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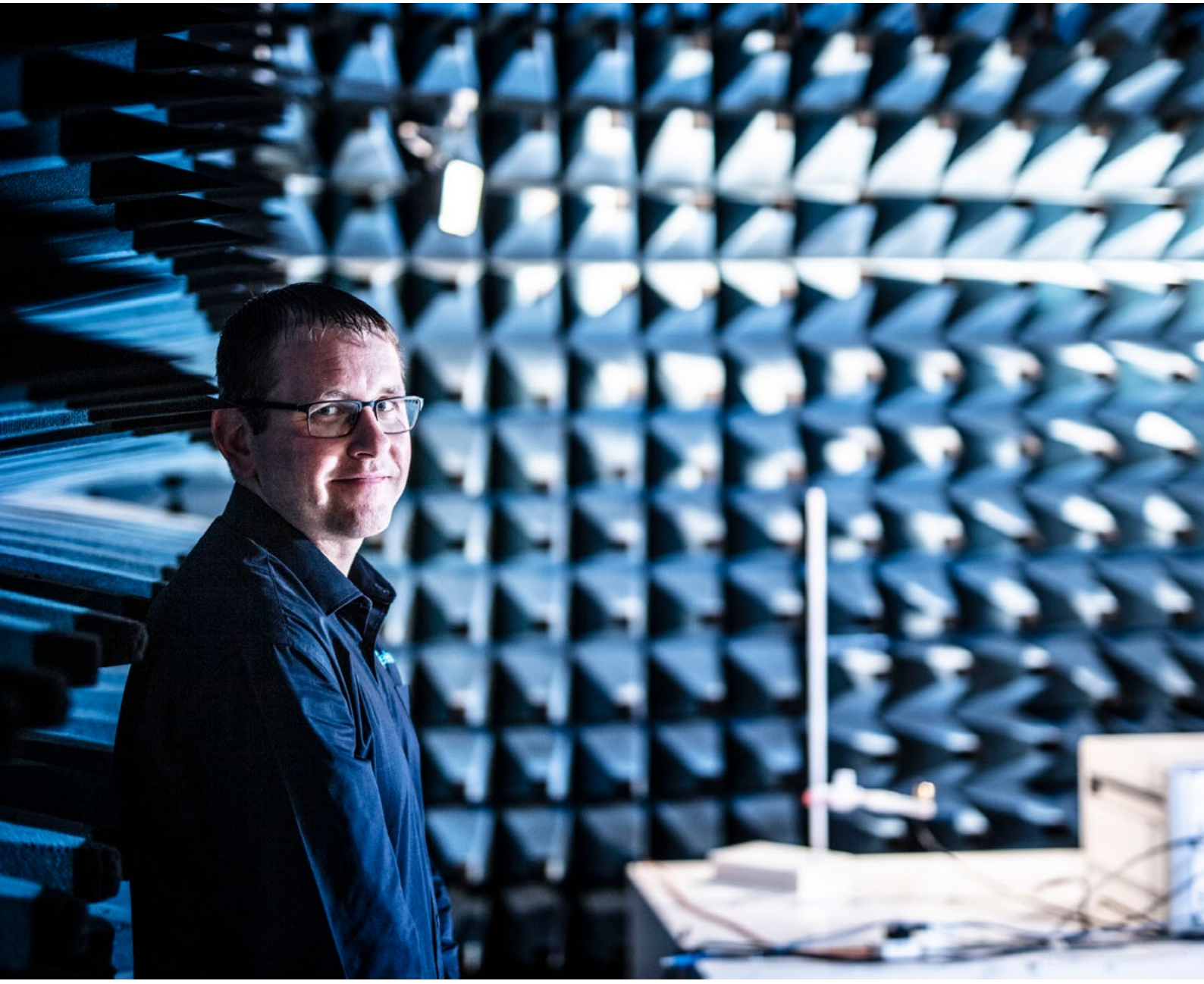

UNDERSTANDING TESTING AND APPROVAL OF RADIO MODULES IN NORTH AMERICA

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INTRODUCTION

Products ranging from energy management and home security solutions to smart appliances such as washing machines or dishwashers are classified as radio equipment, meaning testing and approval of radio modules are becoming relevant to more and more manufacturers. Some manufacturers may decide to invest in a pre-certified radio module hoping to simplify their route to market, failing to appreciate that they will still need to understand the Federal Communications Commission (FCC) rules for radio compliance and testing.

THE DIFFERENCE BETWEEN TESTING AND APPROVAL

When seeking to get equipment approved for use by meeting the regulatory requirements, it is crucial to separate the process of testing from approval and understand the difference.

A test laboratory usually performs testing to determine if the hardware will pass or fail a test standard. Approval is the administrative and legal process for getting the product authorized for sale and placement on the market.

While a device may pass the necessary tests required to meet a standard, the correct legal procedures must have been taken to be authorized for use. Equally, a product that appears to be legally authorized may fail the necessary tests if the correct instructions are not followed. Changes made to a product may also result in the product needing to be re-tested yet not re-approved, or vice versa.

FCC CERTIFICATION AND ISED CANADA CERTIFICATION

Certification for radio transmitters is required in North America by both the FCC and the Innovation, Science and Economic Development Canada (ISED Canada).

As part of the FCC and ISED Canada certification process, the product must be registered with the relevant national authority, and the product's technical details must be specified.

Both regulatory bodies require the manufacturer to test their transmitter prior to getting it certified by a telecommunications certification body (TCB) and then submit the test results as part of the technical file for the device. The device's certification filing submitted to the FCC or ISED is then referenced by the FCC ID or ISED certification number.

MODULAR APPROVAL

While certification applies to most transmitters, it is also possible to obtain modular approval, which is a type of certification specific to radio modules intended to be installed into other equipment. It is worth noting, however, that it is not mandatory for the module manufacturer to have all modules certified, enabling modules to be sold in the USA and Canada to installers with or without certification.

It is also possible to bypass the modular approval route and certify a radio module as a standard radio transmitter. However, the device would then only be certified for use as a stand-alone radio, which is not the intention of most module manufacturers.

The FCC and ISED have therefore established a modular approvals process to enable the certification of a radio transmitter module to remain valid after its installation into a host product.

MEETING ADDITIONAL REQUIREMENTS

To achieve modular approval, the radio module must pass all the tests associated with the type of radio transmitter and must also meet certain additional requirements. These include the module being tested in a stand-alone configuration, ideally on the end of a length of cable, as well as controlling the antenna used with the module.

The voltage must also be regulated to ensure that the final transmitter section of the module will see the same voltage, regardless of the supply from the host. In addition, a shield must be provided over the module's transmitter section to reduce the coupling of signals between the module and the host. Finally, the module must be labeled with its own unique FCC ID or ISED certification number.

However, even after all these factors have been met, it is still possible for the radio module transmitter to fail some of the tests when installed into the host product.

In summary, if the radio module manufacturer tests a module in a stand-alone configuration and then certifies it as a radio transmitter and a radio module, the module can be used in any host and under most conditions. However, the FCC Grant or ISED certificate does need to state "modular approval." There are also specific parameters associated with RF exposure compliance, which are an exception.

It is possible to obtain "limited modular approval" (LMA) certification for a radio module that has not met all of the necessary requirements for modular approval. LMA is where the module is specifically tested and certified for use within an intended host product or device, or within another host device that shares the same conditions, allowing the certification to remain valid for a limited set of installations.

THE FCC GRANT

One part of modular approvals which often confuses people is the text on the FCC Grant. Most FCC Grants state, "Must not be co-located with any other transmitter" or "Must not be used within 20 cm of a person". This reflects the fact that the module manufacturer did not assess the radio module for use next to another transmitter or used in close proximity to a body. This is normal practice and not a failing by the module manufacturer; as the module manufacturer does not know the intended installation or host product for full modular approval.

CLEAR INSTALLATION INSTRUCTIONS

The installation instructions provided with the radio module are potentially as important as the test report itself.

Taking an antenna as an example, the instructions must clearly state which antenna or antennas can be used. Where a module only provides an RF pin or solder pad for an antenna path built into the host's board, clear details of the antenna path's design must be included in the instructions. This must specify the layout, copper track widths, and track corner angles.

The installation instructions should make it clear to the installer what their ongoing responsibilities are, and that compliance checks must be made. The FCC and ISED approval process is focused on the device's emissions with testing concentrated on transmitter output performance, EMC spurious emissions, and the risk of RF exposure from the transmitter.

UNDERSTANDING COMPLIANCE FROM THE INSTALLER'S PERSPECTIVE

Having looked at the approvals and testing journey chiefly from the module manufacturer's perspective, it is also essential to understand what is required for any company planning to install a radio module into a product and make that final radio enabled product available in North America.

Many installers mistakenly presume that all the work has already been done for them when installing a certified module. In fact, the installer has responsibility for overall technical compliance of the final product. They may carry out less testing if some tests from the module remain valid in the host, and the certified radio module should help to avoid the legal process required for certifying their product.

From a legal perspective, if the radio module's label is not visible when installed in the final radio product, the installer must mark the product to indicate that a certified radio module has been installed. While the radio module itself has been certified, the actual radio product has not. Additional certification may also be required depending on what else is present in the final radio product. If this happens, the final radio product would need to be marked appropriately.

TECHNICAL REQUIREMENT RESPONSIBILITIES

Responsibilities for ensuring that the final product meets all of the technical requirements lay with the manufacturer of the final radio product, often referred to as the installer. While the installer does not have to certify the radio transmitter as it has modular approval, they are required to test the radio transmitter's performance and the final radio product's transmitter emissions. It is therefore important to check if the testing of the digital device or the general electronics of the final product have not been compromised by the insertion of the radio module.

The installer will also need to understand how the integration of a radio module might have affected the transmitter performance of the final radio product. Compliance of the final product cannot simply be signified by the radio module having passed its required tests when on a test jig or in stand-alone mode.

A high number of installations fail such tests the first time, and the installer is responsible for checking the transmitter tests on the final radio product. If the module has been installed correctly and no modifications have taken place, most test cases are unlikely to change. However, the manufacturer of the end product still needs to perform their own test measurements to establish any spurious emissions as well as the output power or equivalent effective isotropic radiated power (EIRP).

A common mistake is to presume that the host product's enclosure will automatically shield radio signals from the module. It should not be assumed that emissions and output power will be lower after the module has been installed in the host just because the module has passed the output power and emissions tests when previously on a jig or in stand-alone mode. Many types of host installation can direct signals or provide a transmission path which did not exist for the module as a stand-alone radio.

As it is essential to make sure that the final radio product passes the necessary tests and some test measurements under laboratory conditions usually need to be made. The testing must also consider if multiple radio modules have been installed or if the final radio product contains multiple radio transmitters that have the potential to transmit simultaneously. While there is not a formalized test approach for this, with no instructions about how many modes and channels you must test, it is the installer's responsibility to test until it has been established that the final radio product meets the technical requirements.

EXCEPTIONS TO THE RULE

There are, of course, always exceptions that need to be considered, such as:

- If the radio module is co-located with another transmitter and both can transmit simultaneously in the same band, you need to check if the combined output powers exceed the total limit for that band and whether the combined emissions pass the tests.
- If the radio module was certified for use at >20 cm from a person (known as 'mobile') and you want to install it into a device used near the body (known as 'portable'), the radio module manufacturer will need to update their module certification for you.
- If you use an antenna that is different from the one certified with the radio module, the radio module manufacturer will need to update their module certification for you.
- If the module is a solder-down type with an RF pin or pad, and if you're not sure if your antenna path trace is identical to the one used on the test jig by the module manufacturer, then you need to check with the radio module manufacturer. If they tell you that your trace layout is not within their parameters, the radio module manufacturer will need to update their module certification for you.

In all the cases above where the module manufacturer is required to change the certification of their module, there does exist the option for the installer to follow an admin process and put their own FCC ID and ISED number onto the module, known as a "Change in ID" (FCC) and "Multiple Listing" (ISED). Following this, the installer could make changes to their own modular approval without the need to keep going back to the radio module manufacturer; because the module certification is then in the installer's name, and the installer has the legal responsibility. It is important to remember that certification still applies to the module rather than the final radio product.

PERMISSIVE CHANGES

Making changes to a certification that is permitted within the rules of the FCC and ISED, known as a 'permissive change,' is up to the company whose name is on the radio module certification. This is the radio module manufacturer, unless the Change in ID and Multiple Listing processes have been followed.

This modular approval method cannot be applied to a radio module that is part of a small portable or wearable device used or held within 20 cm of a person. This would require a type of RF exposure testing called a specific absorption rate (SAR) test, and the final radio product would need to be tested and certified.

LEGAL RESPONSIBILITIES

When looking at legal control and responsibility, a common question is where the responsibility lies if market surveillance finds a non-compliant device. This depends on which economic operator has failed in their duties. The module manufacturer is liable if market surveillance tests a radio module available on the market and finds it non-compliant.

However, if the radio module passes when removed from a host product but the final radio product fails, then the installer is responsible. If the radio module fails after it has been removed from the host product and also causes the final radio product to fail, then both companies are accountable.

CONCLUSION

Manufacturers wishing to incorporate radio into their end products often use radio modules intending to get their final product to market quickly, relatively cost-effectively, and without the burden of additional testing and approvals responsibilities. However, while FCC ID and ISED certification numbers are important signs of compliance and indicate a certain level of quality; it is important that testing, and approval responsibilities DO still exist, and these must be fully understood.

For more information on testing and approval for North America, please contact an Element expert today.

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