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Best Practices for Using Approved Modules

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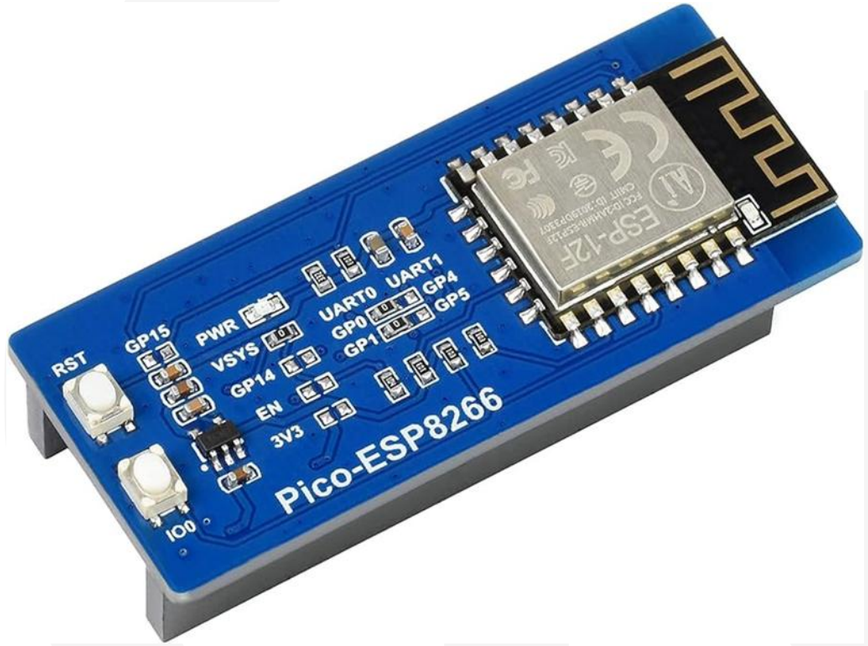
Version 1

KDB 996369

- 996369 D01 Module Certification Guide v04r02
  - Guidance on the modular certification process
- 996369 D02 Module Q&A v02r02
  - Common questions about the modular process answered
- 996369 D03 OEM Manual v01r01
  - Specific guidance on the certification process for modular approval applicants
- 996369 D04 Module Integration Guide v02
  - Information for host manufacturers who want to use certified modules
- 996369 D05 Split Module v01
  - Guidance on the split module certification process

What is a Radio module?

- Radio module is a stand-alone radio transmitter or transceiver on its own PCB with all radio functions built on the board.
- These modules typically integrate all necessary components, including a transmitter, receiver, and sometimes an antenna, into a single compact unit.
- Types of modular approval:
  - Single modular
  - Limited single modular
  - Split modular
  - Limited split modular



Radio Modular Approval types

Single-Modular transmitter

- Satisfies all the 8 requirements in FCC Rule Part §15.212 (Modular transmitters) and ISED RSP-100, Form D (Modular Approval Attestation)
- A Self-contained module that ensures compliance without the need for a host product
- If deemed compliant, it can be incorporated into any device after verification

Limited Single-Modular transmitter

- Does not satisfy one or more of the 8 requirements in FCC Rule Part §15.212 (Modular transmitters) and ISED RSP-100, Form D (Modular Approval Attestation)
- Demonstrates compliance when assessed within a specific type of host and the authorization is now subject to the TCB PAG (Pre-Approval Guidance) procedure

Split-Modular transmitter

- Separate boards house the radio control circuitry and radio front-end
- The radio approval is specified to one or more control circuitry boards and the authorization is now subject to the TCB PAG procedure

Limited Split-Modular transmitter

- A split modular approval that complies with the split modular approval requirements only when constrained to a specific host(s) and/or grant conditions

FCC Rule Part §15.212 – 8 requirements

(i) **The radio elements of the modular transmitter must have their own shielding**. The physical crystal and tuning capacitors may be located external to the shielded radio elements.

(ii) **The modular transmitter must have buffered modulation/data inputs** (if such inputs are provided) to ensure that the module will comply with part 15 requirements under conditions of excessive data rates or over-modulation.

(iii) **The modular transmitter must have its own power supply regulation**.

(iv) **The modular transmitter must comply with the antenna and transmission system requirements of §§ 15.203, 15.204(b) and 15.204(c).** The antenna must either be permanently attached or employ a "unique" antenna coupler (at all connections between the module and the antenna, including the cable). The "professional installation" provision of § 15.203 is not applicable to modules but can apply to limited modular approvals under paragraph (b) of this section.

(v) **The modular transmitter must be tested in a stand-alone configuration, *i.e.*, the module must not be inside another device during testing for compliance with part 15 requirements. Unless the transmitter module will be battery powered, it must comply with the AC line conducted requirements found in § 15.207**. AC or DC power lines and data input/output lines connected to the module must not contain ferrites, unless they will be marketed with the module (see § 15.27(a)). The length of these lines shall be the length typical of actual use or, if that length is unknown, at least 10 centimeters to insure that there is no coupling between the case of the module and supporting equipment. Any accessories, peripherals, or support equipment connected to the module during testing shall be unmodified and commercially available (see § 15.31(i)).

(vi) **The modular transmitter must be equipped with either a permanently affixed label or must be capable of electronically displaying its FCC identification number**.

(vii) **The modular transmitter must comply with any specific rules or operating requirements that ordinarily apply to a complete transmitter and the manufacturer must provide adequate instructions along with the module to explain any such requirements. A copy of these instructions must be included in the application for equipment authorization.**

(viii) **Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in §§ 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate**. Applications for equipment authorization of modular transmitters under this section must contain a statement confirming compliance with these requirements. The modular transmitter must comply with any applicable RF exposure requirements in its final configuration. Technical information showing the basis for this statement must be submitted to the Commission upon request.

Use of Pre-Certified Radio Modules

- Manufacturers utilize pre-certified modules because they provide value for low margin and high-volume products
- Pre-Certified modules satisfies requirements for modular approval as defined by FCC and ISED Canada
- If grant and certification requirements are satisfied, a single modular approval gives the greatest flexibility for integration into numerous host devices.
- Advantages
  - Reduces RF testing once integrated inside a host
  - Enhanced design flexibility
  - Resource efficiency
  - Reduced development cost
  - Faster Time-to-Market

Disadvantages

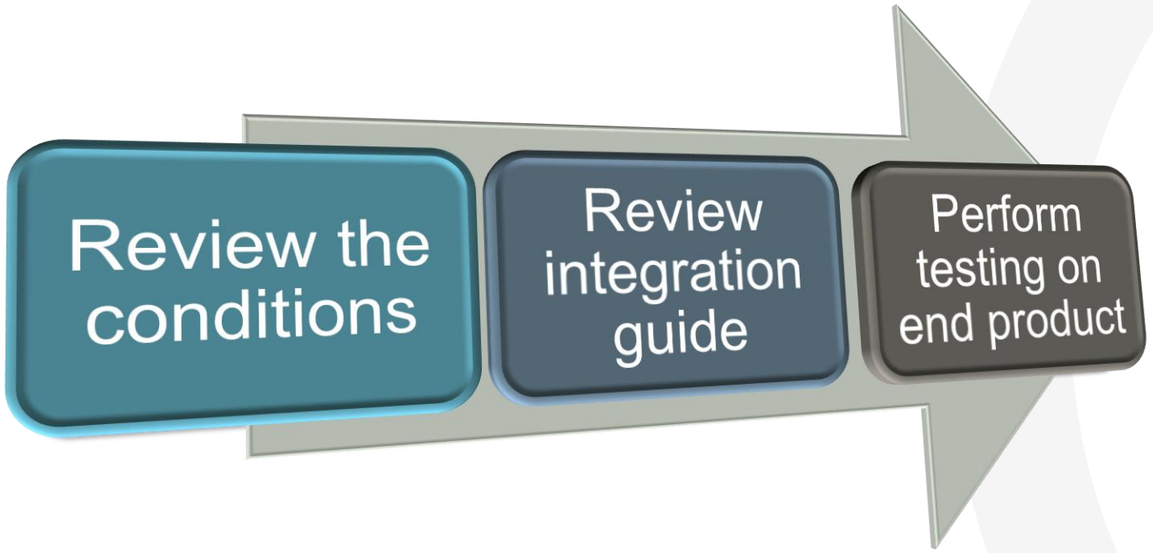
  - Comes with conditions on original report
  - Fixed specifications
  - Requires support from manufacturer on compliance side and software support
  - Single source dependency

Selection consideration while choosing a module

- Must have a correct and up-to-date certification – to align with the version of module selected and the regulatory rules
- Support and Documentation
- Software tools for continuous transmission, frequency selection and modulation etc.
- Technical Specifications
- RF exposure and grant conditions on radio module
- Co-Location conditions on module if multiple transmitters are used
- Future Scalability

Selection consideration while choosing a module

- To achieve compliance, it is necessary to adhere to all limitations and implementation requirements specified in the implementation guide and on the certification.
- The finished product must adhere to electrical safety and electromagnetic compatibility (EMC) regulations after the radio module is incorporated.



Radio Module Integration

- Many countries forbid modular certification as they do not have a modular approval scheme
- Some countries will allow for modular approval but only for a limited range of end products (e.g., ITE and Household products)
- The test data for the module may be used to obtain certification on different end products in a nation that prohibits modular certification, but only one model per certificate may be utilized.
- Some countries that allow modular approval includes (but not limited to):
  - Canada
  - USA
  - China (for radio modules that will be used in ITE or Household devices)
  - EU (self-declaration on end-product)
  - Japan

Radio Module Integration guide for FCC/ISED

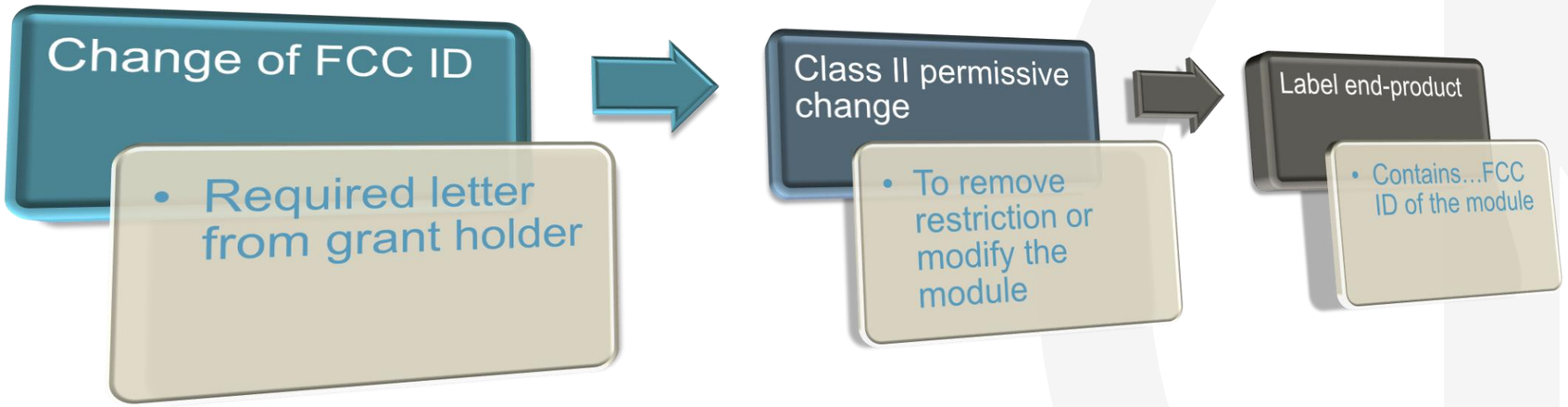
- Manufacturer should follow KDB 996369 D04 Module Integration Guide V02 when using certified module in their final product.
- The General guidance are as follows:
  - Account for all FCC compliance requirements including digital circuitry (unintentional radiators and transmitters)
  - Examine the integration guidelines that come with authorized modular transmitters. Make sure that the restrictions that limited the initial module grant are addressed if the limited module is used. The host manufacturer should collaborate with the module grantee to resolve any unclear instructions..
  - RF exposure integration instructions are to be followed for host product .
  - Obtain the necessary equipment authorization for any host product's unintentional radiator functionalities, as well as any further testing or certification that may be needed for the modular transmitter.
  - Perform testing on host product with transmitters operating simultaneously (if multiple transmitters are present). This test is performed to check fundamental frequency and spurious emissions for compliance with applicable rules.
  - Label the product appropriately as per KDB publication 784748

Who is responsible for compliance?

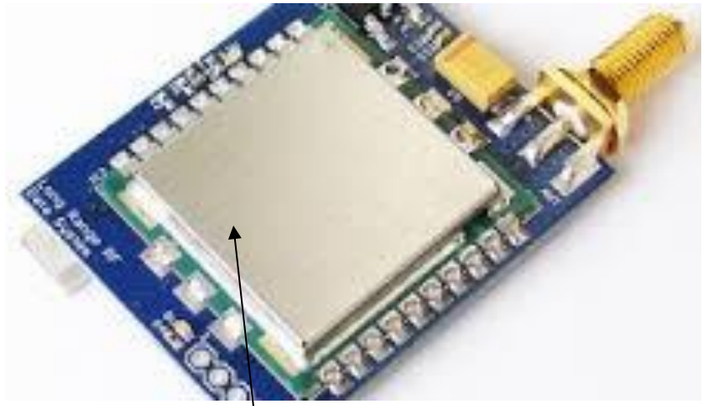
- The certificate holder is always in charge of ensuring that the module is compliant
- The final product's labeling and compliance are always the manufacturer's responsibility
- If the modular integration guide is followed and no modifications are made to the module, then only EMC/RF test reports are acceptable, and no certification is required.
- If there are changes made by host product manufacturer that can affect the antenna gain, SAR characteristics or fundamental RF, Class II permissive change (C2PC) change should be required.

Who is responsible for compliance?

- The original certificate holder should update their approval through Class II permissive change (C2PC) if possible.
- The host product's manufacturer can always take control of the module through Change in ID and then do permissive change (C2PC)



Labelling requirements for FCC/ISED



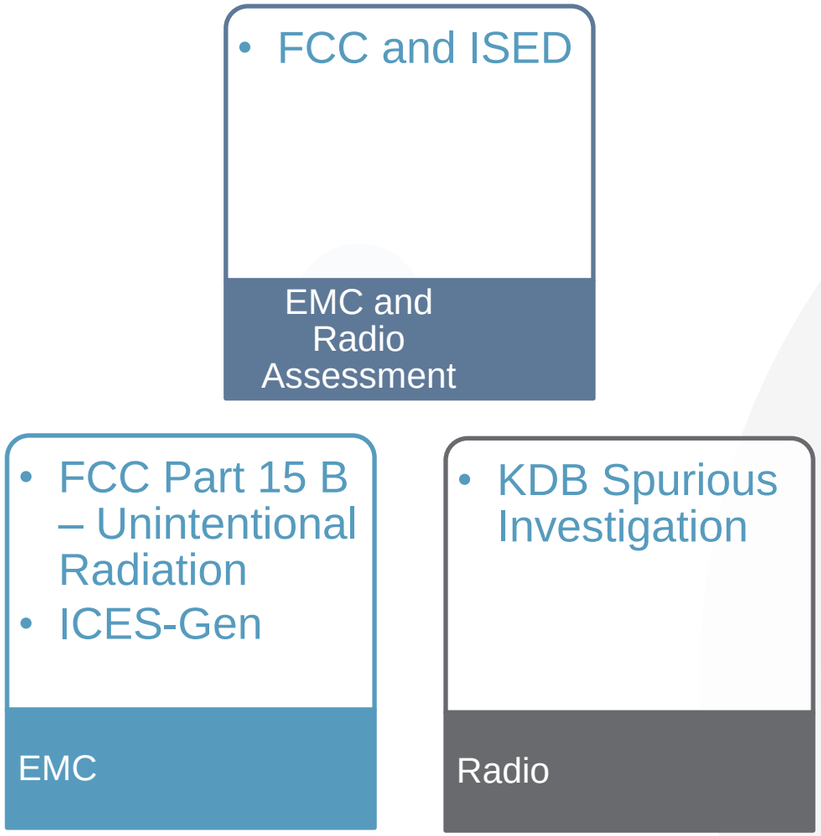
FCC ID: xxxyyy

Labelling is mandatory for module

Contains : FCC ID: xxxyyy

Labelling is also mandatory for the host

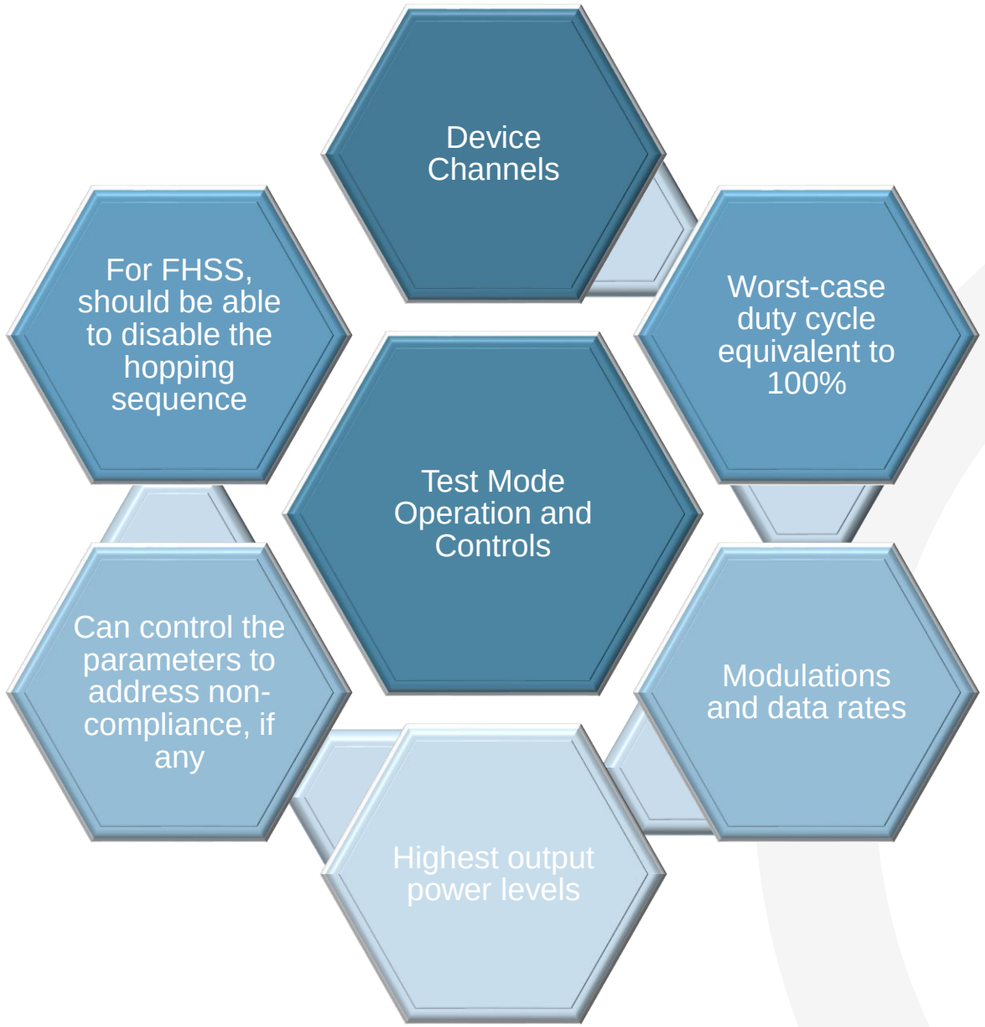
EMC and Radio assessment for host product



KDB 996369 D04v02– Spurious Investigation

- Spurious Investigation looks for emissions that may develop as a result of emissions mixing with other transmitters, digital circuitry, or physical features of the host product.
- It is not essential to retest all transmitter modes. Perform some investigative measures to ensure that the resulting composite system does not exceed spurious emission limits and is not restricted to subsequent testing.
- Frequency spectrum to be investigated is specified in Section 3.2 of KDB 996369 D04 v02. It’s 5 times the fundamental frequency of the radio device and alternatively, for the digital frequencies, as shown in 47 CFR §15.33(b). Whichever frequency range of investigation is higher is the testing frequency.

KDB 996369 D04v02– Spurious Investigation



KDB 996369 D04v02– Spurious Investigation

- Co-Location testing for two approved radios in host
  - If the radios are asynchronous (no simultaneous transmission), co-location testing can be omitted
  - If the radios simultaneously transmit, co-location testing is required. Both transmitters are made to transmit, emissions are checked for intermod emissions.

Case studies

- BLE module
  - Emissions testing should be set in non transmit mode for digital emissions and transmit mode for KDB spurious investigation.
  - To enable unit to transmit continuously, test software or command programming can be used
  - Immunity testing is performed by establishing communication link between module and ancillary equipment (mobile device, nRF connect app).
- LTE module
  - Module use multiple bands for transmission. We choose a band for testing which will have highest antenna gain and highest output power.
  - To enable the unit to transmit continuously , either test software or AT command programming can be used.
  - Immunity testing is performed by using call box (CMW, communication tester).

Case studies

- GPS receiver
  - Emissions testing is done while GPS is set in receive mode.
  - For immunity testing, GPS simulator is used to establish link with unit and stored messages in product is monitored.
- Wi-Fi module
  - For emission testing, modulation which has highest output power is chosen for testing.
  - Immunity testing can be performed by connecting product to router and BER rate is monitored.

Thank you!