABLED_PORTS command.
- API update: improved description of START_DIGITAL_SERVICE and GET_DIGITAL_SERVICE_LIST documentation.
- API update: update FM_VALID_MULT_THRESHOLD range 0-255.
- API update: On FM API, update description of property 0x1710 as signed number.
- API update: Added FMHD_DIGRAD_CDNR_LOW_THRESHOLD FMHD_DIGRAD_CDNR_HIGH_THRESHOLD properties and associated bit in FMHD_DIGRAD_STATUS.
- API update: updated documentation for the DSRV start_digital_service. Added notes regarding the fmhd equivalent names for SID and CID.
- API update: the default of FMHD blending property has been updated.
- API update: add 3rd option for FMHD_BLEND_OPTIONS property 0x9101. Refer API for details.
- API update: Improved description on the FMHD_SET_ENABLED_PORTS command.
- API update: Added “WRITE_STORAGE” and “READ_STORAGE” commands to reserve memory. on the 4680 which can be accessed by the host for high memory usage functionality.
- API update: Removed property FM_BLEND_RSSI_STEREO_SEP, FM_BLEND_SNR_STEREO_SEP, FM_BLEND_MULTIPATH_STEREO_SEP.
- API update: Introduced the HD_DIGRAD_AUTO_ACQUIRE property. Please refer API for details.
- API update: Introduced the FM_RSQ_HD_DETECTION property. Please refer API for details.
- API update: Defaults for FM_VALID properties have been updated.
- API update: FM_ACF_STATUS range for high-cut is adjusted to 10-200. No behavior change.
- API update: Removed the HD_CODEC_MODE_0/3/10/13_Blend_Rate & Blend_Threshold properties.
- API update: Removed HD_Audio_Ctrl_Frame_Delay property.

4.4.1 Errata

- Signal level change of strong deviated FM signal with high frequency audio content could induce noticeable sudden SNR change. This issue will cause Hi-cut and Softmute to engage and audio will have noticeable artifacts.
- Attack and release window minmum time for Blend, Hicut, and Softmute can not be met. The minimum value is 150ms due to RSSI, SNR, and multipath metrics settling time.
- Digital audio output only supported I2S mode.

- CDNRH/L interrupt repeat is not functional properly. Single interrupt works as expected.
- Service list buffer content is not cleared from previous station's service content after a tune command is issued initially before STC is flagged. The workaround is to act on service list after STC is flagged.
- HD_Audio_Ctrl_Program_loss_threshold property is not validated due to unavailability of the test vector.

4.5 Revision 3.0.16

- ***Production Update Release***
- Addressed an issue where the command interface dose not always clear CTS when a new command is received. With the fix, 2 us minimum is required between the SSB goes high after a command from host is finished and the SSB goes low when a READ_REPLY from host is issued.
- Improve a potential system stability issue.
- Reduced the DAC Scalar by 0.4dB and limited the MAX TX Gain to 4dB instead of 6dB to be compliant with HDRadio test vector IB_FMr230a_e1wfr1037.bin
- Addressed an issue where FMHD blend does not correctly blend back to analog under edge condition
- Fixed HD detect anomaly for strong all digital stations.
- Addressed an issue where FMHD blend does not correctly blend back to analog under edge condition.
- Integrate Fast HD detect to the FMHD. HDLEVEL is now always available via FM_RSQ_STATUS, not just with ATTUNE=1.
- API update: Remove FM_RSQ_HD_DETECTION.SNRTHRESH from API description
- API update: Set default value for Ballgame Mode property (0x9702) to 1
- Added "HD_DIGRAD_STATUS.HDLOGO" bit so that HDLOGO display can be supported.
- Added "HD_PLAY_ALERT_TONE" command so that host can decide to play Alert tone.
- Addressed an issue where noise burst in audio during blend to MPS.
- Addressed an issue where slave mode I2S output is -12dB off.

4.5.1 Errata

- Signal level change of strong deviated FM signal with high frequency audio content might induce noticeable sudden SNR change. This issue will cause Hi-cut and softmute to engage and audio will have noticeable artifacts.
- Attack and release window minmum time for Blend, Hicut, and Softmute can not be met. The minimum value is 150ms due to RSSI, SNR, and multipath metrics settling time.
- CDNRH/L interrupt repeat is not functional properly. Single interrupt works as expected.
- HD_Audio_Ctrl_Program_loss_threshold property is not validated due to unavailability of the test vector
- SIS data from previous tune/station is sometimes being returned for the current tune/station. The work around is to maintain the SIS data of previous station and compare it with the current. If the same, then wait for 500ms and pull the SIS data again to see if it has been updated.
- The default value for property 0x9901(HD_CODEC_MODE_0_SAMPLES_DELAY) should be set to 3710 instead of 3700 to time align the digital audio with the analog audio for smooth blending.
- HD Logo in Tune mode 3 is not working and will always remains in ON state.

4.6 Revision 3.0.17

- ***Production Update Release***
  - Feature bit update to support Si4683 and Si4689 devices

4.6.1 Errata

- Signal level change of strong deviated FM signal with high frequency audio content might induce noticeable sudden SNR change. This issue will cause Hi-cut and softmute to engage and audio will have noticeable artifacts.
- Attack and release window minmum time for Blend, Hicut, and Softmute can not be met. The minimum value is 150ms due to RSSI, SNR, and multipath metrics settling time.
- CDNRH/L interrupt repeat is not functional properly. Single interrupt works as expected.
- HD_Audio_Ctrl_Program_loss_threshold property is not validated due to unavailability of the test vector
- SIS data from previous tune/station is sometimes being returned for the current tune/station. The work around is to maintain the SIS data of previous station and compare it with the current. If the same, then wait for 500ms and pull the SIS data again to see if it has been updated.
- The default value for property 0x9901(HD_CODEC_MODE_0_SAMPLES_DELAY) should be set to 3710 instead of 3700 to time align the digital audio with the analog audio for smooth blending.
- HD Logo in Tune mode 3 is not working and will always remains in ON state.

4.7 Revision 3.0.18

- ***Production Update Release***
  - Added I2S 32 bit operation mode support

4.7.1 Errata

- Signal level change of strong deviated FM signal with high frequency audio content might induce noticeable sudden SNR change. This issue will cause Hi-cut and softmute to engage and audio will have noticeable artifacts.
- Attack and release window minmum time for Blend, Hicut, and Softmute can not be met. The minimum value is 150ms due to RSSI, SNR, and multipath metrics settling time.
- CDNRH/L interrupt repeat is not functional properly. Single interrupt works as expected.
- HD_Audio_Ctrl_Program_loss_threshold property is not validated due to unavailability of the test vector
- SIS data from previous tune/station is sometimes being returned for the current tune/station. The work around is to maintain the SIS data of previous station and compare it with the current. If the same, then wait for 500ms and pull the SIS data again to see if it has been updated.
- The default value for property 0x9901(HD_CODEC_MODE_0_SAMPLES_DELAY) should be set to 3710 instead of 3700 to time align the digital audio with the analog audio for smooth blending.
- HD Logo in Tune mode 3 is not working and will always remains in ON state.

4.8 Revision 3.0.19

- ***Production Update Release***
  - Cleaned-up the alert status information of the HD_GET_EVENT_STATUS command.

4.8.1 Errata

- Signal level change of strong deviated FM signal with high frequency audio content might induce noticeable sudden SNR change. This issue will cause Hi-cut and softmute to engage and audio will have noticeable artifacts.

- Attack and release window minmum time for Blend, Hicut, and Softmute can not be met. The minimum value is 150ms due to RSSI, SNR, and multipath metrics settling time.
- CDNRH/L interrupt repeat is not functional properly. Single interrupt works as expected.
- HD_Audio_Ctrl_Program_loss_threshold property is not validated due to unavailability of the test vector
- SIS data from previous tune/station is sometimes being returned for the current tune/station. The work around is to maintain the SIS data of previous station and compare it with the current. If the same, then wait for 500ms and pull the SIS data again to see if it has been updated.
- The default value for property 0x9901(HD_CODEC_MODE_0_SAMPLES_DELAY) should be set to 3710 instead of 3700 to time align the digital audio with the analog audio for smooth blending.
- HD Logo in Tune mode 3 is not working and will always remains in ON state.

4.9 Revision 3.0.23

- ***Production Update Release***
- Added Buzzer tone feature
- Fixed the spit mode for HD channel. The FMHD radio now presents the correct HD channel on the left and right.

4.9.1 Errata

- Signal level change of strong deviated FM signal with high frequency audio content might induce noticeable sudden SNR change. This issue will cause Hi-cut and softmute to engage and audio will have noticeable artifacts.
- Attack and release window minmum time for Blend, Hicut, and Softmute can not be met. The minimum value is 150ms due to RSSI, SNR, and multipath metrics settling time.
- CDNRH/L interrupt repeat is not functional properly. Single interrupt works as expected.
- HD_Audio_Ctrl_Program_loss_threshold property is not validated due to unavailability of the test vector
- SIS data from previous tune/station is sometimes being returned for the current tune/station. The work around is to maintain the SIS data of previous station and compare it with the current. If the same, then wait for 500ms and pull the SIS data again to see if it has been updated.
- The default value for property 0x9901(HD_CODEC_MODE_0_SAMPLES_DELAY) should be set to 3710 instead of 3700 to time align the digital audio with the analog audio for smooth blending.
- HD Logo in Tune mode 3 is not working and will always remains in ON state.

4.10 Revision 4.0.10

- ***Production Update Release***
- First commercial release featuring support for iBiquity's HD Radio All-Digital Transmission mode
- Added advanced DSQM features
  - Updated FM_RSQ_STATUS command with HD valid bit and filtered version of HD valid and HD level.
  - Added two properties- HD Level time constant & HD level Threshold.
- Implemented advanced blend decision for Hybrid Mode
- Added ability to directly tune to SPS in the FM_TUNE_FREQ Command.
- Added support for EZ Blend
- Added "comfort noise" non-hybrid mode blending feature for all-digital mode
- Added audio ramp during service switching or service loss
- Added Buzzer sound feature

- Added setting to configure the DAC output in mono mode
- Adjusted default setting for time-alignment between HD and Analog as needed based on new library for All-Digital mode
- SIS data is updating/refreshing correctly when going from one station to another
- HD Radio digital metric DAAI now clears to 0 upon losing the HD signal
- HD logo in tune mode 3 is working as expected
- CDNR H/L interrupt repeat functionality restored

4.10.1 Errata

- Audio frequency response rolling off at 18KHz
- Radio cannot handle transmit gain of more than 4 dB.
- Short interrupt acquisition time exceeds the specification
- At the edge of HD coverage, if the user selects an SPS, the audio program may unexpectedly fall back to MPS instead of the desired behavior which is mute/silence and remain on SPS. Silicon Labs recommends that the host MCU monitor HD_DIGRAD_STATUS for the AUDIO_PROG_PLAYING value. If AUDIO_PROG_PLAYING is different than the selected audio program, the host MCU should issue a mute command to the Tuner and issue a START_DIGITAL_SERVICE command to re-select the desired SPS. The host should continue to monitor and correct the audio program as necessary, and release the mute once the desired SPS program is available.
- Static noise is heard instead of silence- when tuning to all digital station.
- Selectivity performance due to lower 3rd adjacent FMHD Hybrid signal blocker is below the specification.
- Highly deviated weak FM analog signal shall cause sudden SNR change resulting in noticeable audio artifacts.
- Attack time for Blend, Hicut, and Softmute cannot be met. This time is dominated by settling time of RSSI, SNR and multipath metric. Release time for Blend, Hicut and Softmute is off by ~10%.

4.11 Revision 4.0.11

- ***Production Update Release***
- Fixed the mono to stereo blend behavior. The receiver can now blend from mono to stereo for highly deviated signal
- Fixed the tune related audio behavior. The receiver can now handle the analog tune command while in hybrid mode with no mute in the audio.

4.11.1 Errata

- Audio frequency response rolling off at 18KHz
- FMHD radio cannot handle transmit gain of more than 4 dB.
- Short interrupt acquisition time for FMHD radio exceeds Ibiquity's specification
- At the edge of HD coverage, if the user selects an SPS, the audio program may unexpectedly fall back to MPS instead of the desired behavior which is mute/silence and remain on SPS. Silicon Labs recommends that the host MCU monitor HD_DIGRAD_STATUS for the AUDIO_PROG_PLAYING value. If AUDIO_PROG_PLAYING is different than the selected audio program, the host MCU should issue a mute command to the Tuner and issue a START_DIGITAL_SERVICE command to re-select the desired SPS. The host should continue to monitor and correct the audio program as necessary, and release the mute once the desired SPS program is available.
- Static noise is heard instead of silence- when tuning to all digital station.

- Selectivity performance due to lower 3rd adjacent FMHD Hybrid signal blocker is below the specification.
- Fast attack time for Blend, Hicut, and Softmute is dominated by RSSI, SNR and multipath metric. Release time for Blend, Hicut and Softmute is off by ~10% from the property setting.

4.12 Revision 4.0.12

- ***Production Update Release***
- Updated the reporting status of AUDACQINT and AUDACQ bits in HD_DIGRAD_STATUS command. AUDACQINT now reports change in the digital audio acquisition state and AUDACQ reports digital HD audio state.

4.12.1 Errata

- Audio frequency response rolling off at 18KHz
- FMHD radio cannot handle transmit gain of more than 4 dB.
- Short interrupt acquisition time for FMHD radio exceeds Ibiquity's specification
- At the edge of HD coverage, if the user selects an SPS, the audio program may unexpectedly fall back to MPS instead of the desired behavior which is mute/silence and remain on SPS. Silicon Labs recommends that the host MCU monitor HD_DIGRAD_STATUS for the AUDIO_PROG_PLAYING value. If AUDIO_PROG_PLAYING is different than the selected audio program, the host MCU should issue a mute command to the Tuner and issue a START_DIGITAL_SERVICE command to re-select the desired SPS. The host should continue to monitor and correct the audio program as necessary, and release the mute once the desired SPS program is available.
- Static noise is heard instead of silence- when tuning to all digital station.
- Selectivity performance due to lower 3rd adjacent FMHD signal is below Ibiquity's specification.
- Fast attack time for Blend, Hicut, and Softmute is dominated by RSSI, SNR and multipath metric. Release time for Blend, Hicut and Softmute is off by ~10% from the property setting.
- Read Offset command(0x10) is not functioning.
- *The CLK_MODE parameter mode-2(single ended buffer) and mode-3(differential buffer)within the POWER_UP command argument are getting ignored.*

4.13 Revision 5.0.4

- ***Production Release***
- Read Offset command(0x10) is fixed.
- Add's status bit RFFE_ERR in the status register (Status Register 3 bit 5) indicating the state of the RF Front End.
- Add's ability to read AGC status
- Add's properties to change RF AGC threshold.
- Fixes issue with opening invalid port
- Fixes issue with the CLK_MODE parameter passed in the POWER_UP command. The CLK_MODE parameter mode-2(single ended buffer) and mode-3(differential buffer) selections were getting ignored in the previous releases.

4.13.1 Errata

- Audio frequency response rolling off at 18KHz
- FMHD radio cannot handle transmit gain of more than 4 dB.

- Short interrupt acquisition time for FMHD radio exceeds Ibiquity's specification
- At the edge of HD coverage, if the user selects an SPS, the audio program may unexpectedly fall back to MPS instead of the desired behavior which is mute/silence and remain on SPS. Silicon Labs recommends that the host MCU monitor HD_DIGRAD_STATUS for the AUDIO_PROG_PLAYING value. If AUDIO_PROG_PLAYING is different than the selected audio program, the host MCU should issue a mute command to the Tuner and issue a START_DIGITAL_SERVICE command to re-select the desired SPS. The host should continue to monitor and correct the audio program as necessary, and release the mute once the desired SPS program is available.
- Static noise is heard instead of silence- when tuning to all digital station.
- Selectivity performance due to lower 3rd adjacent FMHD signal is below Ibiquity's specification.
- Fast attack time for Blend, Hicut, and Softmute is dominated by RSSI, SNR and multipath metric. Release time for Blend, Hicut and Softmute is off by ~10% from the property setting.

5. DAB Firmware

5.1 Revision 0.0.2

- ***Engineering release only – not a production release***
- Demonstrates DAB audio service decoding capability only.
- Need to be used with bootloader patch "rom00_patch.011.bin" together. Refer to AN649 Ver 0.6 for more details.
- Refer to AN649 Ver 0.6 (for more programming details).

5.1.1 Errata

- Sometimes after first tune, starting a service does not render audio. The workaround is to switch to another service and switch back.
- DAB Audio has noticable stutter when started.
- Sometimes after boot audio is severely distorted. If it happens, reset the chip would fix it.
- Certain audio services on the London IZT playback do not playback audio.
- DAB audio dropouts occur occasionally.
- Audio stops after acquisition loss. The work around is to re-start the service after such an event.
- System ceases to respond if property 0xE800 is changed after an audio stream mode BER test service is started around sensitivity level. If doing audio stream mode BER test, the workaround is to:
    - Enable BER checking function by setting 0xE800 property before starting the audio stream mode BER service.
    - Stop such service before disable the BER checking function.
- DAB 0.0.2 is only qualified for temperature no lower than -15deg C.

5.2 Revision 0.0.6

- ***Engineering release only – not a production release***
- Demonstrate both DAB and DAB+ audio services decoding capabilities.
- Improved stability.
- DLS is supported only in DAB+ mode. DLS+ is not yet supported with this release.
- Need to be used with bootloader patch "Rom00.Patch11.bin" together. Refer to AN649 Ver 0.7 for more details.
- Unless otherwise noted in 0.0.6 errata, 0.0.2 errata are fixed.

5.2.1 Errata

- DAB Audio has noticeable stutter when started.
- On small percentage of DAB/DAB+ service with odd CU ending address, the audio quality is slightly impaired. Audio examples of the impairment are available upon request for issue identification purposes. This is an understood issue and will be addressed in the next release.
- Mode I ensemble is the only supported type with this release. Complete mode supports will come in the next release.
- "Fire code" error correction is not supported in the release.
- Audio error concealment is not yet optimized in this release. Noticeable sharp noise can be heard at signal level strength around or below sensitivity.
- DLS does not yet transport character set information correctly.
- In DAB service, DLS is not returned as expected. This is an understood issue and will be addressed in the next release.
- DLS packet payload is expected to change in future releases to support additional features. The current implementation should only be used for evaluation purposes.
- When using test vector with low number of services, there are occasions that the ACQ bit is not turned on at the first tune. Retuning will resolve the issue.
- Ensemble reconfiguration event can lead to the following behaviors:

- Cause a playing audio service to cease (but the part is still responsive). A sequence of stop_digital_service and a start_digital_service commands on the same service can restart the audio.
- Occasionally cause the part to be non-responsive. A reset is required to fix the issue.

5.3 Revision 1.0.6

- ***Production release.***
- Improved DAB and DAB+ audio experience. Resolved the issue that certain services with odd CU address cannot be decoded properly.
- PAD forwarding functionality is complete with related API update.
- Improved DLS support on DAB services. DLS is also supported with correct character set information.
- Improved SNR metric reporting behavior when operating at low snr levels. The SNR reporting range is not changed.
- Improved the services automatic restart algorithm so that services restart attempts do not continue if the acquisition is lost during a restart attempt.
- Improved AGC decision algorithm for response to null symbol in the frame.
- Implemented muting capability reacting to weak RF conditions with related API update.
- Implemented `FICERRINT` in dab_digrad_status to indicate an unrecoverable FIC error.
- Only Mode I ensemble is supported. Other modes are currently not recognizable by DAB 1.0.6.
- Removed the POWER_DOWN api from the xml and the firmware.
- Added WRITE_STORAGE and READ_STORAGE commands to extend memory for cost-effective host MCUs.
- Added DAB_GET_SUBCHAN_INFO & DAB_GET_AUDIO_INFO commands.
- Default frequency list now includes all valid ensembles for Europe - add 10N, 11N, 12N, 13E, 13F.
- Addressed an issue where the DSRV interrupts are not being cleared at tune time.
- Addressed an issue where the DAB_Get_Ensemble_Info command returns full 16 characters.
- Addressed an issue where sytem can be unresponsive during the reconfiguration event.
- Addressed an issue where a non-affected continuous service during reconfiguration event can be stopped.
- Addressed an issue where started audio XPAD data service can stop if a new data service component starts.
- Digital audio interface is supported. In this release, only I2S mode is supported.
- Updated API description of dab_set_freq_list, stating the maximum number of frequencies to be 48.
- Updated API description on property DAB_TUNE_FE_VARM.
- Updated API description in INT_CTL_REPEAT from DIGREP to DACQREP.
- Digital_service_data API is updated with DLS and DL+ support, please refer to AN649 for details.

5.3.1 Errata

- "Fire code" error correction is not supported in the release.
- During ensemble reconfiguration event, a minor audio short blip can be heard.
- DAB performance is not yet fully optimized under certain fading profiles in lab testing.
- An audio blip can be heard when setting mute or volume property immediately after start a audio service.
- Digital audio interface only support I2S mode in this release.

5.4 Revision 2.0.3

- ***Production release.***
- AGC table is updated for improved performance.
- "Fire code" checking has been implemented for DAB+.
- Bug fix: Addressed "During ensemble reconfiguration event, a minor audio short blip can be heard."
- Bug fix: Addressed an issue where Stream mode TDC data is not forwarded to data service interface.
- Bug fix: Addressed "An audio blip can be heard when setting mute or volume property immediately after start a audio service."
- API change: DAB_MUTE_SIGLOSS_THRESHOLD default is changed to 6.

5.4.1 Errata

- At RF level of ~-53dBm, CNR can have a sudden change which can go to 60.
- Start a digital service between reconfiguration warning interrupt and reconfiguration interrupt will result muting until reconfiguration interrupt finishes.
- Digital audio interface only support I2S mode in this release.
- DAB performance is not yet fully optimized under certain fading profiles in lab testing.

5.5 Revision 3.0.5

- ***Production release***
- Addressed an issue where the command interface dose not always clear CTS when a new command is received. With the fix, 2 us minimum is required between the SSB goes high after a command from host is finished and the SSB goes low when a READ_REPLY from host is issued.
- Addressed an issue where Slave mode I2S output is -12dB off.
- Add Alternate ensemble support utilizing FIG0/21.
- Addressed an issue where At RF level of ~-53dBm, CNR has a sudden jump to 60.
- Reported CNR is limited at 54dB.
- Improved an issue where starting a digital service during reconfiguration period will result muting until reconfiguration period finishes. If the host makes a selection when there are less then 2 seconds before reconfiguration, the new audio service will start after reconfig.
- Improve DAB_GET_AUDIO_INFO API to return audio decoder input frame length.
- Improved varactor tuning to compensate for AGC capacitive attenuator changes. Added VHFCAPS bit to FM_TUNE_FE_CFG/DAB_TUNE_FE_CFG which can be used to disable this feature and return to the previous behavior.
- Added a property DAB_EVENT_MIN_SVRLIST_PERIOD_RECONFIG to reduce the service list debounce timer when in an ensemble reconfiguration event.
- Add the RSSILINT and RSSIHINT interrupts to the DAB image.
- Compliant with DRUK required fading profiles tests.
- Addressed an issue where DAB_SET_SERVICE_LINKING_INFO did not return the correct information.
- The DAB typical tune time has been reduced to 740ms.
- SNR metric is re-calibrated such that it reads 6dB at sensitivity. Also changed the metric such that it is 10log10(S/N).
- RSSI is capped as 63dBuV at strong level.
- For DAB_GET_COMPONENT_INFO, added a total byte count for all UA data. Added a padding byte count if UA data length is even.
- Added DAB_CTRL_DAB_MUTE_SIGLOW_THRESHOLD property address an issue where audio is intermittently muted when RF level has a step change.

- Fixed an extreme rare issue where the part fail to acquire or stop responding given tuning scenarios.

5.5.1 Errata

- DAB ACQINT interrupt not working when signal acquisition is lost.
- Test ETI files with conditional access info in Fig 0/4 could render the part unresponsive. A reset to chip will resolve this issue.

5.6 Revision 3.2.0

- ***Production release***
- Implemented a temporary work around to fix the problem with ETI files with conditional access.
- Fixes the SFN issue. Updated the PHY to deal with stationary low velocity receiver impairments in an SFN/Multipath environment.
- Added a property(DAB_PHY_SYNC_AVG_SHIFT) to control the PHY sync average shift. This property takes effect at tune time.
- Added a property(DAB_TEST_PHY_DEBUG_ENABLE) to control the forwarding of PHY telemetry and IFFT debug data at run time.This property takes effect at tune time. Data associated with this property are forward to the host on Service ID=0 and Component ID=0.
- DAB ACQINT interrupt is fixed.

5.7 Revision 3.2.1

- ***Production release***
- Addressed an issue where tuner cannot decode DAB+ signal generated by signal generator MPD1506.

5.8 Revision 3.2.4

- ***Production release***
- Added a property DAB_VALID_SYNC_Time that is used for early disqualification of invalid stations. This feature will reduce the disqualification time by about 1/2 when the RSSI check passes on an invalid station
- Added a property DIGITAL_SERVICE_RESTART_DELAY which sets the delay time (in miliseconds) to restart digital service when recovering from acquisition loss. This delay time is reduced from 1 second to 200 miliseconds.
- Reduce DAB audio mute holdoff time from 800ms to 700ms when starting an audio service.
- Fixed the DAB audio clipping issue

5.8.1 Errata

- DAB_VALID_SYNC_Time property for early disqualification of invalid stations shall not be set to a value less than 300 ms.

5.9 Revision 3.2.7

- ***Production release***
- Change default value of property DAB_PHY_COARSE_TFPR_COR_WINDOW to 32.
- Fixed DAB reconfiguration related issue associated with AUDIO_BIT_RATE response field of command DAB_GET_AUDIO_INFO. The AUDIO_BIT_RATE response field updates correctly after the reconfiguration event.
- Fixed DAB reconfiguration issue associated with CU_Level response field of DAB_DIGRAD_STATUS command. The CU_LEVEL response field updates correctly after the reconfiguration event.

- Fixed issue in supporting large(8K+)MOT slideshows.
- Fixed DAB reconfiguration issue associated with DAB_GET_SUBCHAN_INFO. The DAB radio command DAB_GET_SUBCHAN_INFO updates correctly after the reconfiguration event.
- Updated API command DAB_GET_SUBCHAN_INFO to include CU count and CU start address

5.9.1 Errata

- DAB_VALID_SYNC_Time property for early disqualification of invalid stations shall not be set to a value less than 300 ms.
- Frequency Information in the FIC channel is limited to 10. Exceed this limit may cause inaccurate replies from DAB_GET_FREQ_INFO command.

5.10 Revision 3.2.10

- ***Production release - 3.2.10 complies with Digital Radio Technical specifications for use of Digital Radio Certification Mark(tick mark)***
- Fixed DAB+ reconfiguration issue associated with changing the sampling rate from 32KHz to 48KHz
- Fixed DAB+ reconfiguration issue associated with changing the audio mode from Mono to Mono with SBR
- Fixed DAB issue in handling 10 secondary data components- when primary tuned component is audio. The primary audio component can now be played back without any issues, and the reporting of the audio information is correct.
- Increase the handling of number of services to 50 from 32.
- Increase the handling of frequency information in the FIC channel to 40 from 10.

5.10.1 Errata

- DAB_VALID_SYNC_Time property for early disqualification of invalid stations shall not be set to a value less than 300 ms.

5.11 Revision 3.2.12

- ***Production release - 3.2.12***
- Added support for displaying the ECC(Extended Country Code) response. The Ensemble ECC response is appeneded to the existing command DAB_GET_ENSEMBLE_INFO. And, the Service ECC response is reported by adding a new command DAB_GET_SERVICE_INFO.

5.11.1 Errata

- DAB_VALID_SYNC_Time property for early disqualification of invalid stations shall not be set to a value less than 300 ms.

5.12 Revision 4.0.3

- ***Production release – 4.0.3***
- Added DAB Fast detect feature to reliably detect DAB stations and reduce the overall scan time
- Added buzzer tone alarm feature
- Added Dynamic Range control feature
- Added abbreviated label support for service names
- Change the acquisition valid time(Property 0xB202) from 1200 ms to 2000 ms
- Change the sync time(Property 0xB203) from 450 ms to 1200 ms
- Fixed the DLS string issue where current DLS is interrupted by next DLS

5.12.1 Errata

- DAB_VALID_SYNC_Time property for early disqualification of invalid stations shall not be set to a value less than 300 ms.

5.13 Revision 4.0.5

- ***Production release – 4.0.5***
- Added DABSoft Mute feature
- Added DAB Announcement support
- Added new API command –DAB_GET_OE_SERVICES_INFO- for providing FIG 0/24- Other Ensemble- related information, and updated existing API command – DAB_GET_SERVICE_LINKING_INFO- for providing FIG 0/6- Service Linking- related information.

5.13.1 Errata

- DAB_VALID_SYNC_Time property for early disqualification of invalid stations shall not be set to a value less than 300 ms.
- Read Offset command(0x10) is not functioning.

5.14 Revision 5.0.2

- ***Production release – 5.0.2***
- Fix a bug with DRUK_4_5_1 : dls clear command was not reported to host
- Fix a bug with packet mode service TPEG
- Fix a bug in the READ_OFFSET command
- Fix a bug with DRUK_2_4_1 : with previous FW release 7 data components could be output instead of 10
- XPAD improvement : now supports multiple XPAD streams
- Added DAB Comfort Noise feature
- Added DAB property to enable and control the Audio Mute features (Soft Mute and Comfort Noise)
- Added DAB Soft Mute and Comfort Noise statuses available in the DAB_ACF_STATUS command reply.
- Remodeled Soft Mute properties to match Comfort Noise property.
    - Removed :
        - DAB_CTRL_DAB_MUTE_SIGLOW_THRESHOLD
        - DAB_CTRL_DAB_MUTE_WIN_THRESHOLD
        - DAB_CTRL_DAB_UNMUTE_WIN_THRESHOLD
    - Renamed :
        - DAB_CTRL_DAB_MUTE_SIGLOSS_THRESHOLD
        - DAB_CTRL_DAB_SOFTMUTE_RAMP_UP_TIME
        - DAB_CTRL_DAB_SOFTMUTE_RAMP_DOWN_TIME
- Removed field HARDMUTE in the DAB_DIGRAD_STATUS reply command as the audio muting is now handle through other commands properties
- Added LNA status to notify the host to reset the chip through RFFE_ERR bit field in the reply bit status of any commands
- Added the ability to clear the FIB error counter of the DAB_DIGRAD_STATUS command
- Added the character set and ensemble label abbreviation mask to the DAB_GET_ENSEMBLE_INFO command
- Added user application information associated with the XPAD of a program service to the DAB_GET_COMPONENT_INFO command

- *Fixes issue with the CLK_MODE parameter passed in the POWER_UP command. The CLK_MODE parameter mode-2(single ended buffer) and mode-3(differential buffer) selections were getting ignored in the previous releases.*

5.14.1 Errata

- DAB_VALID_SYNC_Time property for early disqualification of invalid stations shall not be set to a value less than 300 ms.

5.15 Revision 5.0.3

- ***Production release – 5.0.3***
- Fixes a DRC related issue under weak signal conditions
- Updates the description of the response field Audio_DRC_gain within the command DAB_GET_AUDIO_INFO

5.15.1 Errata

- DAB_VALID_SYNC_Time property for early disqualification of invalid stations shall not be set to a value less than 300 ms.

5.16 Revision 5.0.4

- ***Production release – 5.0.4***
- Fixes an issue where SVRLIST bit of DAB_GET_EVENT_STATUS is not asserted when User Application(UA) type is “Not Used”
- API update: The size of the response field EID within the command DAB_GET_OE_SERVICES _INFO is changed from 32 bits to 16 bits.

5.16.1 Errata

- DAB_VALID_SYNC_Time property for early disqualification of invalid stations shall not be set to a value less than 300 ms.
- Properties 0xB505(DAB_ACF_SOFTMUTE_ATTACK_Time) and 0xB506(DAB_ACF_SOFTMUTE_RELEASE_Time) are interchanged. To correctly use these properties, consdider:
    - Property 0xB505 as DAB_ACF_SOFTMUTE_RELEASE_Time with default value 4000ms
    - Property 0xB506 as DAB_ACF_SOFTMUTE_ATTACK_Time with default value 100ms.

5.17 Revision 5.0.5

- ***Production release – 5.0.5***
- Fixes an issue related to interchange of property 0xB505(DAB_ACF_SOFT_MUTE_ATTACK) with property 0xB506(DAB_ACF_SOFTMUTE_RELEASE)

5.17.1 Errata

- DAB_VALID_SYNC_Time property for early disqualification of invalid stations shall not be set to a value less than 300 ms.

6. AMHD/FMHD/DMB Firmware

6.1 Si4660 Parts

6.1.1 Revision 0A

- ***Engineering release only – not a production release***
- FM Firmware Component Revision 0.0.5
- DMB Firmware Component Revision 0.0.3

6.1.2 Revision 0B

- ***Engineering release only – not a production release***
- FM Firmware Component Revision 1.0.3
- DMB Firmware Component Revision 1.0.4

6.1.3 Revision 10

- ***Production release***
- FMHD Firmware Component Revision 2.0.12
- DMB Firmware Component Revision 2.0.15
- ROM00 Patch Revision 0.0.9

6.2 Si468x Parts

6.2.1 Revision 0B

- ***Engineering release only – not a production release***
- FMHD Firmware Component Revision 1.0.4
- DMB Firmware Component Revision 1.0.3

6.2.2 Revision 10

- ***Production release***
- FMHD Firmware Component Revision 2.0.12
- DMB Firmware Component Revision 2.0.15
- ROM00 Patch Revision 0.0.9

6.2.3 Revision 120731

- ***Engineering release only – not a production release***
- FMHD Firmware Component Revision 2.0.12
- DMB Firmware Component Revision 2.0.15
- ROM00 Patch Revision 0.0.9
- DAB Firmware Component Revision 0.0.2
- ROM00 Patch Revision 0.0.11

6.2.4 Revision 120914

- ***Engineering release only – not a production release***
- FMHD Firmware Component Revision 2.0.12
- DMB Firmware Component Revision 2.0.15
- ROM00 Patch Revision 0.0.9
- DAB Firmware Component Revision 0.0.6
- ROM00 Patch Revision 0.0.11

6.2.5 Revision 121120

- ***DAB production release***
- FMHD Firmware Component Revision 2.0.12

- DMB Firmware Component Revision 2.0.15
- ROM00 Patch Revision 0.0.9
- DAB Firmware Component Revision 1.0.6
- ROM00 Patch Revision 0.0.16

6.2.6 Revision 130215

- ***FMHD/DAB production release***
- DMB Firmware Component Revision 2.0.15
- ROM00 Patch Revision 0.0.9
- FMHD Firmware Component Revision 3.0.11
- DAB Firmware Component Revision 2.0.3
- ROM00 Patch Revision 0.0.16

6.2.7 Revision 130522

- ***FMHD/DAB production release***
- DMB Firmware Component Revision 2.0.15
- ROM00 Patch Revision 0.0.9
- FMHD Firmware Component Revision 3.0.16
- DAB Firmware Component Revision 3.0.5
- ROM00 Patch Revision 0.0.16

6.2.8 Revision 130930

- ***FMHD/DAB production release***
- DMB Firmware Component Revision 2.0.15
- ROM00 Patch Revision 0.0.9
- FMHD Firmware Component Revision 3.0.16
- DAB Firmware Component Revision 3.2.0
- ROM00 Patch Revision 0.0.16

6.2.9 Revision 131018

- ***FMHD/DAB production release***
- DMB Firmware Component Revision 2.0.15
- ROM00 Patch Revision 0.0.9
- FMHD Firmware Component Revision 3.0.17
- DAB Firmware Component Revision 3.2.0
- ROM00 Patch Revision 0.0.16

6.2.10 Revision 131209

- ***FMHD/DAB production release***
- DMB Firmware Component Revision 2.0.15
- ROM00 Patch Revision 0.0.9
- FMHD Firmware Component Revision 3.0.17
- DAB Firmware Component Revision 3.2.1
- ROM00 Patch Revision 0.0.16

6.2.11 Revision 140210

- ***FMHD/DAB production release***
- DMB Firmware Component Revision 2.0.15
- ROM00 Patch Revision 0.0.9
- FMHD Firmware Component Revision 3.0.18

- DAB Firmware Component Revision 3.2.1
- ROM00 Patch Revision 0.0.16

6.2.12 Revision 140325

- ***FMHD/DAB production release***
- FMHD Firmware Component Revision 3.0.18
- DAB Firmware Component Revision 3.2.4
- ROM00 Patch Revision 0.0.16

6.2.13 Revision 140508

- ***FMHD/DAB production release***
- FMHD Firmware Component Revision 3.0.19
- DAB Firmware Component Revision 3.2.4
- ROM00 Patch Revision 0.0.16

6.2.14 Revision 140714

- ***FMHD/DAB production release***
- FMHD Firmware Component Revision 3.0.19
- DAB Firmware Component Revision 3.2.7
- ROM00 Patch Revision 0.0.16

6.2.15 Revision 140722

- ***AMHD/FMHD/DAB production release***
- AMHD Firmware Component Revision 1.0.5
- FMHD Firmware Component Revision 3.0.19
- DAB Firmware Component Revision 3.2.10
- ROM00 Patch Revision 0.0.16

6.2.16 Revision 140814

- ***AMHD/FMHD/DAB production release***
- AMHD Firmware Component Revision 1.0.5
- FMHD Firmware Component Revision 3.0.19
- DAB Firmware Component Revision 3.2.12
- ROM00 Patch Revision 0.0.16

6.2.17 Revision 150120

- ***AMHD/FMHD/DAB production release***
- AMHD Firmware Component Revision 1.0.5
- FMHD Firmware Component Revision 3.0.23
- DAB Firmware Component Revision 4.0.3
- ROM00 Patch Revision 0.0.16

6.2.18 Revision 150210

- ***AMHD/FMHD/DAB production release***
- AMHD Firmware Component Revision 2.0.9
- FMHD Firmware Component Revision 4.0.10
- DAB Firmware Component Revision 4.0.3
- ROM00 Patch Revision 0.0.16

6.2.19 Revision 150313

- ***AMHD/FMHD/DAB production release***
- AMHD Firmware Component Revision 2.0.10
- FMHD Firmware Component Revision 4.0.11
- DAB Firmware Component Revision 4.0.5
- ROM00 Patch Revision 0.0.16

6.2.20 Revision 150406

- ***AMHD/FMHD/DAB production release***
- AMHD Firmware Component Revision 2.0.11
- FMHD Firmware Component Revision 4.0.12
- DAB Firmware Component Revision 4.0.5
- ROM00 Patch Revision 0.0.16

6.2.21 Revision 151106

- ***AMHD/FMHD/DAB production release***
- AMHD Firmware Component Revision 2.0.11
- FMHD Firmware Component Revision 4.0.12
- DAB Firmware Component Revision 5.0.2
- ROM00 Patch Revision 0.0.16

6.2.22 Revision 151201

- ***AMHD/FMHD/DAB production release***
- AMHD Firmware Component Revision 2.0.11
- FMHD Firmware Component Revision 4.0.12
- DAB Firmware Component Revision 5.0.3
- ROM00 Patch Revision 0.0.16

6.2.23 Revision 151204

- ***AMHD/FMHD/DAB production release***
- AMHD Firmware Component Revision 2.0.11
- FMHD Firmware Component Revision 4.0.12
- DAB Firmware Component Revision 5.0.4
- ROM00 Patch Revision 0.0.16

6.2.24 Revision 160121

- ***AMHD/FMHD/DAB production release***
- AMHD Firmware Component Revision 2.0.11
- FMHD Firmware Component Revision 5.0.4
- DAB Firmware Component Revision 5.0.5
- ROM00 Patch Revision 0.0.16

7. ROM Patch

7.1 ROM00 Patch Revision 0.0.9

- ***1.0 Production release***
- Required to issue updated POWER_UP command
- Addressed a critical bug in OTP register function.

7.1.1 Errata

- FLASH_LOAD works with.bin file only. If need to use FLASH_LOAD command with this revision of ROM patch, contact Silicon Labs for the corresponding .bin file.
- LOAD_INIT after patch doesn't set CTS properly.
- INTB is not pulsed when CTSIEN bit in POWER_UP command is set.

7.2 ROM00 Patch Revision 0.0.11

- ***Engineering release only – not a production release***
- Addressed the issue where LOAD_INIT after patch doesn't set CTS properly. No delay is needed after patch on HOST_LOAD commands.
- FLASH_LOAD works with both .bif and .bin files.
- Addressed the issue where INTB is not pulsed when CTSIEN bit in POWER_UP command is set. The INTB signal begin to pulse after the patch is loaded.

7.3 ROM00 Patch Revision 0.0.16

- ***Production release***
- FLASH_LOAD is pipelined with three 4 KByte buffers.
- Added capability to update SST25VF032B FLASH part through Si4680.

8. API Changes- AMHD/FMHD/DAB

8.1 API changes FMHD 5.0.4

8.1.1 Command 0x00 RD_REPLY

RD_REPLY command must be called to return the status byte and data for the last command sent to the device. This command is also used to poll the status byte as needed. To poll the status byte, send the RD_REPLY command and read the status byte. This can be done regardless of the state of the CTS bit in the status register. Please refer to individual command descriptions for the format of returned data. RD_REPLY is a hardware command and can be issued while device is powered down. For commands where the size of the response is returned, the user should send the RD_REPLY command to read the SIZE first. Each time the RD_REPLY command is sent, the STAUS bytes will still be returned.

Parameters

- None

Command

RD_REPLY Command	7	6	5	4	3	2	1	0
CMD	0x00							

Reply

RD_REPLY Reply	7	6	5	4	3	2	1	0
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	RSQINT	RDSINT	ACFINT	STCINT
STATUS1	X	X	DEVNTINT	X	X	X	X	DACFINT
STATUS2	X							
STATUS3	PUP_STATE[1:0]		RFFE_ERR	DSPERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	DATA_0[7:0]							
DATA5	DATA_N[7:0]							

Response

- CTS - Clear to Send.
  - 0 = Wait before sending next command.
  - 1 = Clear to send next command. The next command may be sent.

- ERR_CMD - Command Error.
  - 0 = No error

  - 1 = Error. The previous command failed. Read byte 5 of the reply to get the error code. The next successfully executed command will clear the error.

- DACQINT
  - Digital radio link change interrupt indicator. Indicates that something in the digital radio ensemble acquisition status has changed.
  - Service via the HD_DIGRAD_STATUS commands.

- DSRVINT - Indicates that an enabled data component of one of the digital services requires attention. Service using the GET_DIGITAL_SERVICE_DATA command.

- RSQINT
  - Received Signal Quality interrupt indicator.Indicates that a received signal metric is above or below a threshold defined by threshold properties.
  - Service via FM_RSQ_STATUS command.

- RDSINT
  - RDS Data Interrupt indicator.
  - Service via [ref FM_RDS_STATUS].

- ACFINT
  - Automatically controlled features interrupt indicator. Indicates the one of the dynamically system modifiers has crossed a programmed threshold
  - Service via FM_ACF_STATUS command.

- STCINT - Seek/Tune complete.
  - 0 = Tune complete has not been triggered. Do not send a new TUNE/SEEK command.
  - 1 = Tune complete has been triggered. It is safe to send a new TUNE/SEEK command.

- DEVNTINT
  - Digital radio event change interrupt indicator. Indicates that a new event related to the digital radio has occurred.
  - Service via the HD_DIGRAD_STATUS commands.

- DACFINT
  - HD radio ACF status change interrupt indicator. Indicates that a new interrupt related to the HD radio ACF feature has occurred. Service via the HD_ACF_STATUS command

- PUP_STATE[7:6] - Indicates the powerup state of the system.
  - 0 = The system has been reset but no POWER_UP command has been issued. The system is currently waiting on the POWER_UP command.
  - 1 = Reserved
  - 2 = The bootloader is currently running.
  - 3 = An application was successfully booted and is currently running.

- RFFE_ERR - When set indicates that the RF front end of the system is in an unexpected state.

- DSPERR - The DSP has encountered a frame overrun. This is a fatal error.

- REPOFERR - When set the control interface has dropped data during a reply read, which is a fatal error. This is generally caused by running at a SPI clock rate that is too fast for the given data arbiter and memory speed.

- CMDOFERR - When set the control interface has dropped data during a command write, which is a fatal error. This is generally caused by running at a SPI clock rate that is too fast for the data arbiter and memory speed.

- ARBERR - When set an arbiter error has occurred.

- ERRNR - When set a non-recoverable error has occurred. The system keep alive timer has expired.

- DATA_0[7:0]
  - First Data byte.
  - If ERR_CMD bit is set, this byte returns the error code. Possible command error codes are:
  - 0x01 = unspecified
  - 0x02 = reply overflow
  - 0x03 = not available
  - 0x04 = not supported
  - 0x05 = bad frequency
  - 0x10 = command not found
  - 0x11 = bad arg1
  - 0x12 = bad arg2
  - 0x13 = bad arg3
  - 0x14 = bad arg4
  - 0x15 = bad arg5
  - 0x16 = bad arg6
  - 0x17 = bad arg7
  - 0x18 = command busy
  - 0x19 = at band limit
  - 0x20 = bad NVM
  - 0x30 = bad patch
  - 0x31 = bad bootmode
  - 0x40 = bad property
  - 0x50 = not acquired
  - 0xff = APP not supported

- DATA_N[7:0] - Nth Data byte.

8.1.2 GET_AGC_STATUS

- Summary: *Reports the status of the AGC.*
- **Parameters**
  - WRITE_AS_0[7:0] - Reserved parameter, always write as 0.
    - TYP = 0
- **Response**
  - VHFLNA[7:0] - VHF LNA Gain setting
  - VHFCATT[7:0] - VHF Front End Capacitive attenuator setting
  - VHFRATT[15:0] - VHF Front End Resistive attenuator setting
  - RFINDEX[7:0] - RF AGC table index
    - Range: 0-60
- **Command**

GET_AGC_STATUS Command	7	6	5	4	3	2	1	0
CMD	0x17							
ARG1	WRITE_AS_0[7:0]							

- **Reply**

GET_AGC_STATUS Reply	7	6	5	4	3	2	1	0
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	RSQINT	RDSINT	ACFINT	STCINT
STATUS1	x	x	DEVNTINT	x	x	x	x	DACFINT
STATUS2	x							
STATUS3	PUP_STATE[1:0]		RFFE_ERR	DSPERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	XXXXXXXX							
DATA5	XXXXXXXX							
DATA6	XXXXXXXX							
DATA7	XXXXXXXX							
DATA8	XXXXXXXX							
DATA9	XXXXXXXX							
DATA10	XXXXXXXX							

DATA11	XXXXXXXX
DATA12	xxxxxx
DATA13	xxxxxxx
DATA14	VHFLNA[7:0]
DATA15	VHFCATT[7:0]
DATA16	VHFRATT[7:0]
DATA17	VHFRATT[15:8]
DATA18	XXXXXXXX
DATA19	XXXXXXXX
DATA20	XXXXXXXX
DATA21	RFINDEX[7:0]
DATA22	XXXXXXXX

8.1.3 AGC_RF_THRESHOLD

- Summary: *Adjusts the midpoint of threshold for the RF Threshold Detector.*
- Purpose
  - Adjusts the midpoint of threshold for the RF Threshold Detector. Signed Q15.1 format. Each index unit is 0.5 dB
  - When tuning to analog only mode, range is from -35 to 21. When tuning to HD mode, range is from -46 to 6.
- Property: 0x170C
- **Default:** 0
- Fields
  - RF_THRESHOLD[15:0] - default:0x0000
    - Adjusts the midpoint of threshold for the RF Threshold Detector. Signed Q15.1 format. Each index unit is 0.5 dB
    - When tuning to analog only mode, range is from -12 to 12. When tuning to HD mode, range is from -12 to 6.
    - Range: -12-12
- Register View

AGC_RF_THRESHOLD															
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
RF_THRESHOLD[15:0]															
0x0000															

8.2 DAB API 5.0.2

8.2.1 Enabling Mute features

8.2.1.1 DAB_ACF_ENABLE

- Summary: *enables the feature of soft mute and comfort noise when signal level is low.*
- Purpose
  - Enables the audio processing (soft mute, comfort noise) when signal level is low.
  - Changes to this property will take effect at tune/acquisition time.
- Property: 0xB500
- **Default:** 3 **Units:** value
- Fields
  - COMF_NOISE_ENABLE - default:1 Enable the comfort noise feature when signal level is low.
    - 0 = disable comfort noise feature.
    - 1 = enable comfort noise feature.
  - SOFTMUTE_ENABLE - default:1 Enable the soft mute feature when signal level is low.
    - 0 = disable soft mute.
    - 1 = enable soft mute.
- Register View

DAB_ACF_ENABLE															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x00000														COMF_NOISE_ENABLE	SOFTMUTE_ENABLE
0x00000														1	1

8.2.1.2 DAB_ACF_MUTE_SIGLOSS_THRESHOLD

- Summary: *Set the signal RSSI threshold to mute audio. RSSI below this threshold indicates that signal is lost. In this case, audio will be muted.*
- Purpose
  - Sets the threshold to mute audio when signal is loss.
  - If signal is lost, which means RSSI is below this threshold, audio soft mute will engage and audio attenuation level is maximum.
- Property: 0xB501
- **Default:** 6 **Units:** dBuV
- Fields
  - MUTE_SIGLOSS_THRESHOLD[15:0] - default:0x0006
    - Sets the threshold to mute audio when signal is loss.
    - If signal is lost, which means RSSI is below this threshold, audio soft mute will engage and audio attenuation level is maximum.
- Register View

DAB_ACF_MUTE_SIGLOSS_THRESHOLD															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUTE_SIGLOSS_THRESHOLD[15:0]															
0x0006															

8.2.2 Soft Mute feature

8.2.2.1 DAB_ACF_SOFTMUTE_BER_LIMITS

- Summary: *Sets the BER limits when softmute engages.*
- Purpose
  - Sets the BER limits when softmute engages.
  - Set the estimated sub-channel BER limits when softmute engages. BER=20*log10(BER_linear). It is a negative number.
  - Changes to this property will take effect at tune/acquisition time.
- Property: 0xB503
- **Default:** 0xe2a6 **Units:** dB
- Fields
  - SOFTMUTE_BER_MAX[7:0] - default:0xE2 When estimated sub-channel BER is over this value, audio softmute attenuation is maximum.
    - Range: -127-0
  - SOFTMUTE_BER_MIN[7:0] - default:0xA6 When estimated sub-channel BER is over this value, audio softmute begins to engage.
    - Range: -127-0
- Register View

DAB_ACF_SOFTMUTE_BER_LIMITS															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SOFTMUTE_BER_MAX[7:0]								SOFTMUTE_BER_MIN[7:0]							
0xE2								0xA6							

8.2.2.2 DAB_ACF_SOFTMUTE_ATTENUATION_LEVEL

- Summary: *Sets audio attenuation level.*
- Purpose
  - Sets audio attenuation level.
  - When soft mute engages, the maximum audio attenuation level.
  - Changes to this property will take effect at tune/acquisition time.
- Property: 0xB504
- **Default:** 80 **Units:** dB
- Fields
  - ATTN_LEVEL[7:0] - default:0x50 Softmute attenuation level in units of dB.
    - Range: 0-90
- Register View

DAB_ACF_SOFTMUTE_ATTENUATION_LEVEL

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x00								ATTN_LEVEL[7:0]							
0x00								0x50							

8.2.2.3 DAB_ACF_SOFTMUTE_ATTACK_TIME

- Summary: *Sets mute time in ms.*
- Purpose
  - Sets mute time in ms.
  - Sets the transition time for which softmute lowers the audio level.
  - Changes to this property will take effect at tune/acquisition time.
- Property: 0xB505
- **Default:** 100 **Units:** ms
- Fields
  - ATTACK_TIME[15:0] - default:0x0064 Softmute ramp up time in units of ms.
- Register View

DAB_ACF_SOFTMUTE_ATTACK_TIME															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ATTACK_TIME[15:0]															
0x0064															

8.2.2.4 DAB_ACF_SOFTMUTE_RELEASE_TIME

- Summary: *Sets unmute time in ms.*
- Purpose
  - Sets unmute time in ms.
  - Sets the transition time for which softmute restores the audio level.
  - Changes to this property will take effect at tune/acquisition time.
- Property: 0xB506
- **Default:** 4000 **Units:** ms
- Fields
  - RELEASE_TIME[15:0] - default:0x0FA0 Softmute ramp down time in units of ms.
- Register View

DAB_ACF_SOFTMUTE_RELEASE_TIME															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RELEASE_TIME[15:0]															
0x0FA0															

8.2.3 Comfort Noise feature

8.2.3.1 DAB_ACF_CMFTNOISE_BER_LIMITS

- Summary: *Sets the BER limits when softmute engages.*

- Purpose
  - Sets the BER limits when softmute engages.
  - Set the estimated sub-channel BER limits when softmute engages. BER=20*log10(BER_linear). It is a negative number.
  - Changes to this property will take effect at tune/acquisition time.
- Property: 0xB503
- **Default:** 0xe2a6 **Units:** dB
- Fields
  - SOFTMUTE_BER_MAX[7:0] - default:0xE2 When estimated sub-channel BER is over this value, audio softmute attenuation is maximum.
    - Range: -127-0
  - SOFTMUTE_BER_MIN[7:0] - default:0xA6 When estimated sub-channel BER is over this value, audio softmute begins to engage.
    - Range: -127-0
- Register View

DAB_ACF_SOFTMUTE_BER_LIMITS															
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
SOFTMUTE_BER_MAX[7:0]								SOFTMUTE_BER_MIN[7:0]							
0xE2								0xA6							

8.2.3.2 DAB_ACF_CMFTNOISE_LEVEL

- Summary: *Sets the comfort noise level.*
- Purpose
  - Sets the comfort noise level.
  - When comfort noise engages, sets the comfort noise level as a fractional number between 0 and 1. Where 0 is off and 0x3FFF is 0dBFS. The actual level can be calculated from N = 20log(NOISE_LEVEL/131072), where N will be in dBFS.
  - Changes to this property will take effect at tune/acquisition time.
- Property: 0xB508
- **Default:** 0x200 **Units:** dB
- Fields
  - CMFTNOISE_LEVEL[15:0] - default:0x0200 comfort noise level as a fractional number between 0 and 1.
    - Range: 0-4000
- Register View

DAB_ACF_CMFTNOISE_LEVEL															
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
CMFTNOISE_LEVEL[15:0]															
0x0200															

8.2.3.3 DAB_ACF_CMFTNOISE_ATTACK_TIME

- Summary: *Sets comfort noise attack time in ms.*
- Purpose

  - Sets comfort noise attack time in ms.
  - Sets the transition time for which comfort noise ramps up to full level.
  - Changes to this property will take effect at tune/acquisition time.
- Property: 0xB509
- **Default:** 100 **Units:** ms
- Fields
  - ATTACK_TIME[15:0] - default:0x0064 comfort noise ramp up time in units of ms.
- Register View

DAB_ACF_CMFTNOISE_ATTACK_TIME															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ATTACK_TIME[15:0]															
0x0064															

8.2.3.4 DAB_ACF_CMFTNOISE_RELEASE_TIME

- Summary: *Sets comfort noise release time in ms.*
- Purpose
  - Sets comfort noise release time in ms.
  - Sets the transition time for which comfort noise ramps down to 0.
  - Changes to this property will take effect at tune/acquisition time.
- Property: 0xB50A
- **Default:** 4000 **Units:** ms
- Fields
  - RELEASE_TIME[15:0] - default:0x0FA0 comfort noise ramp down time in units of ms.
- Register View

DAB_ACF_CMFTNOISE_RELEASE_TIME															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RELEASE_TIME[15:0]															
0x0FA0															

8.2.4 Status reading of the Mute features

8.2.4.1 DAB_ACF_STATUS

- Summary: *Returns status information about automatically controlled features.*
- Purpose
  - This command returns status information about automatically controlled features of the device. The automatically controlled features include comfort noise and softmute. See property DAB_ACF_ENABLE to control these features.
- **Parameters**
  - `WRITE_AS_0[7:0]` - Reserved parameter, always write as 0.
    - `TYP = 0`
- **Response**
  - `RFU1[7:0]` - RFU

- RFU2[7:0] - RFU
- AUDIO_LEVEL[15:0] - Returns the audio level. When soft mute engages, the audio level is a fractional number between 0 and 1. Where 0 is mute and 0x3FFF is 0dBFS. The actual level can be calculated from N = 20log(AUDIO_LEVEL/16383), where N will be in dBFS. This level excludes DRC gain.
- CMFT_NOISE_LEVEL[15:0] - Returns the comfort noise level. When comfort noise engages, the noise level is a fractional number between 0 and 1. Where 0 is mute and 0x3FFF is 0dBFS. The actual level can be calculated from N = 20log(AUDIO_LEVEL/131072), where N will be in dBFS.

- **Command**

DAB_ACF_STATUS Command	7	6	5	4	3	2	1	0
CMD	0xC2							
ARG1	WRITE_AS_0[7:0]							

- **Reply**

DAB_ACF_STATUS Reply	7	6	5	4	3	2	1	0
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	XXX			STCINT
STATUS1	RSVD	RSVD	DEVNTINT	RSVD	RSVD	RSVD	RSVD	DACFINT
STATUS2	RSVD_STAT0[7:0]							
STATUS3	PUP_STATE[1:0]		RFFE_ERR	DSPERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	RFU1[7:0]							
DATA5	RFU2[7:0]							
DATA6	AUDIO_LEVEL[7:0]							
DATA7	AUDIO_LEVEL[15:8]							
DATA8	CMFT_NOISE_LEVEL[7:0]							
DATA9	CMFT_NOISE_LEVEL[15:8]							
DATA10	RSVD[7:0]							
DATA11	RSVD[15:8]							

8.2.5 Clear the FIB error counter

8.2.5.1 DAB_DIGRAD_STATUS

- Summary: *Returns status information about the digital radio and ensemble.*
- Purpose
  - DAB_DIGRAD_STATUS returns status information about the digital radio and ensemble including a change in ensemble acquisition state, current estimates for ensemble's MSC (Main Service Channel) BER (bit error rate), FIC (Fast Information Channel) BER along with number of FIBs (Fast Information Block) that failed a CRC check and number of Reed-Solomon decoder errors (DAB+ and DMB only). The bits RSSILINT, RSSIHINT, ACQINT are sticky meaning they will remain set until DIGRAD_ACK is set. If the

condition is still true after the interrupt is cleared another interrupt will fire assuming that bit is enabled in DAB_DIGRAD_INTERRUPT_SOURCE.

- **Parameters**
  - DIGRAD_ACK - Clears all pending digital radio interrupts.
    - TYP = 0
  - ATTUNE - Return the values as of DAB_VALID_RSSI_TIME after tune. Only the signal quality metric RSSI is affected by setting this bit.
    - 0 = Return the current status
    - 1 = Return the snapshot taken at DAB_VALID_RSSI_TIME
    - TYP = 0
  - FIBERR_ACK - Clears the Fast Information Blocks error counter (FIB_ERROR_COUNT) when set. The FIB error counter will reset to 0 and continue counting.
    - TYP = 0
  - STC_ACK - Clears the STC interrupt status when set.
    - TYP = 0
- **Response**
  - FICERRINT - Indicates the FIC decoder has encountered unrecoverable errors. This is likely due to poor signal conditions.
  - ACQINT - Indicates a change in the ensemble acquisition state.
  - RSSIHINT - Indicates RSSI below DAB_DIGRAD_RSSI_LOW_THRESHOLD.
  - RSSILINT - Indicates RSSI above DAB_DIGRAD_RSSI_HIGH_THRESHOLD.
  - FICERR - When set to 1 the ensemble is experiencing FIC errors. Signal quality has been degraded and acquisition may be lost.
  - ACQ - When set to 1 the ensemble is acquired.
  - VALID - When set to 1, the RSSI is at or above the valid threshold. It is recommended that the valid bit be used as part of tune validation. Once STC is set the valid bit can be checked to verify that then tune has passed both the RSSI valid threshold and that acquisition has been achived. The host should set the RSSI thershold, validation time and acquisition time to achieve solid tune time performance. Doing this helps insure an accurate tune indication and helps to decrease scan times due to quick station disqualification.
  - RSSI[7:0] - Received signal strength indicator.
    - Range: -128-63
  - SNR[7:0] - Indicates the current estimate of the digital SNR in dB.
    - Range: 0-20
  - FIC_QUALITY[7:0] - Indicates the current estimate of the ensembles FIC quality. The number is provided is between 0 and 100.
    - Range: 0-100
  - CNR[7:0] - Indicates the current estimate of the CNR in dB. The CNR is the ratio of the OFDM signal level during the on period and during the off (null) period.
    - Range: 0-54
  - FIB_ERROR_COUNT[15:0] - Indicates the num of Fast Information Blocks received with errors.
  - TUNE_FREQ[31:0] - indicates the currently tuned frequency in kHz.
  - TUNE_INDEX[7:0] - Indicates the currently tuned frequency index.
    - Range: 0-47
  - FFT_OFFSET[7:0] - Indicates the frequency offset of the DQPSK tones of the OFDM signal relative to the center of the FFT bins of the digital demod.
  - READANTCAP[15:0] - Returns the antenna tuning cap value.
  - CU_LEVEL[15:0] - Returns the CU usage indicator (number of currently decoded CU's)
    - Range: 0-470

- FAST_DECT[7:0] - Returns the statistical metric for DAB fast detect. The metric is a confidence level that dab signal is detected. The threshold for dab detected is greater than 4.

- **Command**

DAB_DIGRAD_STATUS Command	7	6	5	4	3	2	1	0
CMD	0xB2							
ARG1	0000				DIGRAD_ACK	ATTUNE	FIBERR_ACK	STC_ACK

- **Reply**

DAB_DIGRAD_STATUS Reply	7	6	5	4	3	2	1	0
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	XXX			STCINT
STATUS1	RSVD	RSVD	DEVNTINT	RSVD	RSVD	RSVD	RSVD	DACFINT
STATUS2	RSVD_STAT0[7:0]							
STATUS3	PUP_STATE[1:0]		RFFE_ERR	DSPERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	XXXX				FICERRINT	ACQINT	RSSIHINT	RSSILINT
DATA5	XXXX				FICERR	ACQ	X	VALID
DATA6	RSSI[7:0]							
DATA7	SNR[7:0]							
DATA8	FIC_QUALITY[7:0]							
DATA9	CNR[7:0]							
DATA10	FIB_ERROR_COUNT[7:0]							
DATA11	FIB_ERROR_COUNT[15:8]							
DATA12	TUNE_FREQ[7:0]							
DATA13	TUNE_FREQ[15:8]							
DATA14	TUNE_FREQ[23:16]							
DATA15	TUNE_FREQ[31:24]							
DATA16	TUNE_INDEX[7:0]							
DATA17	FFT_OFFSET[7:0]							
DATA18	READANTCAP[7:0]							
DATA19	READANTCAP[15:8]							
DATA20	CU_LEVEL[7:0]							
DATA21	CU_LEVEL[15:8]							
DATA22	FAST_DECT[7:0]							

8.2.6 Character set and ensemble label abbreviation mask

8.2.6.1 DAB_GET_ENSEMBLE_INFO

- Summary: *Gets information about the current ensemble*
- Purpose
  - DAB_GET_ENSEMBLE_INFO gets information about the current ensemble such as the ensemble ID and label.
- **Parameters**
  - WRITE_AS_0[7:0] - Reserved parameter, always write as 0.
    - TYP = 0
- **Response**
  - EID[15:0] - The ensemble ID EID. See section 6.4 of ETSI EN 300401.
  - LABEL0[7:0] - First of 16 characters for the ensemble label.
  - LABEL1[7:0] - The second of 16 characters of the component label.
  - LABEL2[7:0] - The third of 16 characters of the component label.
  - LABEL3[7:0] - The fourth of 16 characters of the component label.
  - LABEL4[7:0] - The fifth of 16 characters of the component label.
  - LABEL5[7:0] - The sixth of 16 characters of the component label.
  - LABEL6[7:0] - The seventh of 16 characters of the component label.
  - LABEL7[7:0] - The eighth of 16 characters of the component label.
  - LABEL8[7:0] - The nineth of 16 characters of the component label.
  - LABEL9[7:0] - The tenth of 16 characters of the component label.
  - LABEL10[7:0] - The eleventh of 16 characters of the component label.
  - LABEL11[7:0] - The twelfth of 16 characters of the component label.
  - LABEL12[7:0] - The thirteenth of 16 characters of the component label.
  - LABEL13[7:0] - The fourteenth of 16 characters of the component label.
  - LABEL14[7:0] - The fifteenth of 16 characters of the component label.
  - LABEL15[7:0] - The sixteenth of 16 characters of the component label.
  - ENSEMBLE_ECC[7:0] - The ensemble Extended Country Code (ECC).
  - CHARSET[7:0] - Charset of the ensemble label.
  - CHAR_ABREV[15:0] - The component label abbreviation mask. Used to indicate which characters in the label are used to create the abbreviated label.
- **Command**

DAB_GET_ENSEMBLE_INFO Command	7	6	5	4	3	2	1	0
CMD	0xB4							
ARG1	WRITE_AS_0[7:0]							

- **Reply**

DAB_GET_ENSEMBLE_INFO Reply	7	6	5	4	3	2	1	0
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	XXX			STCINT
STATUS1	RSVD	RSVD	DEVNTINT	RSVD	RSVD	RSVD	RSVD	DACFINT
STATUS2	RSVD_STAT0[7:0]							

STATUS3	PUP_STATE[1:0]	RFFE_ERR	DSPERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	EID[7:0]						
DATA5	EID[15:8]						
DATA6	LABEL0[7:0]						
DATA7	LABEL1[7:0]						
DATA8	LABEL2[7:0]						
DATA9	LABEL3[7:0]						
DATA10	LABEL4[7:0]						
DATA11	LABEL5[7:0]						
DATA12	LABEL6[7:0]						
DATA13	LABEL7[7:0]						
DATA14	LABEL8[7:0]						
DATA15	LABEL9[7:0]						
DATA16	LABEL10[7:0]						
DATA17	LABEL11[7:0]						
DATA18	LABEL12[7:0]						
DATA19	LABEL13[7:0]						
DATA20	LABEL14[7:0]						
DATA21	LABEL15[7:0]						
DATA22	ENSEMBLE_ECC[7:0]						
DATA23	CHARSET[7:0]						
DATA24	CHAR_ABREV[7:0]						
DATA25	CHAR_ABREV[15:8]						

8.2.7 XPAD user application information

8.2.7.1 DAB_GET_COMPONENT_INFO

- Summary: *Gets information about components within the ensemble if available.*
- Purpose
  - DAB_GET_COMPONENT_INFO gets information about components within the ensemble if available.
- **Parameters**
  - SERVICEID[31:0] - The service ID
  - COMPID[31:0] - The component ID.
- **Response**
  - GLOBAL_ID[7:0] - The global reference for the component. See clause 6.3.5 of 300-401. This field gets concatenated with the Service ID of the service list to form the unique global component ID.
  - LANG[5:0] - The language of the component. See tables 9 and 10 of ETSI TS 101-756.
  - CHARSETID[5:0] - The character set for the component label. See tables 1 of ETSI TS 101-756.
  - LABEL0[7:0] - The first of 16 characters of the component label.
  - LABEL1[7:0] - The second of 16 characters of the component label.

- LABEL2[7:0] - The third of 16 characters of the component label.
- LABEL3[7:0] - The fourth of 16 characters of the component label.
- LABEL4[7:0] - The fifth of 16 characters of the component label.
- LABEL5[7:0] - The sixth of 16 characters of the component label.
- LABEL6[7:0] - The seventh of 16 characters of the component label.
- LABEL7[7:0] - The eighth of 16 characters of the component label.
- LABEL8[7:0] - The nineth of 16 characters of the component label.
- LABEL9[7:0] - The tenth of 16 characters of the component label.
- LABEL10[7:0] - The eleventh of 16 characters of the component label.
- LABEL11[7:0] - The twelfth of 16 characters of the component label.
- LABEL12[7:0] - The thirteenth of 16 characters of the component label.
- LABEL13[7:0] - The fourteenth of 16 characters of the component label.
- LABEL14[7:0] - The fifteenth of 16 characters of the component label.
- LABEL15[7:0] - The sixteenth of 16 characters of the component label.
- CHAR_ABREV[15:0] - The component label abbreviation mask. Used to indicate which characters in the label are use to create the abbreviated label.
- NUMUA[7:0] - The number of user application types.
- LENUA[7:0] - The total length (in byte) of the UATYPE, UADATALEN and UADATA fields, including the padding bytes which is described in UADATAN field.
- UATYPE[15:0] - The user application type. If multiple UA Types exist, all UATTYPE fields will be aligned on a 16-bit (2 byte) boundary.
- UADATALEN[7:0] - The UADATA field length, excluding the padding byte which is described in UADATAN field.
- UADATA0[7:0] - This is the first byte of the UADATA field. This UADATA field contains both "X-PAD data" and "User Application Data" field as shown in ETSI EN 300 401 V1.4.1 clause 8.1.20, Figure 68.
- UADATAN[7:0] - This is the last byte of the UADATA field. If the user application data field length (UADATALEN) is odd, this byte will be a valid UADATA byte. If the user application data field length (UADATALEN) is even, this byte will be a padding byte. The content of the padding byte is 0x00. By adding a padding byte, each UATYPE field will be aligned on a 16-bit (2 byte) boundary. The padding byte will not be counted in the UADATALEN field, but will be counted in the LENUA field.

- **Command**

DAB_GET_COMPONENT_INFO Command	7	6	5	4	3	2	1	0
CMD	0xBB							
ARG1	0x00							
ARG2	0x00							
ARG3	0x00							
ARG4	SERVICEID[7:0]							
ARG5	SERVICEID[15:8]							
ARG6	SERVICEID[23:16]							
ARG7	SERVICEID[31:24]							
ARG8	COMPID[7:0]							
ARG9	COMPID[15:8]							
ARG10	COMPID[23:16]							
ARG11	COMPID[31:24]							

- **Reply**

DAB_GET_COMPONENT_INFO Reply	7	6	5	4	3	2	1	0
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	XXX			STCINT
STATUS1	RSVD	RSVD	DEVNTINT	RSVD	RSVD	RSVD	RSVD	DACFINT
STATUS2	RSVD_STAT0[7:0]							
STATUS3	PUP_STATE[1:0]		RFFE_ERR	DSPERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	GLOBAL_ID[7:0]							
DATA5	XXXXXXXX							
DATA6	XX		LANG[5:0]					
DATA7	XX		CHARSETID[5:0]					
DATA8	LABEL0[7:0]							
DATA9	LABEL1[7:0]							
DATA10	LABEL2[7:0]							
DATA11	LABEL3[7:0]							
DATA12	LABEL4[7:0]							
DATA13	LABEL5[7:0]							
DATA14	LABEL6[7:0]							
DATA15	LABEL7[7:0]							
DATA16	LABEL8[7:0]							
DATA17	LABEL9[7:0]							
DATA18	LABEL10[7:0]							
DATA19	LABEL11[7:0]							
DATA20	LABEL12[7:0]							
DATA21	LABEL13[7:0]							
DATA22	LABEL14[7:0]							
DATA23	LABEL15[7:0]							
DATA24	CHAR_ABREV[7:0]							
DATA25	CHAR_ABREV[15:8]							
DATA26	NUMUA[7:0]							
DATA27	LENUA[7:0]							
DATA28	UATYPE[7:0]							
DATA29	UATYPE[15:8]							
DATA30	UADATALEN[7:0]							
DATA31	UADATA0[7:0]							
DATA32	UADATAN[7:0]							

8.2.8 Announcement (information not in the programming guide)

8.2.8.1 DAB_ANNOUNCEMENT_ENABLE

- Summary: *commontext*
- Purpose
  - DAB_ANNOUNCEMENT_ENABLE enables announcement types.
- Property: `0xB700`
- **Default:** `0x07FF`
- Fields
  - `RESERVED5` - default:`0` RESERVED.
  - `RESERVED4` - default:`0` RESERVED.
  - `RESERVED3` - default:`0` RESERVED.
  - `RESERVED2` - default:`0` RESERVED.
  - `RESERVED1` - default:`0` RESERVED.
  - `FINANCIAL` - default:`1` Enable or disable Financial Report Announcement.
    - `0` = disable Financial Report Announcement.
    - `1` = enable Financial Report Announcement.
  - `SPORT` - default:`1` Enable or disable Sport Report Announcement.
    - `0` = disable Sport Report Announcement.
    - `1` = enable Sport Report Announcement.
  - `PROGRAM` - default:`1` Enable or disable Programme Information Announcement.
    - `0` = disable Programme Information Announcement.
    - `1` = enable Programme Information Announcement.
  - `SPECIAL` - default:`1` Enable or disable Special Event Announcement.
    - `0` = disable Special Event Announcement.
    - `1` = enable Special Event Announcement.
  - `EVENT` - default:`1` Enable or disable Event Announcement.
    - `0` = disable Event Announcement.
    - `1` = enable Event Announcement.
  - `WEATHER` - default:`1` Enable or disable Area Weather Flash Announcement.
    - `0` = disable Area Weather Flash Announcement.
    - `1` = enable Area Weather Flash Announcement.
  - `NEWS` - default:`1` Enable or disable News Flash Announcement.
    - `0` = disable News Flash Announcement.
    - `1` = enable News Flash Announcement.
  - `WARNING` - default:`1` Enable or disable Warning Service Announcement.
    - `0` = disable Warning Service Announcement.
    - `1` = enable Warning Service Announcement.
  - `TRANSPORT` - default:`1` Enable or disable Transport Flash Announcement.
    - `0` = disable Transport Flash Announcement.
    - `1` = enable Transport Flash Announcement.
  - `TRAFFIC` - default:`1` Enable or disable Road Traffic Flash Announcement.
    - `0` = disable Road Traffic Flash Announcement.
    - `1` = enable Road Traffic Flash Announcement.
  - `ALARM` - default:`1` Enable or disable Alarm Announcement.
    - `0` = disable Alarm Announcement.
    - `1` = enable Alarm Announcement.
- Register View

DAB_ANNOUNCEMENT_ENABLE															
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
RESERVED5	RESERVED4	RESERVED3	RESERVED2	RESERVED1	FINANCIAL	SPORT	PROGRAM	SPECIAL	EVENT	WEATHER	NEWS	WARNING	TRANSPORT	TRAFFIC	ALARM
0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1

8.2.8.2 DAB_GET_EVENT_STATUS

- Summary: *Gets information about the various events related to the DAB radio.*
- Purpose
  - DAB_GET_EVENT_STATUS gets information about the various events related to the DAB radio. These events include signaling the reception of new PAD (Programme-Associated Data) data, service lists and announcements. The bits SVRLISTINT, ANNOINT, RECFGWRNINT, and RECFGINT are sticky meaning they will remain set until EVENT_ACK is set. If the condition is still true after the interrupt is cleared another interrupt will fire assuming that bit is enabled in DAB_EVENT_INTERRUPT_SOURCE.
- **Parameters**
  - EVENT_ACK - Clears all pending digital radio event interrupts.
    - TYP = 0
- **Response**
  - RECFGINT - Ensemble reconfiguration event. Indicates that an ensemble reconfiguration has occurred. All changes to the service list that occured after the RECFGWRNINT event will now take effect. If a service that was in operation no longer exists it will be stopped. All other services that did not change should remain active accross the reconfiguration boundary. At this time the host should communicate any relevant changes to the user.
  - RECFGWRNINT - Ensemble reconfiguration warning. Indicates that an ensemble reconfiguration will occur in 6 seconds. From this point on all service list updates will apply to the new ensemble configuration. These changes will not take effect until the RECFGINT is received. At this time the host act upon all changes in the service list.
  - ANNOINT - Announcement information interrupt. Indicates that an announcement event (started or stopped) is available. The event is retrieved with the DAB_GET_ANNOUNCEMENT_INFO command.
  - OESERVINT - Other Ensemble (OE) Services interrupt. Indicates that new OE service information is available or has changed. The other ensemble information is retrieved with the DAB_GET_OE_SERVICES_INFO command.
  - SERVLINKINT - Service linking information interrupt. Indicates that new service linking information is available or has changed. The service linking information list is retrieved with the DAB_GET_SERVICE_LINKING_INFO command.
  - FREQINFOINT - New Frequency Information interrupt. Indicates that new Frequency Information is available. The Frequency Information list is retrieved with the DAB_GET_FREQ_INFO command. The rate at which frequency information interrupts can occur is defined by the DAB_EVENT_MIN_FREQINFO_PERIOD property.
  - SVRLISTINT - New service list interrupt. Indicates that a new digital service list is available. The new service list is retrieved with the GET_DIGITAL_SERVICE_LIST command.
  - ANNO - Announcement available.
    - 0 = No announcement is active.

    - 1 = One or more announcements are active.
  - OESERV - Indicates that OE service information is available (FIG0/24). The OE service information is retrieved with the DAB_GET_OE_SERVICES_INFO command.
  - SERVLINK - Service linking information (FIG 0/6) available. Indicates that service linking information is available. The service linking information list is retrieved with the DAB_GET_SERVICE_LINKING_INFO command.
  - FREQ_INFO - Frequency Information (FI) (FIG0/21) available. Indicates that Frequency Information (FI) is available. The FI list is retrieved with the DAB_GET_FREQ_INFO command.
  - SVRLIST - Service list available. Indicates that a digital service list is available. The service list is retrieved with the GET_DIGITAL_SERVICE_LIST command. If a service list is not available or it is in transition, this bit will be low. When the service list is in transition, this bit will remain low until the service list debounce timer has expired. See the DAB_EVENT_MIN_SVRLIST_PERIOD property for more details.
  - SVRLISTVER[15:0] - Indicates the current version of the digital service list. This field is incremented by 1 each time the service list is updated. The host can use this field to help determine if a new service list needs to be collected.

- **Command**

DAB_GET_EVENT_STATUS Command	7	6	5	4	3	2	1	0
CMD	0xB3							
ARG1	0000000							EVENT_ACK

- **Reply**

DAB_GET_EVENT_STATUS Reply	7	6	5	4	3	2	1	0
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	XXX			STCINT
STATUS1	RSVD	RSVD	DEVNTINT	RSVD	RSVD	RSVD	RSVD	RSVD _8
STATUS2	RSVD_STAT0[7:0]							
STATUS3	PUP_STATE[1:0]		RSVD	DSPEERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	RECFGINT	RECFGWRNINT	X	ANNOINT	OESERVINT	SERVLINKINT	FREQINFOINT	SVRLISTINT
DATA5	XXX			ANNO	OESERV	SERVLINK	FREQ_INFO	SVRLIST
DATA6	SVRLISTVER[7:0]							
DATA7	SVRLISTVER[15:8]							

8.2.8.3 DAB_GET_ANNOUNCEMENT_SUPPORT_INFO

- Summary: *DAB_GET_ANNOUNCEMENT_SUPPORT_INFO gets the announcement support information.*
- Purpose
  - DAB_GET_ANNOUNCEMENT_SUPPORT_INFO gets the announcement support information encoded in FIG 0/18 (Announcement Support), FIG 0/25 (OE Announcement Support) and FIG 0/27 (FM Announcement Support).
  - This is static information about the types of announcements by which the service may be interrupted.
- **Parameters**
  - `SRC[1:0]` - Announcement source
    - `0` = Current ensemble. Gets announcement support information encoded in FIG 0/18 (Announcement Support).
    - `1` = Other ensemble.Gets other ensemble announcement support information encoded in FIG 0/25 (OE Announcement Support).
    - `2` = FM. Gets FM announcement support information encoded in FIG 0/27 (FM Announcement Support).
    - `TYP = 0`
  - `SID[31:0]` - The service ID of which the announcement support information will be returned.
- **Response**
  - `NUM_IDS[7:0]` - Number of IDs in the ID list.
  - `RESERVED[7:0]` - RESERVED.
  - `ASU[15:0]` - ASu (Announcement support) flag. This 16-bit field specifies the types of announcements by which the service may be interrupted. The interpretation of this field is defined in TS 101 756, table 14. Host can set property DAB_ANNOUNCEMENT_ENABLE to select interested announcement types.
  - `ID0[15:0]` - The first ID in the ID list. When SRC is current ensemble, this is the cluster id. When SRC is other ensemble, this is other ensemble EID. When SRC is FM, this is the FM PI.
  - `IDn[15:0]` - The last ID in the ID list. When SRC is current ensemble, this is the cluster id. When SRC is other ensemble, this is other ensemble EID. When SRC is FM, this is the FM PI.
- **Command**

DAB_GET_ANNOUNCEMENT_SUPPORT_INFO Command	7	6	5	4	3	2	1	0
CMD	0xB5							
ARG1	000000						SRC[1:0]	
ARG2	0x00							
ARG3	0x00							
ARG4	SID[7:0]							
ARG5	SID[15:8]							
ARG6	SID[23:16]							
ARG7	SID[31:24]							

- **Reply**

DAB_GET_ANNOUNCEMENT_SUPPORT_INFO Reply	7	6	5	4	3	2	1	0
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	XXX			STCINT
STATUS1	RSVD	RSVD	DEVNTINT	RSVD	RSVD	RSVD	RSVD	RSVD
STATUS2	RSVD_STAT0[7:0]							
STATUS3	PUP_STATE[1:0]		RSVD	DSPERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	NUM_IDS[7:0]							
DATA5	RESERVED[7:0]							
DATA6	ASU[7:0]							
DATA7	ASU[15:8]							
DATA8	ID0[7:0]							
DATA9	ID0[15:8]							
DATA10	IDn[7:0]							
DATA11	IDn[15:8]							

8.2.8.4 DAB_GET_ANNOUNCEMENT_INFO

- Summary: *DAB_GET_ANNOUNCEMENT_INFO gets announcement information from the announcement queue.*
- Purpose
  - DAB_GET_ANNOUNCEMENT_INFO gets announcement information from the announcement queue.
  - The announcement information are encoded in FIG 0/19 (Announcement Switching), FIG 0/26 (OE Announcement Switching) and FIG 0/28 (FM Announcement Switching).
  - Whenever an announcement starts or stops, ANNOINT interrupt is triggered, and the information about the event is put to an announcement queue. Host needs to call this command to retrieve the event from the announcement queue and gets the detailed information. Host can utilize the information to decide how to response to the announcement event. The announcement queue can hold up to 10 events. Once the announcement queue overflows, the latest announcement event will be discarded and cannot be recovered.
- **Parameters**
  - None
- **Response**
  - ANNO_Q_OVFL - announcement queue overflow flag
    - 0 = queue has not overflowed.
    - 1 = queue has overflowed. Some announcement event has been discarded and cannot be recovered.
  - ANNO_Q_SIZE[4:0] - Indicates number of events that have been queued up in the announcement queue. The announcement queue can hold up to 10 announcement events.
  - CLUSTER_ID[7:0] - Cluster ID of the announcement. This field identify the announcement cluster for which the announcement is intended. Please refer to clause 8.1.6.2, 8.1.10.5.2 and 8.1.11.2.2 of ETSI EN 300 401 V1.4.1

- ANNO_STAT - announcement status
  - 0 = Indicates that an announcement has stopped.
  - 1 = Indicates that an announcement has started.
- REGION_FLAG - region flag
  - 0 = region id is not available
  - 1 = region id is available
- SRC[1:0] - announcement source
  - 0 = Current ensemble
  - 1 = Other ensemble
  - 2 = FM
  - 3 = RESERVED
- ASW[15:0] - This field specifies the announcement types which apply to the announcement. The individual bits indicate whether or not a particular announcement type is signalled. 0 indicates that announcement type is invalid. 1 indicates that announcement type is valid. The interpretation of the flags shall be as defined in TS 101 756, table 14.
- ID1[15:0]
  - Announcement ID1 indicates the ID information where the host can retrieve the announcement.
  - If announcement source (SRC) is current ensemble, this field is the service ID. Note that it is the lower 16 bits of the service ID and it is assumed that the upper 16 bits are 0. Use the component ID in ID2 field to locate the announcement service in current ensemble. If announcement source (SRC) is other ensemble, this field is other ensemble EID. If announcement source (SRC) is FM, this field is FM PI.
- ID2[15:0]
  - Announcement ID2 indicates the ID information where the host can retrieve the announcement.
  - If announcement source (SRC) is current ensemble, this field is component ID. Use the service ID in ID1 field to locate the announcement service in current ensemble. If announcement source is other ensemble, this field is other ensemble cluster ID. If announcement source is FM, this field is 0.
- REGIONID1[7:0] - If REGION_FLAG is set, this field shall identify the region in the current ensemble to which the announcement is targeted. It uses the lower part of the Region Identifier. The upper part of the Region Identifier shall be set to 0. See clause 8.1.16 of ETSI EN 300 401 V1.4.1.
- REGIONID2[7:0] - If REGION_FLAG is set, this field shall identify the region in the other ensemble to which the announcement is targeted. It uses the lower part of the Region Identifier. The upper part of the Region Identifier shall be set to 0. See clause 8.1.16 of ETSI EN 300 401 V1.4.1. This field is only valid if announcement source (SRC) is other ensemble. Set to 0 when SRC is current ensemble or FM.

- **Command**

DAB_GET_ANNOUNCEMENT_INFO Command	7	6	5	4	3	2	1	0
CMD	0xB6							

- **Reply**

DAB_GET_ANNOUNCEMENT_INFO Reply	7	6	5	4	3	2	1	0
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	XXX			STCINT
STATUS1	RSVD	RSVD	DEVNTINT	RSVD	RSVD	RSVD	RSVD	RSVD
STATUS2	RSVD_STAT0[7:0]							
STATUS3	PUP_STATE[1:0]		RSVD	DSPERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	XXXXXXX							ANNO_Q_OVFL
DATA5	XXX		ANNO_Q_SIZE[4:0]					
DATA6	CLUSTER_ID[7:0]							
DATA7	XXXX				ANNO_STAT	REGION_FLAG	SRC[1:0]	
DATA8	ASW[7:0]							
DATA9	ASW[15:8]							
DATA10	ID1[7:0]							
DATA11	ID1[15:8]							
DATA12	ID2[7:0]							
DATA13	ID2[15:8]							
DATA14	REGIONID1[7:0]							
DATA15	REGIONID2[7:0]							

8.2.9 Service Following (information not in the programming guide)

8.2.9.1 DAB_GET_OE_SERVICES_INFO

- Summary: *Provides other ensemble (OE) services (FIG 0/24) information for the passed in service ID.*
- Purpose
  - DAB_GET_OE_SERVICES_INFO provides the (FIG 0/24) other ensemble (OE) other services information for the passed in service ID. It provides the ensemble ID(s) in which the passed in service ID will reside. The passed in service IDs can be any service ID found in the current ensemble or a service ID from another ensemble. In general the passed in service ID is obtained using the DAB_GET_SERVICE_LINKING_INFO command with the DAB SID option or can be any service ID in the current ensemble. Please see ETSI TS 103-176 for full details regarding OE Services and service linking. This command is intended to be used in conjunction with the DAB_GET_SERVICE_LINKING_INFO and DAB_GET_FREQ_INFO commands to paint a complete service linking picture. Note: this command may be used alone to determine if an other ensemble is carrying exactly the same service as one existing in the current ensemble.
- **Parameters**

- SERVICEID[31:0] - The service ID for which the OE EIDs are needed. This service ID can be an ID from the current ensemble (find exactly the same service) or one returned by DAB_GET_SERVICE_LINKING_INFO command.

- **Response**
  - SIZE[15:0] - The total number of bytes returned in the service linking information payload.
  - NUM_EIDS[7:0] - The total number of ensemble IDs returned in the response payload.
  - EID_0[31:0] - The first EID returned. This field gets repeated NUM_EIDS times.
- **Command**

DAB_GET_OE_SERVICES_INFO Command	7	6	5	4	3	2	1	0
CMD	0xC1							
ARG1	0x00							
ARG2	0x00							
ARG3	0x00							
ARG4	SERVICEID[7:0]							
ARG5	SERVICEID[15:8]							
ARG6	SERVICEID[23:16]							
ARG7	SERVICEID[31:24]							

- **Reply**

DAB_GET_OE_SERVICES_INFO Reply	7	6	5	4	3	2	1	0
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	XXX			STCINT
STATUS1	RSVD	RSVD	DEVNTINT	RSVD	RSVD	RSVD	RSVD	RSVD
STATUS2	RSVD_STAT0[7:0]							
STATUS3	PUP_STATE[1:0]		RSVD	DSPERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	SIZE[7:0]							
DATA5	SIZE[15:8]							
DATA6	NUM_EIDS[7:0]							
DATA7	XXXXXXXX							
DATA8	EID_0[7:0]							
DATA9	EID_0[15:8]							
DATA10	EID_0[23:16]							
DATA11	EID_0[31:24]							

8.2.9.2 DAB_GET_SERVICE_LINKING_INFO

- Summary: *Provides service linking (FIG 0/6) information for the passed in service ID.*
- Purpose

- DAB_GET_SERVICE_LINKING_INFO provides the FIG 0/6 service linking information for the passed in service ID. It provides service IDs for alternate services or supplemental services relating to the passed in service ID. These services may be found in the current ensemble, another ensemble, or an FM broadcast. Please see clause 8.1.15 of ETSI 300-401 and ETSI TS 103-176 for full details regarding service linking and this commands response. This command is intended to be used in conjunction with the DAB_GET_OE_SERVICES_INFO and DAB_GET_FREQ_INFO commands to paint a complete service linking picture.

- **Parameters**
  - ACTIVE - Selects between active and inactive links when the ACTIVEEN bit of the ENABLE parameter is set. This field will be ignored when the ACTIVEEN bit is cleared. In this case both active and inactive link sets will be returned.
    - 0 = Only show inactive links when ACTIVEEN is set.
    - 1 = Only show active links when ACTIVEEN is set.
    - TYP = 1
  - LINKTYPE[5:4] - Selects which link type will be returned when the LINKTYPEEN bit of the ENABLE parameter is set. This field will be ignored when the LINKTYPEEN bit is cleared. In this case all link types will returned.
    - 0 = Select only DAB/DMB service links.
    - 1 = Select only RDS PI-code links.
    - 2 = Select only AM and FM service links (currently not used per ETSI TS 103-176).
    - 3 = Select only DRM and AMSS service links.
    - TYP = 0
  - SELRSVD2 - RFU
    - TYP = 0
  - SELRSVD1 - RFU
    - TYP = 0
  - HARD - Selects between hard and soft links when the HARDEN bit of the ENABLE parameter is set. This field is ignored when the HARDEN bit is cleared. In this case both hard and soft links will be returned.
    - 0 = Only show soft links when HARDEN is set.
    - 1 = Only show hard links when HARDEN is set.
    - TYP = 1
  - ILS - Selects international links when set. This field is ignored when the ILSEN bit of the ENABLE parameter is cleared. In this case both national and international links will be returned.
    - 0 = Only national links are returned when ILSEN is set.
    - 1 = Only international links are returned when ILSEN is set.
    - TYP = 0
  - ACTIVEEN - When set the ACTIVE bit will be honored and all links returned will be either active or inactive depending on the state of the ACTIVE bit.
    - 0 = Ignore the ACTIVE bit and show all activated and deactivated links.
    - 1 = Show links as selected by the ACTIVE bit.
    - TYP = 0
  - LINKTYPEEN - When set the LINKTYPE field will be honored and all links returned will be of the type specified by LINKTYPE.
    - 0 = Ignore the LINKTYPE bit and show link types.
    - 1 = Show links as selected by the LINKTYPE bit.
    - TYP = 0

- ENRESVD2 - RFU
  - TYP = 0
- ENRESVD1 - RFU
  - TYP = 0
- HARDEN - When set the HARD bit will be honored and all links returned will be either hard or soft depending on the state of the HARD bit.
  - 0 = Ignore the HARD bit and show all hard and soft links.
  - 1 = Show links as selected by the HARD bit.
  - TYP = 0
- ILSEN - When set the ILS bit will be honored and all links returned will be either notional or or international depending on the state of the ILS bit.
  - 0 = Ignore the ILS bit and show all national and international links.
  - 1 = Show links as selected by the ILS bit.
  - TYP = 0
- SERVICEID[31:0] - The service ID in the current ensemble for which the service linking information will be returned. This service ID is provided in the digital service list.

- **Response**
  - SIZE[15:0] - The total number of bytes returned in the service linking information payload.
  - NUM_LINKSETS[7:0] - The total number of Linkage Set segments returned in the payload. Note: If a linkage set contains several link types multiple (up to 4) linkage set segments will be returned for each Linkage Set. The remaining reply fields will be repeated NUM_LINKSETS times for each linkage set segment returned.
  - LSN_0[15:0] - The Linkage Set Number (LSN) for linkage set segment 0.
  - ACTIVE - Indicates whether or not this linkage set segment is activated or deactivated.
    - 0 = The links in this linkage set segment are not activated.
    - 1 = The links in this linkage set segment are activated.
  - SHD - Indicates whether or not this linkage set has the SHD (shorthand) flag set. When set service IDs in the linkage set having bits b11 to b8 in the range of 0x04 ot 0x0F represents a list of up to 12 services sharing the same country ID and same 8 least significant bits.
    - 0 = The service IDs in this linkage set represent a single service.
    - 1 = The service IDs in this linkage set represent upto 12 services.
  - LINK_TYPE[5:4] - Indicates the link type for all links in linkage set segment 0. Note: If a linkage set contains multiple link types and the LINKTYPEEN bit of the ENABLE parameter is cleared multiple linkage set segments may be returned (up to 4) for a given linkage set. If LINKTYPEEN is set only one linkage set segment is returned for each LSN which corresponds to the link type selected in the LINKTYPE field of the SELECT parameter.
    - 0 = Link IDs are a DAB/DMB service IDs.
    - 1 = Link IDs are a RDS PI-codes.
    - 2 = Link IDs are a AM or FM services (currently not used).
    - 3 = Link IDs are a DRM or AMSS services.
  - RSVD2 - Reserved OE currently always 0.
  - RSVD1 - Reserved P/D
  - HARD - Indicates if the links in linkage set segment 0 are soft or hard links.
    - 0 = Links in this linkage set segment are soft links. This type of link carries service information that are related to SERVICEID.

  - 1 = Links in this linkage set segment are hard links. This type of link carries the same primary service as SERVICEID.
- ILS - Indicates if the links in linkage set segment 0 are national or international.
  - 0 = Link is a national link.
  - 1 = Link is an international link.
- NUM_LINKS_0[7:0] - The number of links returned in linkage set segment 0.
- LINKID_0_0[31:0] - The first link ID of linkage set segment 0. This field gets repeated NUM_LINKS_0 times for each link in the linkage set segment.

- **Command**

DAB_GET_SERVICE_LINKING_INFO Command	7	6	5	4	3	2	1	0
CMD	0xB7							
ARG1	ACTIVE	0	LINKTYPE[1:0]		SELRSVD2	SELRSVD1	HARD	ILS
ARG2	ACTIVEEN	00		LINKTYPEEN	ENRESVD2	ENRESVD1	HARDEN	ILSEN
ARG3	0x00							
ARG4	SERVICEID[7:0]							
ARG5	SERVICEID[15:8]							
ARG6	SERVICEID[23:16]							
ARG7	SERVICEID[31:24]							

- **Reply**

DAB_GET_SERVICE_LINKING_INFO Reply	7	6	5	4	3	2	1	0
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	XXX			STCINT
STATUS1	RSVD	RSVD	DEVNTINT	RSVD	RSVD	RSVD	RSVD	RSVD
STATUS2	RSVD_STAT0[7:0]							
STATUS3	PUP_STATE[1:0]		RSVD	DSPERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	SIZE[7:0]							
DATA5	SIZE[15:8]							
DATA6	NUM_LINKSETS[7:0]							
DATA7	XXXXXXXX							
DATA8	LSN_0[7:0]							
DATA9	LSN_0[15:8]							
DATA10	ACTIVE	SHD	LINK_TYPE[1:0]		RSVD2	RSVD1	HARD	ILS
DATA11	NUM_LINKS_0[7:0]							
DATA12	LINKID_0_0[7:0]							

DATA13	LINKID_0_0[15:8]
DATA14	LINKID_0_0[23:16]
DATA15	LINKID_0_0[31:24]

8.2.9.3 DAB_GET_EVENT_STATUS

- Summary: *Gets information about the various events related to the DAB radio.*
- Purpose
  - DAB_GET_EVENT_STATUS gets information about the various events related to the DAB radio. These events include signaling the reception of new PAD (Programme-Associated Data) data, service lists and announcements. The bits SVRLISTINT, ANNOINT, RECFGWRNINT, and RECFGINT are sticky meaning they will remain set until EVENT_ACK is set. If the condition is still true after the interrupt is cleared another interrupt will fire assuming that bit is enabled in DAB_EVENT_INTERRUPT_SOURCE.
- **Parameters**
  - EVENT_ACK - Clears all pending digital radio event interrupts.
    - TYP = 0
- **Response**
  - RECFGINT - Ensemble reconfiguration event. Indicates that an ensemble reconfiguration has occurred. All changes to the service list that occured after the RECFGWRNINT event will now take effect. If a service that was in operation no longer exists it will be stopped. All other services that did not change should remain active accross the reconfiguration boundary. At this time the host should communicate any relevant changes to the user.
  - RECFGWRNINT - Ensemble reconfiguration warning. Indicates that an ensemble reconfiguration will occur in 6 seconds. From this point on all service list updates will apply to the new ensemble configuration. These changes will not take effect until the RECFGINT is received. At this time the host act upon all changes in the service list.
  - ANNOINT - Announcement information interrupt. Indicates that an announcement event (started or stopped) is available. The event is retrieved with the DAB_GET_ANNOUNCEMENT_INFO command.
  - OESERVINT - Other Ensemble (OE) Services interrupt. Indicates that new OE service information is available or has changed. The other ensemble information is retrieved with the DAB_GET_OE_SERVICES_INFO command.
  - SERVLINKINT - Service linking information interrupt. Indicates that new service linking information is available or has changed. The service linking information list is retrieved with the DAB_GET_SERVICE_LINKING_INFO command.
  - FREQINFOINT - New Frequency Information interrupt. Indicates that new Frequency Information is available. The Frequency Information list is retrieved with the DAB_GET_FREQ_INFO command. The rate at which frequency information interrupts can occur is defined by the DAB_EVENT_MIN_FREQINFO_PERIOD property.
  - SVRLISTINT - New service list interrupt. Indicates that a new digital service list is available. The new service list is retrieved with the GET_DIGITAL_SERVICE_LIST command.
  - ANNO - Announcement available.
    - 0 = No announcement is active.
    - 1 = One or more announcements are active.
  - OESERV - Indicates that OE service information is available (FIG0/24). The OE service information is retrieved with the DAB_GET_OE_SERVICES_INFO command.

- SERVLINK - Service linking information (FIG 0/6) available. Indicates that service linking information is available. The service linking information list is retrieved with the DAB_GET_SERVICE_LINKING_INFO command.
- FREQ_INFO - Frequency Information (FI) (FIG0/21) available. Indicates that Frequency Information (FI) is available. The FI list is retrieved with the DAB_GET_FREQ_INFO command.
- SVRLIST - Service list available. Indicates that a digital service list is available. The service list is retrieved with the GET_DIGITAL_SERVICE_LIST command. If a service list is not available or it is in transition, this bit will be low. When the service list is in transition, this bit will remain low until the service list debounce timer has expired. See the DAB_EVENT_MIN_SVRLIST_PERIOD property for more details.
- SVRLISTVER[15:0] - Indicates the current version of the digital service list. This field is incremented by 1 each time the service list is updated. The host can use this field to help determine if a new service list needs to be collected.

- **Command**

DAB_GET_EVENT_STATUS Command	7	6	5	4	3	2	1	0
CMD	0xB3							
ARG1	0000000							EVENT_ACK

- **Reply**

DAB_GET_EVENT_STATUS Reply	7	6	5	4	3	2	1	0
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	XXX			STCINT
STATUS1	RSVD	RSVD	DEVNTINT	RSVD	RSVD	RSVD	RSVD	RSVD
STATUS2	RSVD_STAT0[7:0]							
STATUS3	PUP_STATE[1:0]		RSVD	DSPEERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	RECFGINT	RECFGWRNINT	X	ANNOINT	OESERVINT	SERVLINKINT	FREQINFOINT	SVRLISTINT
DATA5	XXX			ANNO	OESERV	SERVLINK	FREQ_INFO	SVRLIST
DATA6	SVRLISTVER[7:0]							
DATA7	SVRLISTVER[15:8]							

8.3 DAB API 5.0.3

8.3.1 DRC

8.3.1.1 DAB_GET_AUDIO_INFO

- Summary: *Gets audio service info*
- Purpose
  - DAB_GET_AUDIO_INFO gets information about the current audio service (decoder bps, audio mode).
- **Response**
  - AUDIO_BIT_RATE[15:0] - Audio bit rate of the current audio service (kbps).
  - AUDIO_SAMPLE_RATE[15:0] - Sample rate of the current audio service (Hz).
  - AUDIO_PS_FLAG - Audio PS flag. only applicable to DAB+. Set to 0 for DAB
    - 0 = SBR is not used
    - 1 = SBR is used
  - AUDIO_SBR_FLAG - Audio SBR flag. only applicable to DAB+. Set to 0 for DAB
    - 0 = SBR is not used
    - 1 = SBR is used
  - AUDIO_MODE[1:0] - Audio mode
    - 0 = dual
    - 1 = mono
    - 2 = stereo
    - 3 = joint stereo
  - AUDIO_DRC_GAIN[7:0] - The dynamic range control (DRC) gain that is applied to the current audio service. The range of this field is from 0 to 63, representing 0 to 15.75dB in increment of 0.25dB.

- **Command**

DAB_GET_AUDIO_INFO Command	7	6	5	4	3	2	1	0
CMD	0xBD							

- **Reply**

DAB_GET_AUDIO_INFO Reply	7	6	5	4	3	2	1	0
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	XXX			STCINT
STATUS1	x	x	DEVNTINT	x	x	x	x	x
STATUS2	xxxx							
STATUS3	PUP_STATE[1:0]		RFFE_ERR	DSPERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	AUDIO_BIT_RATE[7:0]							
DATA5	AUDIO_BIT_RATE[15:8]							
DATA6	AUDIO_SAMPLE_RATE[7:0]							

DATA7	AUDIO_SAMPLE_RATE[15:8]			
DATA8	XXXX	AUDIO_PS_FLAG	AUDIO_SBR_FLAG	AUDIO_MODE[1:0]
DATA9	AUDIO_DRC_GAIN[7:0]			
DATA10	XXXXXXXX			
DATA11	XXXXXXXX			
DATA12	XXXXXXXX			
DATA13	XXXXXXXX			
DATA14	XXXXXXXX			
DATA15	XXXXXXXX			
DATA16	XXXXXXXX			
DATA17	XXXXXXXX			
DATA18	XXXXXXXX			
DATA19	XXXXXXXX			

8.4 DAB 5.0.4

8.4.1 DAB_GET_OE_SERVICES_INFO

- Summary: *Provides other ensemble (OE) services (FIG 0/24) information for the passed in service ID.*
- Purpose
  - DAB_GET_OE_SERVICES_INFO provides the (FIG 0/24) other ensemble (OE) other services information for the passed in service ID. It provides the ensemble ID(s) in which the passed in service ID will reside. The passed in service IDs can be any service ID found in the current ensemble or a service ID from another ensemble. In general the passed in service ID is obtained using the DAB_GET_SERVICE_LINKING_INFO command with the DAB SID option or can be any service ID in the current ensemble. Please see ETSI TS 103-176 for full details regarding OE Services and service linking. This command is intended to be used in conjunction with the DAB_GET_SERVICE_LINKING_INFO and DAB_GET_FREQ_INFO commands to paint a complete service linking picture. Note: this command may be used alone to determine if an other ensemble is carrying exactly the same service as one existing in the current ensemble.
- **Parameters**
  - SERVICEID[31:0] - The service ID for which the OE EIDs are needed. This service ID can be an ID from the current ensemble (find exactly the same service) or one returned by DAB_GET_SERVICE_LINKING_INFO command.
- **Response**
  - SIZE[15:0] - The total number of bytes returned in the service linking information payload.
  - NUM_EIDS[7:0] - The total number of ensemble IDs returned in the response payload.
  - EID_0[15:0] - The first EID returned. This field gets repeated NUM_EIDS times.
- **Command**

DAB_GET_OE_SERVICES_INFO Command	7	6	5	4	3	2	1	0
CMD	0xC1							

ARG1	0x00
ARG2	0x00
ARG3	0x00
ARG4	SERVICEID[7:0]
ARG5	SERVICEID[15:8]
ARG6	SERVICEID[23:16]
ARG7	SERVICEID[31:24]

- **Reply**

DAB_GET_OE_SERVICES_INFO Reply	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
STATUS0	CTS	ERR_CMD	DACQINT	DSRVINT	XXX			STCINT
STATUS1	x	x	DEVNTINT	x	x	x	x	x
STATUS2	xxxx							
STATUS3	PUP_STATE[1:0]		RFFE_ERR	DSPERR	REPOFERR	CMDOFERR	ARBERR	ERRNR
DATA4	SIZE[7:0]							
DATA5	SIZE[15:8]							
DATA6	NUM_EIDS[7:0]							
DATA7	XXXXXXXX							
DATA8	EID_0[7:0]							
DATA9	EID_0[15:8]							