Improving the PAG KDB Inquiry Process

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Introduction

- Following up on the October 2023 TCB workshop, a revised format for submitting PAG Inquiries has been presented in KDB Publication 388624-D01

- The new format is designed to streamline the filing of the manufacturer's data and simplify both the TCB and FCC reviews.

- The key point is to provide all the information for the review in the PAG inquiry, while larger files are provided in EAS as a compliance document of record

- PAG inquiries may point to their own file attachments to show the analysis that shows that the PAG guidance has been followed, thus speeding up the review process.

- For that purpose, PAG attachments may report data/analyses pertinent only for the PAG checklist, e.g., discussing relevant worst-case scenarios.

PAG KDB Inquiry Format Changes (I)

- Goal: easier/faster PAG/MPAG reviews.

- Approach: the KDB Inquiry that refers to the (M)PAG shall contain **all** the necessary pointers to information required for the review, either in the main body and/or in the attachments, depending on the complexity.

- Typically, the PAG review needs only a **small subset** of the content uploaded in EAS (there might be allowed exceptions, where large datasets are needed).

- Rule-of-thumb: if it does not address the PAG, it does not need to be in the inquiry
  - Examples: calibration data, large tables showing details with measurements well-below the limits, compliance-related plots, etc., do not need to be filed with the KDB Inquiry

- The content uploaded in EAS represents the formal document of record for full compliance demonstration purposes.

- The KDB Inquiry shall provide a top-down approach to guide the review:

  – What is it? Description of the device functionality and main, relevant specs.

  – Why the PAG? Description of the PAG item(s) and of what triggers the PAG (or each PAG)

  – How is it compliant? Follow a checklist style (either FCC-provided, or if applicant-devised)

  – Summary/concluding remarks

- In most cases, the information for the review shall be organized in attachment files:

  – A PAG Summary Table to connect the attachments/PAG items to the various TC numbers

  – Use attachments with self-describing names: reviewers do not need to search for information

  – Clearly point to the pertinent attachments in the main body of the Inquiry

  – Within the attachments, clearly separate PAG items and/or related checklist items
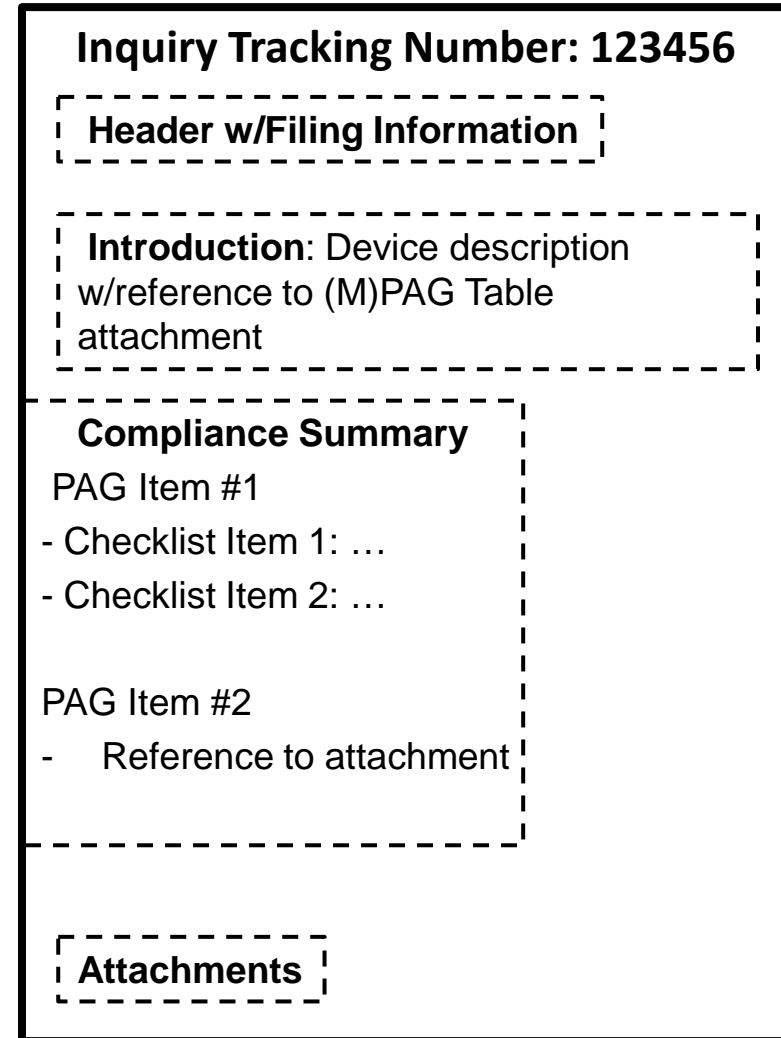
High-level format (in the KDB Inquiry text section)

- **Header and Introduction:**
  - Address what/why questions (see previous slide)
  - Attachment for device documentation is ok, but provide the essential information
  - Leverage info from the summary (M)PAG table

- **Compliance Summary**
  - For each PAG item, show how each checklist item is being addressed (pointing to file attachments, as needed).
  - Reviewers don't know which attachment pertains to what item

Inquiry Tracking Number: 123456

Header w/Filing Information

Introduction: Device description w/reference to (M)PAG Table attachment

Compliance Summary

PAG Item #1
- Checklist Item 1: …
- Checklist Item 2: …

PAG Item #2
- Reference to attachment

Attachments

- For each checklist item provide

  - the essential narrative on what was done

  - set of plots, and/or tabular data demonstrating compliance in a compelling fashion

  - do not expect the reviewer to find out where/how compliance is demonstrated

- As needed, only for accessory/additional information, or truly required large files, provide reference to the pertinent EAS exhibits

  - Attachments in the PAG Inquiry must be a streamlined version of the EAS exhibit data

  - PAG attachments shall use consistent pointers to EAS file descriptors, (use the same file descriptors appearing in EAS)

1. **For frequencies up to 8500 MHz provide spatial peak SAR evaluation based on …**

The DUT operates in the 5925-7125 MHz range. Accordingly, per OVER6G Checklist in KDB 388624-D02, spatial peak SAR evaluation is provided. SAR evaluation for both head and body exposure configurations are considered, as determined by DUT design and use conditions.

Head SAR

The SAR head test was performed according to the phantom positioning in Figures 1 and (per KDB 123456 guidance) with a test separation distance of 5 mm (see [1] page 34).

Figure 1 - Phantom Head SAR Test Photo 1

Figure 2 - Phantom Head SAR Test Photo 2

The maximum reported SAR over all applicable bands is 1.2 W/Kg at 6300 MHz, band *xx*. The overall device tolerance for those operating conditions is 0.1 W/Kg, with an actual evaluated SAR of 1.1 W/Kg (see [1] page 45).

…

2. This policy considers a device compliant for Equipment Authorization purposes, so long as the SAR …

Based on the data in the previous item 1., the DUT is therefore RF Exposure compliant for single-transmitter operations.

The DUT is also RF Exposure compliant for simultaneous transmission: evaluations (see [2], page 171), yielded a maximum TER=0.91 from the operations of bands *xx (UNII, freq. range .…), yy (BLE, freq. range .…)* and *zz (LTE, freq. range .…).*

Table 1 - Simultaneous Transmissions - Largest TER

Technology	Band	RFX Test	TER			

The DUT is then compliant for all its modes of operation.

…

References

[1] Application TC123456, RF Exposure exhibit "SARTest1234_Part5"

[2] Application TC123456, RF Exposure exhibit "SARTest1234_Part7"

1. Provide an analysis demonstrating how the proposed duty factor is effectively maintained…

The DUT operates between 3200 and 3250 MHz; it was tested at 100 % duty factor using a factory test mode that disables the off-time via firmware upload.

The DUT RF exposure compliance requires 1-g SAR evaluation on a flat phantom; the maximum reported 1-g SAR level was found to be 2.1 W/Kg at 3210 MHz. A duty factor as high as 70% is implemented in the transmitter to limit the average power over a 1-second window, thus well below the time averaging requirements for equipment authorization (re-affirmed in TCB Workshop Oct. 2023, 4.1, page 11).

The duty factor used by the transmitter is hardcoded by design, using digital logic and hardware components on the PCB to determine the on-off durations. (See *xyz* chip and annex component in the schematic of page 23 of [1].

2. Show how the design inherently protects alterations of the maximum duty factor …

Based on the previous item 1., the duty factor changes would require very specialized knowledge and tools, as well as alteration of the device integrity.

3. Provide RF exposure evaluations related to the maximum achievable duty factor condition …

At the 70% maximum achievable duty factor, the maximum SAR is 1.44 W/Kg at 3210 MHz ([1] page 83).

References

[1] Application TC123456, RF Exposure exhibit "20241016MySARReport1234"

1. Contention Based Protocol (CBP)

1.1 CBP testing shall be performed on one channel in each U-NII sub-band of operation for both the narrowest and widest bandwidths.

The DUT operates between xxxx and yyyy MHz. The sub-bands of operations, selected test channels and bandwidths are shown in Table 1 (excerpt from [1], page 45).

Table 1

Sub-band	Frequency (MHz)	Channel
Narrowest	aaaa - bbbb	3
Widest	cccc - dddd	6

1.2 When testing a 160 MHz channel or wider, use three separate 10 MHz AWGN signals. The simulated incumbent signal must also be a 10 MHz wide AWGN signal.

The Channels 5 bandwidth is 160 MHz (see previous Table 1). The three separate AWGN test signals and the simulated incumbent 10 MHz are generated according to the setup in Table 2 (see [1] page 123).

Table 2

AWGN	Bandwidth (MHz)	Feature 1	Feature 2
Test signal 1	xx MHz	…	…
Test Signal 2	xx MHz	…	…
Test Signal 3	xx MHz	…	…
Simulated Incumbent	10 MHz	…	…

Examples: Portion of UN6GHZ Checklist Attachment (II)

1.3 Report the lowest AWGN signal detectable by EUT.

Using the setup in Table 2, the EUT was able to detect a signal as low as -66 dBm, as shown in Figure 1 (from [1], pages 32-33)

Figure 1 – Detection of a -65 dBm AWGN test signal
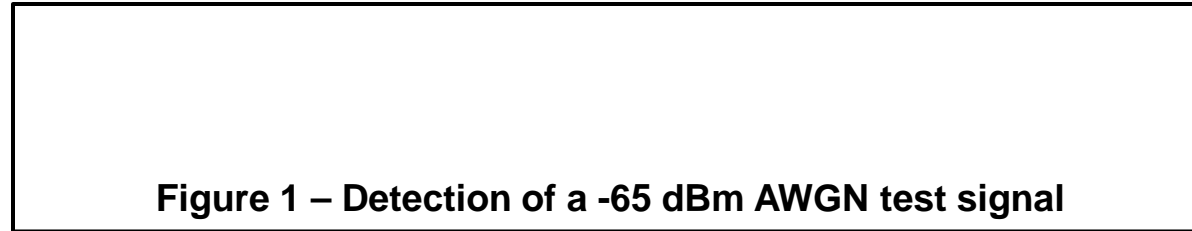
1.4 Verify that the testing was performed with the AWGN signal set to the lowest level (for example, 100 dBm) and increased until the EUT detects and stops transmitting.

The test progression was started from -100 dBm, increments of 10 dBm, and then reduced to 1 dBm from the 10 dBm step before when the EUT detected a signal, as follows:

-100 dBm; -90 dBm; -80 dBm; -70 dBm; -60 dBm => signal detected, re-start from -70 dBm

-70 dBm; -69 dBm; -68 dBm; -67 dBm; -66 dBm => signal detected

References

[1] Application TC123456, Test Report Exhibit "20241016MySetupReport1234"

"Unofficial" Checklist Based on KDB 996369 D01

- **Only if at least one** of KDB 996369 D01 Sect. 2.1 conditions applies, **then** the *Module* is suitable for a *Limited Module* grant and the MODLIM PAG is required.

- Example answers for all five listed requirements in KDB 996369 D01.

1. **Limited Modules with no RF shielding.**

   The Figure 1 shows the layout of the Module *xyz* (red circle on the PCB) showing lack of RF shielding (from [1], page 33)

   Figure 1 – Module with no RF shielding as mounted on the PCB

   A test plan for the host integrator is detailed in the file "*NoShieldTest.pdf*", provided as an attachment to this PAG KDB Inquiry.

(…Continued) "Unofficial" Checklist Based on KDB 996369 D01

2. No buffered modulation/data inputs.

The *Module* data inputs are processing directly (no buffering) digital raw data as provided, for example, from a digital image acquisition system. See schematic in [2], page 45 for more details.

3. Voltage Regulation

A test plan for the host integrator is detailed in the file "*VoltageRegulationTest.pdf*", provided as an attachment to this PAG KDB Inquiry.

4. Antenna LMA for Professional Host Installation

…

5. Module Can Not Be Tested in a Stand-Alone Configuration

…

References

[1] Application TC123456, Internal Photos Exhibit "20241016MyInternalPhoto1234"

[2] Application TC123456, Operational Description Exhibit "20241016MyLimitedModule1234_Part3"

KDB Inquiry Submission

Currently Displaying Inquiry Tracking Number: 123456

- Inquiry Details
- Correspondence
- Status History
- Data Change Report

Contact Information:

...

Inquiry Details on 09/26/2023:

First category:	PBA Submittal
Second category:	Multi-PAG
Subject:	MPAG for ABCDEF and GHIJKL (FCC ID XYZ0000001)

Text of Inquiry:

Pursuant to KDB 388624 D02 Pre-Approval Guidance List v18r03, we are hereby submitting a Pre-Approval request for this applications. MPAG Summary Table is included in the attachment 20230926_MPAG_123456_Summary Table

...

PAG Item ABCDEF

Devices incorporating … technologies except when ….
Checklist is provided in KDB Publication 000000 and all items are addressed here below

- **Checklist Item 1**

The proposed design has a maximum conducted of … mW thus it is below the limit considered for the ABCDEF PAG Item

- **Checklist Item 2**

The maximum channel bandwidth allowed by design is .. MHz, therefore meeting the requirement of the ABCDEF PAG Item

- **Checklist Item 3**

The spurious emissions are below the required mask, as shown in detail in the file *20230926_ ABCDEF_Item3_Spurious* herein attached

PAG Item GHIJKL

Devices incorporating … technologies except when ….
No checklist is currently provided for this PAG. The following items are then chosen by the applicant to address PAG

- **Item 1**

The device is equipped with … technology, following the … manufacturer specifications that were accepted in the KDB Inquiry … Accordingly, the device is exempt from the SAR testing, as discussed in the GHIJKL PAG Item

- **Item 2**

The power density was measured at the prescribed distances and was found less or equal to the 1 mW/cm² required in the PAG Item GHIKLM. Details of the measurements are provided in the attachment *20230926_ GHIKLM_Item2_PowerDensity*

….

Attachment List:

20230926_MPAG_123456_Summary Table
20230926_ABCDEF_Item3_Spurious
20230926_GHIKLM_Item2_PowerDensity

- In some instances, a PAG may not require extensive documentation: in that case supporting information for PAG item can be provided in the text of the Inquiry.

- For example, the PAG KDB Inquiry may look like the following:

PAG Item <mark>ABCDEF</mark> - *Devices incorporating … technologies except when ….*

The checklist is provided in KDB Publication <mark>123456</mark> and all items are addressed here below

- **Checklist Item 1**
–The proposed design has a maximum conducted power of … mW, thus it is below RF exposure test exemption threshold that is required for the <mark>ABCDEF</mark> PAG Item
- **Checklist Item 2**
–The maximum channel bandwidth allowed by design is .. MHz, therefore meeting the requirement of the <mark>ABCDEF</mark> PAG Item

    ….

- An MPAG KDB Inquiry may also have a separate attachment for each PAG item, with a clearly self-identifying filename, for example:

PAG Item GHIJKL: *Devices incorporating … technologies except when ….*

No checklist is currently provided for this PAG. The following items are then chosen to address PAG:

- **Item 1** - The device is equipped with … following…. that were accepted in the NAG KDB Inquiry ….. Accordingly, the device is exempt from the SAR testing, as per provision outlined in the GHIJKL PAG Item1

- **Item 2** - The power density was measured at the prescribed distances and was found less or equal to the 1 mW/cm^2 required in the PAG Item GHIKLM. Details of the measurements are provided in the attachment *20231024_GHIKLM_Item2_PowerDensity*

- **Item 3** - The spurious emissions are below the required mask, as shown in detail in the file *20231024_GHIKLM_Item3_Spurious* herein attached

….

Attachment List:

MPAG123456_Summary Table

MPAG123456 _GHIKLM_Item1

MPAG123456 _GHIKLM_Item2_PowerDensity

MPAG123456 _GHIKLM_Item3_Spurious

General Template for the PAG Inquiry (IV)

- The compliance narrative section (and related file attachments) shall only contain information related to one particular PAG item: no additional material unrelated to the PAG shall be included.

- File attachments must refer to checklists, either posted by the FCC provided, or with applicant-proposed checklist.

- File attachments shall be organized in sections, each referring to a particular element of the checklist, or to the list of items that the applicant chooses to provide.

- Any additional information required as a document of record for compliance purposes shall be included in the report(s) filed in EAS.

MPAG Table Format

- Example of MPAG Inquiry with three PAG items, pointing to the KDB Inquiry attachments (as opposed to EAS files, unless required).

#	PAG Item	Description		FCC Guidance	KDB Attachment
1	PWRDYN	RF Exposure. TAS implementation		Pub. 388624 Inquiry 123456	111222_PWRDYN_RF_Exposure_Evaluation 111222_PWRDYN_TAS_Verification
2	UN6GHZ	EMC. Contention-based protocol.		Pub. 987594 D02 Pub. 987594 D04	111222_UN6GHZ_....
3	WAIVER	HAC guidance for handsets certified under the waiver DA 23-914		KDB 285076 D05	111222_WAIVER_….

- The Summary Table is now focused on the KDB Inquiry file attachments/content.

- A simple "Summary Table" (especially for single PAG, or small MPAGs) may also be typed line-by-line in the PAG inquiry main test body.

- EAS exhibits are indirectly referenced through the information in the PAG inquiry (in the pertinent file attachment, or in the text main body of the PAG Inquiry).

- TC application numbers are listed in the main body of the inquiry to guide the EAS release after the review is complete.

Transition to the New PAG Format

- Some flexibility is being now provided to help the transition to a full implementation of the 388624-D01 guidance (in effect since Aug. 1, 2024).

- The examples that have been discussed here for the PAG format are suggestions that can be freely adapted, while preserving the goal of providing all the information in the PAG Inquiries.

- More, example-based guidance will be provided to supplement PAG checklists, as well as will be included in future new PAG items, as needed.

Conclusions

- Improved format for PAG KDB Inquiry will provide self-contained documentation for the review

- Will help TCB in their review and checking PAGs before they are sent to the FCC

- Better FCC processing: application of the new format leads to faster reviews…

- Feedback and suggestions are welcome and will be accounted for.

- We have already seen good work in progress toward implementing the new guidance: thank you for those submissions!