

**Federal Communications Commission
Office of Engineering and Technology
Laboratory Division**

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TEST REDUCTIONS VIA DATA REFERENCING

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1. INTRODUCTION

This publication provides guidance on the conditions under which FCC equipment certification applications are permitted to include exhibits that use test data that pertain to a different, fully tested RF device (referred to as “parent” or “reference” device) and featuring the same transmitter¹. For clarity, this process is referred to as "data referencing" (in this context, the older terminology "reuse" is deprecated).

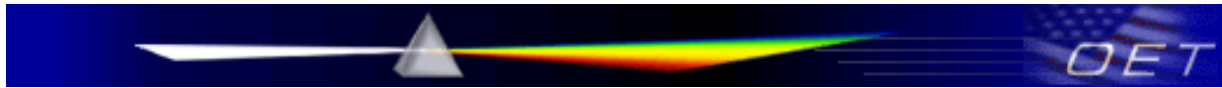
The devices for which the data referencing is used are named “variants”, and shall use materials, form factors, functions, printed circuit board (PCB) layouts, and components that are the same as the “reference” device. This procedure requires first that a manufacturer (or their agent) obtains FCC acceptance of the proposed data referencing plan; this shall be accomplished by submitting a KDB inquiry (not a PAG²) under the Equipment Compliance Review (ECR³) procedure, as described further below in this document.

It is important to emphasize that Data Referencing is about establishing that a report from another device (the reference device) is sufficient to represent the variant device for the purpose of compliance pertaining to the test for which the Data Referencing was applied. That is the main purpose of establishing (Section 3) the maximum deviations from the referenced data allowed for the variants.

¹ The “same transmitter” refers to electronic circuits using identical parts, layout, and pin assignments.

² The Pre-Approval Guidance (PAG) is discussed in [KDB Publication 388624](#)

³ The Equipment Compliance Review (ECR) procedure KDB Publication 951290



The key elements of the data referencing process are as follows:

- Reference Device. An original device that provides compliance test data to be used in the application for certifications for other, similar, devices.
- Variant Device (variant). An RF device designed based on a reference device, with variations due to population, depopulation⁴, or replacement of components. A variant may have a different FCC ID from the reference device, or be a different model of the reference device with the same FCC ID.
- Data Referencing Applicability. As compared to the reference device, the model variants must feature common form factors, materials, functions, PCB layout, and components for all transmitter hardware. The manufacturer defines which is the reference model, and which are the variants, but that needs to obtain FCC acceptance (as part of the ECR KDB 951290 Inquiry process).
- Spot-Check Plan. The process requires the definition of a spot-check test plan that provides the criteria for accepting or discarding the referenced data for use with the variant devices. This plan needs to obtain FCC acceptance (through the same aforementioned ECR KDB 951290 Inquiry process).
- Applicant Responsibility. All data referencing proposals shall contain a justification statement as to why the choice of referencing the data is appropriate (as discussed in Section 3 below). FCC acceptance of the data referencing proposal does not waive the applicant's full responsibility in stating that the filed certification data properly demonstrate FCC compliance of the variant devices.
- Test Report Format. Filings for certification of a variant device shall be provided with a full test report that integrates both the data being referenced and spot-check data, as required in Section 4 below. In addition, when there are compliance requirements for which data referencing is not applied, data from a full test shall be included. For instance, an RF exposure data referencing plan may refer only to SAR testing, while for frequencies above 6 GHz full testing is done to provide power density data.

2. GENERAL GUIDANCE

Data referencing for both EMC test data (that includes DFS⁵) and RF Exposure requires case-by-case FCC acceptance obtained via ECR⁶ KDB Inquiry submitted by the applicant/agent. Presently, data referencing for Hearing Aid Compatibility (HAC) testing is not allowed. Also, RF exposure data referencing for Power Density test data for frequencies above 6 GHz, is not allowed.

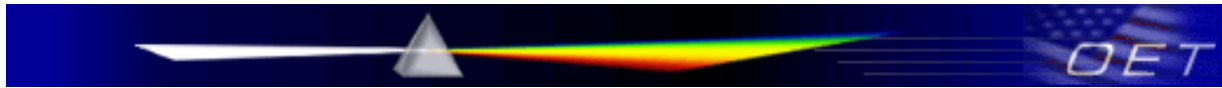
This guidance applies to variations of a product either considered under separate FCC IDs or in some cases, different models under the same FCC ID when certified as an initial application⁷. Different versions of a

⁴ In this context, “population” (“depopulation”) refers to the insertion (removal) of some RF device components.

⁵ DFS – Dynamic Frequency Selection

⁶ See [Section 5](#) of this document.

⁷ After initial certification, changing a device through insertion, removal, depopulation, or relocation of significant components is not permitted under § 2.1043 (as a Class I or II permissive change) and requires a new application. 47 CFR 2.907(b) Certification pertains to all units subsequently marketed by the grantee that are identical (see § 2.908) to the sample tested, except for permissive changes or other variations authorized by the Commission under § 2.1043.



product may be considered under the same FCC ID, but only when the initial certification includes all the versions, and the differences are typically due to insertion, removal, or relocation of some components.

A Data Referencing ECR inquiry may be acceptable for a variant device that, as compared to its reference device, shows only minor differences between components and PCB trace routing, for instance, to meet a new pin layout for a different integrated circuit, while most of all other components and overall layout remain the same. The final establishment of what constitutes an acceptable “minor” difference is provided by the FCC, based on best engineering judgment and data provided in the justification narrative by the applicant. In general, the guiding principle for the acceptance of a data referencing proposal is based on the assessment that the modifications in the variants are not significantly affecting the RF emissions pertaining to the tests for which the data from the reference device is going to be applied.

More specifically, a device variant may be considered acceptable if it can be shown that all the changes in the device result only in “small differences” in the EM emissions patterns for all the frequencies related to the specific compliance test under consideration. Case-by-case considerations would apply for defining what the term “small differences” entails but, for instance, that could be the case for tests showing closely superimposed traces on a spectrum analyzer or oscilloscope. Also, differences that are in the same range as the tolerance declared in the product specifications may be acceptable.

In some cases, it may be permitted to propose referencing for a variant for EMC, but not for RF exposure (or vice versa, albeit less likely), due to the possible modifications in the near-field emissions patterns due to component and layout changes. This could be the situation when, as compared to the reference device, a model variant may show significant field pattern⁸ differences close to the antenna (typically, in the near-field), but small differences for radiated (typically, in the far field) and conducted emissions. In this case, data referencing may be allowed only for demonstrating compliance with EMC unwanted emissions limits requirements.

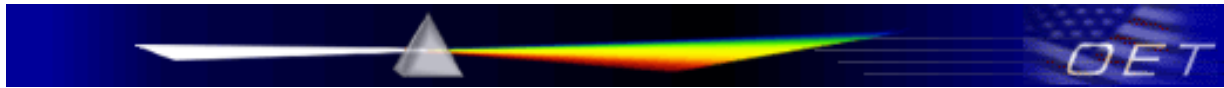
As another example, a variant device may show, as compared to the reference model, small differences in all the radiated field patterns that are relevant for RF exposure tests (that typically, for §2.1093-*Portable* devices, are those related to the near-field region). Then, in this case, data referencing may be allowed to show compliance with RF exposure requirements.

3. APPLICABILITY OF THE DATA REFERENCING PROCESS

The determination of whether a variant qualifies for data referencing is established by the FCC in the reply to the ECR KDB. As it was stated, the basic (and of qualitative nature) requirement is that, as compared to the reference model, variant devices for the most part must be characterized by the same materials, form factor, functions, PCB layout, and components.

Under 47 CFR 2.908, the term “identical” means “the same within the variation expected to arise due to quantity production techniques”.

⁸ In this context, field patterns may be estimated through any combination of testing, numerical simulation, or analytic models.



Additionally, the reference device shall:

- Be selected as the version that is “fully populated”, or at least the one that contains the majority of the components or mode of operations/features to be tested. Data referencing for variants derived from a fully populated version are more likely to be accepted.
- Undergo full compliance testing, as required for certification under the specified rule part(s).
- Variants may be eligible for certification when filed as new applications under separate FCC IDs using data referencing, which can be for EMC and/or RF exposure test data (see Fig. 1).

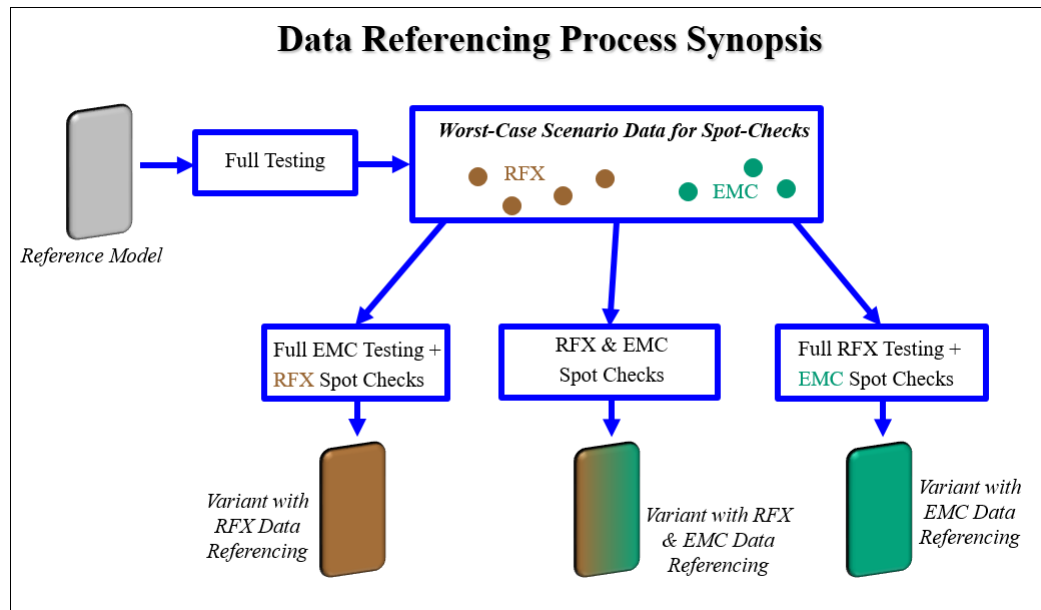


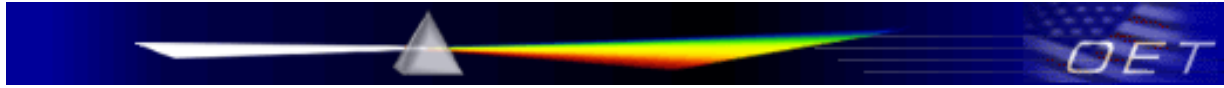
Figure 1 – Synopsis of the data referencing process. The reference model is fully tested and yields the worst-case scenarios for both EMC and RF exposure (RFX) compliance. Variants can either refer to EMC data, RFX data, or both, as obtained from the reference model. Accordingly, spot-check plans shall be set in place to test the variants for the conditions leading to the worst-case(s) identified in the reference model full testing.

The variant filings must demonstrate that the referenced test data remain valid for the variant device by including spot-check measurements that meet the following criteria:

- Spot-check measurements shall be made in correspondence to the worst-case scenario reported in the reference device filing, i.e., for those conditions that are the closest to non-compliance.
- Spot-check measurements, while being always compliant with the applicable rule part(s) for the test under consideration, may show a deviation d_{dB} from the reference data no larger than 3 dB (applicable for both field and power quantities):

$$d_{dB} = |V_{dB} - R_{dB}| \leq 3 \text{ dB}, \quad (1)$$

where V_{dB} is the variant spot-check level in dB, and R_{dB} is the corresponding measurement level



in dB for the reference model.

- An alternative to the limit of eq. (1) is available, and is based on considering how far the reference data R_{dB} is from the compliance threshold C_{dB} (also expressed in dB), for the particular test under consideration. In this case, if $M_{dB} = |C_{dB} - R_{dB}|$ is the margin in dB from the compliance limit, a spot check may be considered acceptable when the deviation d_{dB} from the reference data satisfies the following condition:

$$d_{dB} = |V_{dB} - R_{dB}| \leq (3 + M_{dB}/20) \text{ dB} \quad , \text{ for } 0 \leq M_{dB} \leq 60 \text{ dB} \quad . \quad (2)$$

$$d_{dB} = |V_{dB} - R_{dB}| = 6 \text{ dB} \quad , \text{ for } M_{dB} > 60 \text{ dB}$$

When using the option in eq. (2), d_{dB} increases linearly from 3 dB to 6 dB (as shown in Fig. 2):

- for $M_{dB}=0$ dB, then $d_{dB}=3$ dB, that is when R_{dB} is right at the compliance threshold C_{dB} , thus the margin $M_{dB}=0$ and the variant can only be allowed to go lower than R_{dB} ;
- for $M_{dB}=60$ dB, then $d_{dB}=6$ dB, i.e., the reference model data is 60 dB below the compliance threshold M_{dB} .

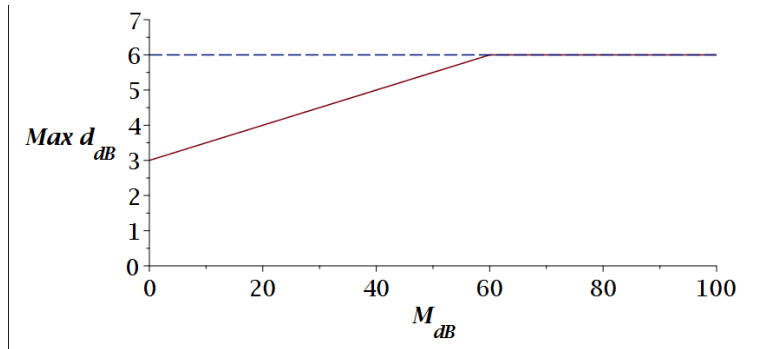


Figure 2 – The piecewise linear function for the maximum spot-check deviation, as given by eq. (2)

Example.

For a particular EMC test, the compliance threshold is $500 \mu\text{V/m}$ ($C_{dB}=54 \text{ dB}\mu\text{V/m}$), the reference model test shows a worst case of $100 \mu\text{V/m}$ ($R_{dB}=40 \text{ dB}\mu\text{V/m}$), while the variant spot-check yields $150 \mu\text{V/m}$ ($V_{dB}=43.5 \text{ dB}\mu\text{V/m}$). Then

$$d_{dB} = |43.5 \text{ dB}\mu\text{V/m} - 40 \text{ dB}\mu\text{V/m}| = 3.5 \text{ dB} > 3 \text{ dB},$$

and the variant is not acceptable according to the criterion of eq. (1). However, considering that

$$M_{dB} = |C_{dB} - R_{dB}| = 54 \text{ dB}\mu\text{V/m} - 40 \text{ dB}\mu\text{V/m} = 14 \text{ dB},$$

by applying eq. (2) it is found:

$$d_{dB} < 3 + M_{dB}/20 = 3 + 14/20 = 3.7 \text{ dB} .$$

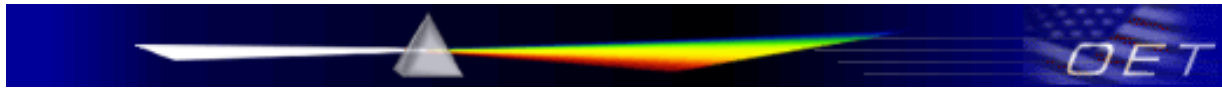
Accordingly, based on the evaluation with the eq. (2) the variant can be accepted because $d_{dB}=3.5 < 3.7$. In a different situation, a lower compliance threshold of $250 \mu\text{V/m}$ ($C_{dB}=48 \text{ dB}\mu\text{V/m}$) is considered. In this case

$$M_{dB} = 48 \text{ dB}\mu\text{V/m} - 40 \text{ dB}\mu\text{V/m} = 8 \text{ dB},$$

and by applying eq. (2) it is found:

$$d_{dB} < 3 + M_{dB}/20 = 3 + 8/20 = 3.4 \text{ dB} .$$

Accordingly, based on the evaluation with the eq. (2) the variant cannot be accepted because $d_{dB}=3.5 > 3.4$.



Finally, it should be noted that using dB for specifying the maximum deviation from the reference data leads to an asymmetry in linear units: for instance, a field quantity that increases by 3 dB corresponds to an increase of about 41.4% in linear units. However, a decrease of 3 dB corresponds to a decrease of about 29% in linear units. This asymmetry is partially compensated for by the fact that the variant spot-checks are constrained by the upper limit provided by the compliance threshold, and by an overall simplification of how the process is implemented.

4. FILING REQUIREMENTS

Applications for variants deemed eligible for the data referencing process (i.e., after they received acceptance through a reply to the pertinent ECR KDB inquiry) must meet the following requirements:

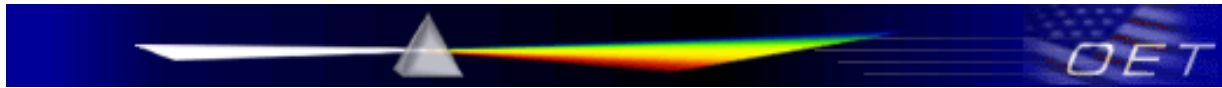
- Filings must contain a full complement of test reports and exhibits, including test data from the referenced device, *i.e.*, the filings shall be self-contained, and no pointers or references to other filings are acceptable.
- Filings must contain sufficient information that clearly distinguishes the test data being referenced from the data that instead refer to the actual test on the variant device (either related to spot checks or to tests for which data referencing is not applied).
- For variant applications seeking to reference DFS test data, a detailed description is required to address spot check testing in relation to the guidance in KDB Publication 905462 for UNII DFS Compliance Procedures.
- Data referencing is permitted only for devices under the same grantee code. In case of multiple Grantees (i.e., when a change of FCC ID was approved per §2.933) each Grantee may only use Data Referencing among the FCC ID's that they own.

5. EQUIPMENT COMPLIANCE REVIEW (ECR) KDB INQUIRY

The “Equipment Compliance Review” (ECR) is a KDB inquiry category that refers only to those cases where an inquiry submission is specifically requested by the FCC in a published procedure. ECR KDB inquiries are to be used only for providing information as requested by FCC procedures concerning some specific aspect of equipment authorization compliance.

The submissions of ECR KDB Inquiry for Data Referencing shall meet the following criteria:

- a) Selecting “Equipment Compliance Review (ECR)” for the first category, and “Data Referencing” for the second category. Choosing the incorrect category will require correction, thus delaying the process.
- b) Only the grantee/applicant of the reference device, may submit a Data Referencing ECR. The applicant may also choose to have a test laboratory, TCB, or other authorized agent submit an ECR on their behalf. Test data can only be referenced within applications under the same Grantee Code. The chosen reference device must be certified for the same grantee, or a change in ID, under Section 2.933, must be filed for the reference device.
- c) The applicant, upon receiving a positive FCC reply to the ECR inquiry (*i.e.*, FCC “acceptance”), can



contact a TCB providing all the required information (e.g., test data) required for the Form 731 applications. This shall be done for the reference model (if not certified yet) and for the variant devices.

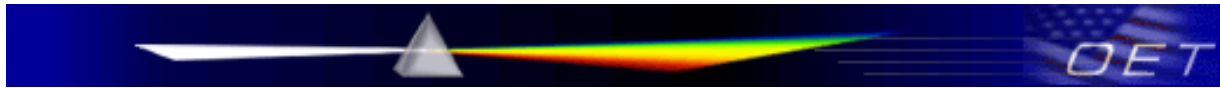
- d) ECR acceptance by the FCC does not represent an endorsement of the validity, or accuracy of the data presented. It is only a technical testament that the variant device meets data referencing requirements.
- e) A copy of the ECR KDB inquiry (showing FCC acceptance) shall be provided to the TCB and uploaded with the Form 731 exhibits as a supporting justification for the data referencing process. The ECR inquiry can be uploaded as a long-term confidential exhibit if needed. TCBs are entitled to a separate KDB inquiry to the FCC, to confirm the validity of the ECR, or any statement therein.
- f) A new, separate, and complete ECR is required pertaining requests for additional variants, or a change of FCC ID for a reference model that was certified for a different grantee.

An ECR KDB Inquiry for Data Referencing shall include the following information (either in the Inquiry main text or in the form of an attachment, as necessary for improved clarity).

- *Introduction.* An introductory statement identifying the device to be referenced, equipment classes, rule parts, and frequency bands. This statement must indicate that the applicant takes full responsibility for the fact that the test data as referenced represents valid data for demonstrating compliance for the variants listed in the application. As mentioned above, the FCC acceptance does not constitute a validation of the data used in the referencing process.
- *Justification.* A brief description of the component and operational differences between each variant and the reference device, clearly explaining why the variant qualifies for data referencing, and specifically for which rule part/test method. To avoid unnecessary review efforts and delays in the approval decision, special care should be taken to write the justification exhibit(s), which should be detailed, and easy to follow.
- *Illustrations.* Side-by-side photos/illustrations of variant and reference devices with annotations that provide the required explanations in terms that should be clear to a reviewer who is not familiar with the specific design of the devices.
- *Spot Check Test Plan(s).* Test plan(s) based on the worst-case (see footnote 6) scenarios, defined by scanning all conditions of operations for the reference model. As needed, these test plans will be, in general, tailored to the specific test (RF exposure and/or EMC) for which the Data Referencing is being considered, and should always include the acceptance criteria for the outcome of the spot check test.

In general, a spot check may yield a significant difference (error quantified in linear units, not dB) between the data measured on the variant and the data that were measured (for the same conditions). Spot-check deviations larger than allowed by formulas (1) or (2) in Section 3, are not acceptable, and the specific test for that variant shall be performed in full. A failing spot check for a particular test does not invalidate the data referencing applicability of all the other tests being considered (see examples in Section 7).

The format and amount of spot-check testing are at the discretion of the applicant's engineering judgment based on their knowledge of the device design. Since the grantee is responsible for continued compliance, spot test plans should establish with high confidence that the variant device will continue to be compliant with all relevant rule parts.



6. FILING FOR GRANT OF CERTIFICATION

As previously outlined, once the ECR KDB has received FCC approval, the manufacturer (or the selected FCC-recognized test laboratory), in order to proceed with the equipment certification, shall supply all the test information to the TCB: this will include the full set of test data for the reference model, additional test data for the variants for the tests for which no data reference is applied, and the test data corresponding to the spot-check measurements.

In addition, the TCB shall receive a copy of the approved ECR KDB (with all the attachments) and a cross-reference table to simplify the data verification. This table provides a synopsis of the compliance test data that are being provided for each variant and shows what data are from full testing and what has been referenced. The table shall reference the test report file name (as uploaded in Form 731), and the filing exhibit category (e.g., “Test Report”, “RF Exposure”, etc.) where it was uploaded.

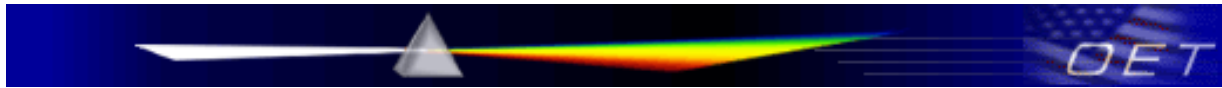
The TCB shall ensure that the file name and exhibit categories in the table correspond to the actual filing. An example of this cross-reference Table is provided below; the terminology “*Pointer to ...*” in the third column is a placeholder that refers to the information for locating the proper file among the uploaded exhibits.

Cross Reference Table Example

Reference Device	Variant Device	Key differences	
FCC ID ABCDE-123-0	FCC ID ABCDE-123-1	Removed components for 5.925–7.125 GHz U-NII band [<i>Pointer to variant description exhibit</i>]	
	FCC ID ABCDE-123-2	Removed Bluetooth components [<i>Pointer to variant description exhibit</i>]	

Rule Part	Test item	Data Referencing	Comments
15.205	Restricted Bands	N	Pointer to full test exhibit
15.207	Conducted Limits	Y	Pointer to spot-check exhibit
15.209	Radiated Limits	N	Pointer to full test exhibit
15.247(a)	6 dB Bandwidth	Y	Pointer to spot-check exhibit
...	...	...	...
15.407(g)	Frequency Stability	Y	Pointer to spot-check exhibit
15.407(h)	TPC and DFS	N	Pointer to full test exhibit
15.407(i)	Security	Y	Pointer to changes in Soft/Firmware

This example shows Cross Reference Table for two variants of the reference model (in this case, all the devices have different FCC ID), and for EMC data. Similar tables shall be compiled separately for cases where RF Exposure is considered. When a compliance test does not rely on referenced data, a full test report is required. “Pointers to ...” refer to the actual exhibit category (e.g., Test Report, RF Exposure) and the file name of the uploaded exhibit.



7. USE-CASE EXAMPLES

7.1 Multi-band Cellular Handset

A cellular telephone (handset) is certified for multi-band operations in the licensed Commercial Mobile Radio Services bands, e.g., Part 22, Part 24, Part 25, and/or Part 27 below 3 GHz. The reference model is certified for all the bands, the variants will use a reduced set of bands.

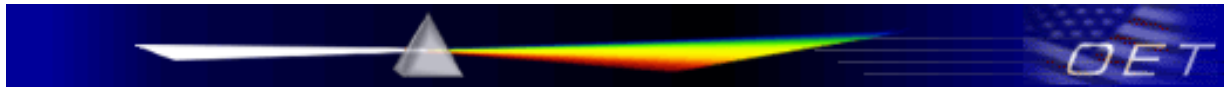
The variant handset(s) have identical components as the reference handset, and the reduced band operation is accomplished via software. In this case, no data referencing process is required, since the test on the reference device includes all the bands, thus covering all the possible use cases as needed for compliance demonstration purposes. All handsets will typically have the same FCC ID, since the only difference pertains to the loaded software or firmware.

If the reduced band functionality for a variant is obtained by depopulating (*i.e.*, removing) components from the reference handset design, then for that variant the data referencing process may be allowed, so long as the component removal does not lead to significant changes in the emission patterns, as compared to the reference model. One should also consider that, for RF Exposure data referencing, the most significant changes are typically those related to the near field emission patterns and that they can arise from small modifications in the PCB layout or component placement.

The reference and variants may or may not be under the same FCC ID: that is a manufacturer choice/request that requires endorsement by the FCC as part of the described acceptance of the ECR KDB Inquiry. However, that is not affecting the certification process, in accordance with Section 2.907(b) of the Rules).

7.2 DFS Data Referencing

DFS data referencing is allowed for DFS clients if client devices meet the requirements of KDB [905462](#). For instance, the DFS test for the reference device report includes 30 trials per BW mode (20, 40, 80 MHz) and for each radar waveform. For an approved variant device (that could also feature non-DFS-related changes), the DFS spot check test report may include 10 trials for the widest BW mode (80 MHz) and for each radar waveform to demonstrate the required passing percentage for each waveform.



CHANGE NOTICE:

10/23/2023: 484596 D01 Referencing Test Data v02 replaces 484596 D01 Referencing Test Data v01. Changes to the document include the following items:

- Introduced extended provision for both EMC and RF Exposure data referencing (incorporating previous Guidance provided at the TCBC Workshops dated October 2020, and April 2021)
- Provided new guidance based on the ECR KDB Inquiry Procedure
- Added examples to illustrate possible scenarios.

12/07/2023: 484596 D01 Referencing Test Data v02r01 replaces 484596 D01 Referencing Test Data v02. Changes to the document for corrections.

12/08/2023: 484596 D01 Referencing Test Data v02r02 replaces 484596 D01 Referencing Test Data ~~v01r02~~ v02r01 Corrected typos in eq. (2) and example in page 5.

03/26/2024: 484596 D01 Referencing Test Data v02r03 replaces 484596 D01 Referencing Test Data v02r02 to correct errors in the Change Notice section for date and document version errors.