

FCC certification guide

For radar modules and host products including radar modules

About this document

Scope and purpose

This document is a practical guide to the FCC certification process for a radar module that operates in an unlicensed frequency band. A host product manufacturer who is not familiar with the FCC certification process can use this document as a guide to the key steps when integrating a radar module into their products. The guide is not exhaustive and is not intended to replace documents published by the regulatory bodies.

Intended audience

The intended audience for this document are host product manufacturers who intend to use Infineon radar modules.

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1 Introduction

1 Introduction

1.1 Overview

The Federal Communications Commission (FCC) is the federal agency responsible for implementing and enforcing United States communications law and regulations. The process to obtain product certification by the FCC can seem complex, especially for those approaching this topic for the first time. Missing out important aspects can have a significant impact on the timeline for a product launch on the US market. On the other hand, the FCC regulations also offer opportunities to benefit from prior testing by the module manufacturer, and thus can reduce the burden on the host product manufacturer. For a time- and cost-efficient product launch, it is therefore important to understand the various requirements and options.

Overall, the certification shall ensure that:

- Various devices can work together without disturbing each other.
- RF exposure is at safe levels for people close to the products.

FCC regulations for products to be certified differentiate between modules and end products. The intended use of a product can make a difference to whether an FCC certification is needed or whether an exception applies. Factors affecting decisions include whether a product is intended for commercial sale, whether it is being imported in small quantities for the purpose of certification or exhibition, or whether it is for evaluation (not a finished product). If the product falls under an exemption – where no certification is needed – strict rules still apply, which regulate topics such as handling, documentation or labeling of the product.

The FCC typically does not deal directly with the companies seeking certification of their products – the communication process is done through a Telecommunication Certification Body (TCB) that has been accredited by the FCC. The TCB reviews the test results provided and related product documents. If the review is successfully completed, the TCB submits the documents to the FCC database and issues the applicant with a “grant of certification” on behalf of the FCC. The FCC then lists the product on its website.

Often the accredited test lab, which the applicant must select to perform the compliance testing, is not a TCB. In that case, ideally, the test lab offers a service to handle communication with the TCB. The typical communication process works as follows:

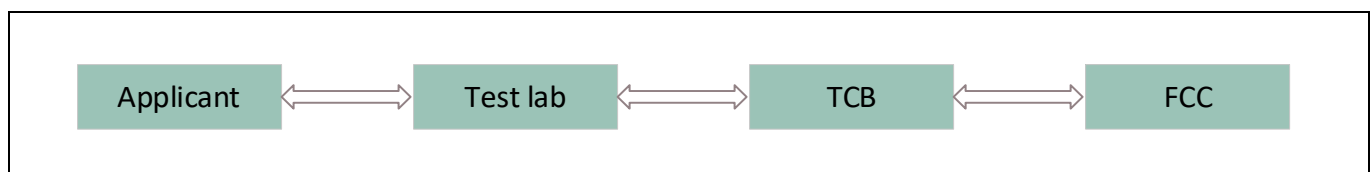


Figure 1 Typical communication process

It is important to understand that the role of the accredited test labs is to perform tests according to the FCC rules and, ideally, to handle the document submission and communication with the TCB; however, the applicant remains responsible for the compliance of the device with all the applicable regulations.

1 Introduction

1.2 Glossary

Table 1 Frequently used terms in the FCC certification process

Acronym/term	Full term/explanation
Agent	The party (e.g., the test lab) selected by the applicant that acts toward the TCB/FCC on behalf of the applicant.
Applicant	The party seeking FCC certification.
C1PC	Class 1 permissive change – relates to changes not increasing emissions.
C2PC	Class 2 permissive change – relates to changes increasing emissions or changes to remove particular grant restrictions.
C3PC	Class 3 permissive change – applies typically to software-defined radio products.
CFR	Code of Federal Regulations.
FCC	Federal Communications Commission.
FCC ID	The first part consists of the grantee code, the second consists of the product code.
FRN	FCC registration number – the FRN is a 10-digit number used to identify the individual or organization doing business with the FCC. The same FRN will be used for future approvals.
Grantee code	The FCC assigns to applicants a 3- to 5-digit code, which remains the same for all future products.
Grantee code registration number	A 6-digit security code used for access to the Equipment Authorization System (EAS), and which is required to modify grantee information. It must only be used by authorized persons and should be protected.
Module grantee	The party responsible for the module grant (typically the applicant).
MPE	Maximum permissible exposure. MPE limits are derived from the SAR limits.
Product code	A 14-digit code assigned to the product, defined by the applicant.
SAR	Specific absorption rate. Different SARs apply for fixed/mobile and portable devices.
TCB	Telecommunication Certification Body.

2 Definitions – modules and host products

In this document, a host product is defined as the finished product with housing that is typically sold to end customers – e.g., a smart thermostat for installation in a home, or a notebook for use in an office.

A module is made by a module manufacturer and is typically sold from business to business: the host product manufacturer purchases the module from a module manufacturer and integrates the module into the host product. A special case would be when the radar module and host product are manufactured within the same company, which greatly simplifies some aspects of FCC certification. In this document, we deal with the more general case where the module and host product are produced by different companies.

In the FCC definition, “a transmitter module generally consists of a completely self-contained transmitter that is missing only an input signal and power source to make it functional. A module is designed to be incorporated into another device, such as a personal computer, personal digital assistant (PDA) or utility meter”. In this document, the term “module” is equivalent to “transmitter module” as understood by the FCC.

Modules can have “full modular approval” or “limited modular approval”. To obtain full modular approval, a module must fulfill all FCC modular approval requirements (see also FCC KDB 996369 D01). When a module does not fulfill one or more of these requirements, it can still obtain limited modular approval.

Most Wi-Fi or Bluetooth modules have full modular approval – they have a metal shield around the RF chips and an antenna outside the shield. On the other hand, radar chips for high frequencies, e.g., 60 GHz, can have “on-chip antennas” – this allows for ultra-compact form factors. As on-chip antennas prevent the module from having a metal shield, such modules cannot obtain full modular approval, but they still can be certified with limited modular approval.

In this document, any FCC paragraph reference refers to CFR Title 47 Chapter 1 Subchapter A.

2.1 Modules with full and limited FCC grant, and without FCC grant

The common module classifications with regard to FCC approval status are:

- Modules with full modular grant: These modules comply with all requirements of §15.212(a)(1).¹
- Modules with limited modular grant: These modules do not meet all requirements, e.g., due to missing shielding or other limitations.
- Modules without grant: For example, modules that have not been submitted for certification or do not comply with regulatory requirements.

The module itself can be – by hardware concept – a single modular transmitter or a split modular transmitter. In this document, we deal with single modular transmitters that comprise the radio front end and the control section.

Sometimes the term “pre-certified” can be read in conjunction with a module – but this is not an official FCC term, and the reader is advised to carefully check the meaning within the specific context.

Even if a module is not (yet) certified, available reports from successful tests performed by the module manufacturer at an accredited test lab can show evidence that a proposed module will likely pass certification.

¹ Part 15 of CFR Title 47 Chapter 1 Subchapter A

2 Definitions – modules and host products

2.2 Mobile and portable devices

Manufacturers of modules or host products dealing with FCC certification will come across the terms “mobile” and “portable” devices. These definitions refer to how a product is intended to be used in the application and are important to determine the correct method for human RF exposure evaluation.

For products defined as mobile devices, persons must be at least 20 cm away from the radiating element. The human exposure to RF radiation can typically be calculated. Sometimes the term “fixed devices” is used. From human exposure considerations, these devices can be seen as equivalent to mobile devices. See §2.1091 for the full definition.

Portable devices are devices where it is expected that the radiating element is closer than 20 cm to the human body – for such devices, SAR measurements are needed. See §2.1093 for the full definition.

2.3 Class A and Class B digital services

Part 15.3 of the FCC regulation defines class A and class B digital devices. Whether a host product falls into class A or B depends on the environment in which the product is used.

Class A digital devices are marketed exclusively for use in business, industrial and commercial environments.

Class B digital devices are marketed for use anywhere, including residential environments.

The formally required information provided by the host manufacturer in the user documentation differs for class A and B devices (§15.105).

As the comparison of conducted (§15.107) and radiated (§15.109) emission limits shows, the technical standards are stricter for class B devices.

3 FCC certification process

Whether or not the device to be certified is a module or a host product, in principle, the overall certification process follows the same steps. The main difference is the set of measurements to be done.

The natural question for the applicant is, “how long will it take?” Aside from the time needed for the applicant’s own preparation, the overall amount of time the certification process takes is governed by two factors: the time until a free slot for testing is available at the test lab, and the time the TCB takes to review the documents and grant the certification. Whereas it can take several weeks until a time slot for testing becomes available, that date is fixed in a contract with the test lab and is known for further planning. On the other hand, the time the TCB needs can take several weeks to several months.

3.1 General certification process

The following list shows the process that applies when a new device is certified. Dealing with changes to an already certified device is described in section 4.

1. Preparatory steps

- Understand how the product will be used in relation to the human body. For instance, it makes a difference for SAR evaluation whether a host product is mounted on a wall or whether people hold in their hand.
- If your own experience regarding regulatory test requirements and available equipment permits, internal company pre-certification testing – done on prototype boards – would be an important step to pre-confirm that the device can pass the compliance testing at the test lab.
- As soon as you have an idea of when a final version of the product will be ready, contact a test lab to arrange a date for testing (see item 2), and in the meantime work on finalizing the product (next bullet).
- Have a final version of the hardware (HW) and software (SW) ready – any changes after certification is granted will require as a minimum some administrative effort, and new certification in the worst-case scenario.

2. Contact an accredited test lab

- See section 6 for the link to a list of test labs.
- Choosing the right test lab is very important, so besides purely looking at the price, further criteria should be considered:
 - Available time slots for testing
 - Location (is it easy/possible to join the testing if needed?)
 - Level of support offered (including quick response)
- The test lab serves several purposes (scope can vary):
 - It is the point of contact with the TCB
 - It gives advice on which test to perform, and which documents need to be provided
 - It performs the required tests, generates related documents, and sends them to the TCB

3. Dealing with the test lab

- Be clear to the test lab and the TCB what the device under test (DUT) is. For instance, if a module is mounted for testing on a test board, it must be clear that the test board is not part of the product.
- Understand that the test lab does not give legal advice or interpretation of the rules; in the end, you are responsible for producing a device that complies with regulations.

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- Review carefully all test reports provided by the test lab; don't take it for granted that all content is correct.
- 4. Tests performed at the test lab
 - Tests to be performed by the test lab can be categorized in three groups: RF, EMC, and safety:
 - RF: Radiated emission tests (intentional and non-intentional emissions)
 - EMC: Conducted emission tests
 - Safety: Human exposure evaluation
 - After all tests are done, keep the DUT and the used SW version, because additional tests might be needed.

5. Deliverables to be provided to the TCB

Depending on the services the test lab offers, the following deliverables must be provided by the test house or by the applicant to the TCB. In any case, the test lab prepares the test report, the SAR results, and the test setup photos. The applicant prepares the other documents. Check with the test lab or the TCB which templates exist (e.g., request for confidentiality, modular approval letter). There are also FCC Knowledge Database (KDB) documents, which give guidance on some of the deliverables – see section 6.

- Cover letters
 - Depending on the product/application a cover letter with some description of the product and application might be needed
 - If a test report from another company is used, a permission from that company will be needed
- Authority letter (if applicable)
 - You grant the test house the authority to act toward the TCB on your behalf
- Request for confidentiality
 - Defines what is publicly accessible on the FCC website and what remains hidden
- Request for modular approval (required only if the product is a module)
- Test report from the test lab
- RF exposure report from the test lab
 - Details how compliance with RF exposure requirements is confirmed (typically it is a calculation or measurement)
- Photographs
 - Test setup (provided by the test lab)
 - External/internal product photographs
- User manual
- Operational description
- Tune-up procedure (if applicable)
- Block diagram
- Schematics
- Part list
- FCC label design and position on product

6. Feedback from the TCB

Ideally, the feedback from the TCB will be positive, and the TCB then issues the “grant of equipment authorization” and uploads the relevant documents to the FCC database. If a modification to the documents

3 FCC certification process

must be made by the applicant or some clarification is to be provided to the TCB, the applicant is advised to check the timeline allowed for providing the modified documents and information.

3.2 Certification testing for host products with integrated modules

Table 2 shows the high-level certification-testing aspects when integrating modules into host devices. The table refers specifically to FCC compliance testing for the USA. Any other testing – required for instance due to certain host product specifics or to achieve regulatory compliance for other countries – would come additional.

Table 2 Certification testing aspects for host products vs. module certification level

Key items to consider for testing of host	A) Module with full FCC grant	B) Module with limited FCC grant	C) Module with no FCC grant
Certification reuse	Certification can be reused. Provide module FCC test report to test lab.	Same as A)	N/A
Radiated emission testing on host product	If the only wireless module: Only host testing for unintentional emissions (FCC part 15B) and RF spot-checking. Otherwise, additional tests or evaluation due to co-location with other wireless modules.	Same as A) if limitation is due to label or missing shielding for module with antenna on module. For other limitations, check with test lab if tests beyond those stated in A) are needed.	Full scope of certification testing needed on host level.
Conducted emission testing	Check for emissions conducted to power supply.	Same as A)	Same as A)
Human exposure	Depending on host product: measurement or calculation. ¹	Same as A)	Same as A)
Additional responsibility of host product manufacturer	Review the module certification and comply with applicable grant notes. Must follow manufacturer's module integration guide.	Same as A)	N/A

- Besides host labeling and updating of host device documents, additional formal aspects are to be followed:
 - In case A) a change in FCC ID for used modules might be needed (see section 4.2).
 - In case B) either a change in FCC ID is done, followed by a C2CP, or the module manufacturer remains responsible and retains control over integration and certification.
 - In case C) it is essential to get a new FCC ID for the host product (more effort than an ID change).
- Depending on the reasons for the limited module grant in case B), there might even be no difference between A) and B) on the testing side.
- For case C) besides the additional time and costs for more intense testing, there is a risk that the final product will fail in certification. To keep that risk low, the module manufacturer should ideally provide a test report showing evidence that the module would pass the FCC compliance requirements.

¹ Calculation can be based on human exposure reports from original certifications of the individual modules.

4 Dealing with changes of certified equipment

When dealing with certified equipment, several types of changes might be needed. The most frequent are changes due to modifications of the originally certified HW and SW and changes regarding the ownership of responsibility (change in ID filing). These topics are covered in the following sections.

4.1 Permissive change policy

The FCC regulations describe in §2.1043 the rules for changes to already certified equipment. Changes can apply to the following categories:

- Antenna changes
- PCB/HW changes
- Enclosure changes
- SW changes
- RF exposure considerations
- Miscellaneous changes

In each category, there can be changes which require an application for new certification, or so-called permissive changes which do not require a new application for certification. Below are some examples.

In the category of HW changes, modifications to the “basic frequency determining and stabilizing circuitry” require new certification. On the other hand, modifications on parts of the circuit which do not affect FCC-relevant performance can be done with a permissive change.

In the category of SW changes, “Changes to the software installed in a transmitter that do not affect the radio frequency emissions do not require any additional filings and may be made by parties other than the holder of the grant of certification”. On the other hand, a change in SW that would result in a higher output power than originally reported would require a new application for certification.

The FCC defines three classes of permissive changes; these classes also impact the amount of documentation and test results to be provided. The following descriptions are an excerpt from §2.1043.

A class 1 permissive change (C1PC) includes those modifications in the equipment which do not degrade the characteristics reported by the manufacturer and accepted by the Commission when certification is granted. This change does not require proactive submission of data to the FCC – only if the FCC would specifically request data.

A class 2 permissive change (CP2C) includes those modifications which degrade the performance characteristics as reported to the Commission at the time of the initial certification. Such degraded performance must still meet the minimum requirements of the applicable rules. When a class 2 permissive change is made by the grantee, the grantee shall provide complete information and the results of tests of the characteristics affected by the change.

A class 3 permissive change (C3PC) includes modifications to the SW of an SDR transmitter that change the frequency range, modulation type or maximum output power (either radiated or conducted) outside the parameters previously approved, or that change the circumstances under which the transmitter operates in accordance with Commission rules. The grantee shall provide a description of the changes and test results showing that the equipment complies with the applicable rules with the new SW loaded, including compliance with the applicable RF exposure requirements.

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4 Dealing with changes of certified equipment

Meanwhile, the regulations require that testing needed for permissive changes is done at an accredited test lab recognized by the FCC.

As there are many exceptions and special cases, the applicant is advised to carefully read the §2.1043, the FCC KDB 178919 and other related documents to understand which case applies to their situation.

Comparing the need for permissive changes for radar modules vs. Wi-Fi/BT modules, one can expect that by the nature of the product, far more permissive changes are/will be needed for radar modules. The reason is that Wi-Fi/BT modules are designed and tested to comply with a certain wireless standard. On the other hand, a radar module can often be loaded with different application SW – e.g., to cover new and innovative applications. For best performance, such SW can also require a change in RF characteristics of the module. Depending on the SW that was originally used for module certification, the new SW might need a C2PC or only a C1PC.

4.2 Change in FCC ID filing

When a module is integrated into a host product, there are two options for ownership of the module certification. Either the ownership remains with the module manufacturer, or it is transferred to the host manufacturer (see also FCC §2.933).

For a host manufacturer, to obtain the certification ownership for a module requires them to get their own FCC ID for that module; this involves the following formal steps:

- Get a signed permission letter from the original grantee, on the original grantee's letterhead, giving permission to file the change of ID.
- The host manufacturer must submit a change in ID application to a TCB, along with the following information:
 - A statement that there is no change in the design, circuitry, or construction, and that the original test results continue to be representative of and applicable to the equipment
 - The original FCC ID used on the equipment prior to the change in ID
 - The date of the original grant of equipment authorization
 - How the equipment bearing the modified ID differs from the original equipment
 - Whether the original test results continue to be representative of and applicable to the equipment bearing the changed ID
 - External photographs:
 - Operating controls available to the user
 - Label
 - Manual (if different from the original filing)

Both options impact the permissive change procedure.

If the ownership remains with the module manufacturer, to apply for a change at the FCC, the host manufacturer needs an authorization letter from the module manufacturer.

If the host manufacturer obtained its own FCC ID for the module, it can apply to the FCC for permissive changes without asking the module manufacturer for an authorization letter.

Where both a permissive change and a change in FCC ID are required or desired, the change in ID application must be processed first, followed by the permissive change filing.

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5 Example of an FCC-certified radar module

5 Example of an FCC-certified radar module

The 60 GHz radar module 60TR13EM011 is based on an Infineon reference design and has a limited modular grant (Figure 2). The listed grant notes state the further items to be considered when integrating that module.

TCB

**GRANT OF EQUIPMENT
AUTHORIZATION**

Certification
Issued Under the Authority of the
Federal Communications Commission

By:

ACB, Inc.
6731 Whittier Avenue Suite C110
McLean, VA 22101

Date of Grant: 09/15/2021
Application Dated: 09/01/2021

TCB

Infineon Technologies AG
Am Campeon 1-15
Neubiberg, 85579
Germany

Attention: Waldemar Marsetz , Director

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is
VALID ONLY for the equipment identified hereon for use under the Commission's
Rules and Regulations listed below.

FCC IDENTIFIER: 2AYSQ-6011

Name of Grantee: Infineon Technologies AG

Equipment Class: Part 15 Low Power Communication Device

Transmitter

Notes: Form Factor Module with BGT60TR13C Radar

Modular Type: Limited Single Modular

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15C	61019.5 - 61479.1	0.0036		

Limited Modular Approval

Output power listed is conducted, calculated from a radiated measurement. The grantee is required to inform all parties to whom this device is marketed that they are required to file a Change-in-ID (Section 2.933) to certify it under their own FCC ID, immediately followed by a Class II Permissive Change to authorize the LMA in their specific host device, before they may market it. RF exposure compliance is addressed for 1.1310 and 2.1091 MPE limits - this device complies with KDB 447498 and is approved for mobile/fixed operation. The antenna(s) used for this transmitter must not transmit simultaneously with any other co-located antenna or transmitter, except in accordance with FCC multi-transmitter product procedures. Grantee must provide installation and operating instructions for complying with FCC multi-transmitter product procedures and RF exposure requirements.

Figure 2 Grant of equipment authorization for 60 GHz radar module

The grant limitations are because the module has no shielding and no label on it. The module comes without shielding because it uses the highly integrated Infineon BGT60TR13C radar sensor. The radar sensor has the antennas on-chip – which enables reduction of the sensor size to just 6.5 x 5 mm². Consequently, a very small module of just 20 x 15 mm² can be designed. Due to lack of space, there is no FCC label on the module. In this case, the regulatory information can be attached to the reels containing the modules. Figure 3 shows the module with some key specifications.

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5 Example of an FCC-certified radar module

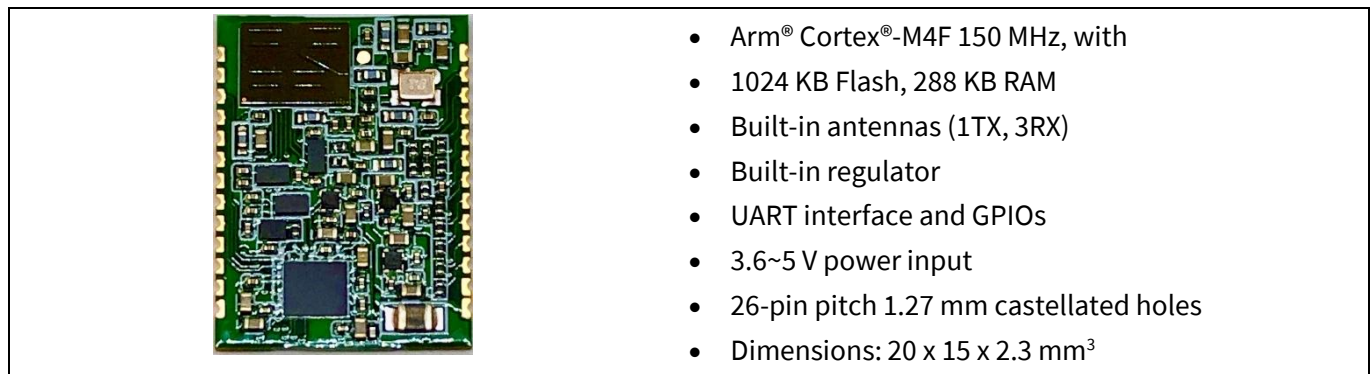


Figure 3 60 GHz radar module

A host manufacturer who would like to integrate that module and reuse the certification would take the following steps:

- Change the FCC ID for the module (formal process to transfer ownership for compliance with FCC regulations from Infineon to the new party):
 - Ask Infineon for an approval letter that grants the right to apply to the FCC for a change in FCC ID for the module.
 - Request a change in FCC ID for the module from the FCC.
- Go to an accredited test lab and perform all necessary certification testing for the host product with the integrated module (see also section 3.2). The test lab will use the certification test reports and finalize the certification for the customer.
- File a C2PC application to authorize the module in specific host device(s).
- Label the host product correctly with the changed FCC ID for the module.

Note: Although the module itself is, due to space constraints, not labeled, when the module is delivered the original FCC ID can be found, e.g., on the module packaging.

6 Important FCC guides and useful links

This section lists some important FCC documents, which can be found in the FCC Knowledge Database (KDB) <https://apps.fcc.gov/oetcf/kdb/index.cfm>. The list is not exhaustive, and the reader/applicant should check which other documents might be relevant in their case – e.g., there are additional documents describing MIMO systems or SDR products. It is also important for the reader/applicant to check the latest references on the FCC pages to get the most recent versions of documents.

1. FCC KDB 996369 D01 Module authorization guide
2. FCC KDB 996369 D02 Module Q&A
3. FCC KDB 996369 D03 OEM manual
4. FCC KDB 996369 D04 Module integration guide
5. FCC KDB 726920 D01 Confidentiality request procedures
6. FCC KDB 784748 General labeling guidelines
7. FCC KDB 784748 e-labeling guidelines
8. FCC KDB 178919 D01 Permissive change policy
9. FCC KDB 178919 D02 Permissive change FAQ
10. FCC KDB 388624 D01 Pre-approval guidance
11. FCC KDB 447498 D01 General RF exposure guidance
12. FCC KDB 594280 D01 Software configuration control
13. FCC KDB 204515 Grantee code

Useful links

List of accredited test labs:

<https://apps.fcc.gov/oetcf/eas/reports/TestFirmSearch.cfm>

FCC Knowledge Database (KDB):

<https://apps.fcc.gov/oetcf/kdb/index.cfm>

Search for product listing on the FCC website:

<https://apps.fcc.gov/oetcf/eas/reports/GenericSearch.cfm>

<https://www.fcc.gov/oet/ea/fccid>

References

- [1] FCC Knowledge Database (KDB), 09.2021, <https://apps.fcc.gov/oetcf/kdb/index.cfm>

Revision history

Revision history

Document revision	Date	Description of changes
1.00	2021-09-20	Initial version
1.10	2023-06-06	Miscellaneous document cleanup updates

Trademarks

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Email: erratum@infineon.com

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Important notice

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