

Certification Requirements for a GSM Device in North America

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Table of Contents

1.	Introduction	3
2.	FCC Certification	3
3.	IC Certification.....	5
4.	PTCRB Certification.....	5
5.	Cellular Carrier Certification	8

1. Introduction

The purpose of this paper is to detail the cellular certification requirements for an M2M device utilizing a pre-certified GSM cellular modem module within the North American market. The regulatory requirements detailed in this paper are subject to change. If in doubt on any requirement, consult with an industry expert.

This paper will focus on devices with only a GSM radio, but the overall cellular certification requirements will, for the most part, be the same if the device has other transmitting radios. The major difference is that there will likely be more regulatory requirements pertaining to the other radio technologies used. The extra regulatory testing required for other radios is out of scope for this document. This document also only applies to new devices seeking certification for the first time. It does not cover re-certification details for modifications made to previously certified devices. This paper will break down the cellular certification requirements by regulatory body and detail the requirements for each. The following regulatory bodies will be detailed:

1. FCC (Federal Communications Commission)
2. IC (Industry Canada)
3. PTCRB (PCS Type Certification Review Board)
4. Cellular Carrier Requirements

2. FCC Certification

A device sold within the US will need to be FCC certified and will need to be labelled with a FCC ID. The main question to be answered upfront is how much and what testing is required? At a high level, this is broken down into two parts for a device with a cellular modem. These are detailed in the following two sections.

2.1 Unintentional Radiator

This is FCC Part 15 Subpart B. This testing is usually required on almost every electronics device, regardless of whether it contains a cellular radio (or any other radio) or not. There are a few exemptions listed in 15.103, but exemptions need to be determined on a case by case basis. This is basic emissions testing. The emissions radiating from the device are measured with the radio(s) turned off and compared to limit levels set by the FCC.

2.2 Intentional Radiator

This is the part of FCC certification that pertains to the cellular radio test requirements. The amount of testing required (if any) is dependent on whether the device can utilize the “modular approval” process.

The most straightforward way to reduce the amount of radio testing required for FCC certification is to utilize the “modular approval” grant of the cellular radio module used within the device. To determine if your cellular modem integration falls under “modular approval”, the modem integration guidelines stated in the FCC modular approval grant letter for the modem must be followed. If modular approval is pursued for the device in question, it will not have its own FCC ID. It will use the FCC ID of the cellular module. Listed below are a few example items that usually will need to be met to obtain modular approval:

- 1.) The gain of the antenna used with the device should be equal to or less than the gain of the antenna used for the cellular modem certification itself.
- 2.) The device should not be used within 20cm of a human body.
- 3.) The cellular radio must not be co-located with another radio within the device

***NOTE** - These are only example guidelines. In order to meet the exact requirements the modular grant letter for the cellular modem used should be referenced to determine exact requirements.

If your device does not meet the guidelines stated in the cellular modem’s FCC modular grant or if you require (or would like to have) your own FCC ID, then the full intentional radiator portion of testing will be required.

2.3 Other Possible FCC Requirements

Outside of the unintentional and intentional radiator requirements, there could be other FCC testing required depending on the device’s other functionality. This is out of the scope of this document, but listed below would be a few of the most common examples to consider:

- 1.) If the device is used within 20cm of a human body SAR (specific absorption rate), testing will most likely be required.
- 2.) If the device is powered by AC, it will most likely need to pass the FCC AC conducted emissions limits.
- 3.) If there are other radios in the device, they may need to be tested to their specific requirements depending on the radio technology used.

3. IC Certification

A device sold in Canada will need to be IC certified and labelled with an IC ID. Industry Canada has their own requirements, but they are similar to the FCC's requirements. For brevity the requirements aren't detailed out here. They will accept a FCC test report if it meets the following conditions:

- 1.) The test report must be less than one year old.
- 2.) If the type of measurement was "radiated", the laboratory who did the testing must have their Test Site (OATS or Anechoic chamber) approved by Industry Canada;
- 3.) If the type of measurement was "conducted", the laboratory who did the testing is not required to have their test site approved by Industry Canada;
- 4.) A cross-reference table must be submitted with the test report to show that the equipment meets all of the applicable Canadian requirements

4. PTCRB Certification

PTCRB certification is required for any GSM device used in North America. The three main tests an M2M device is subject to are:

- 1.) OTA (Over the Air) Performance Testing
- 2.) RSE (Radiated Spurious Emissions) Testing
- 3.) SIM (Subscriber Identity Module) Card Electrical Testing

The level of testing required is dependent on the antenna used with the device. RSE and SIM Card testing are required on every device regardless of the antenna used. OTA

performance is not required on a device that uses an external cabled antenna that is located more than 20cm away from the device. If the device uses an internal antenna or an external antenna that is either directly connected to or cabled and placed 20cm or less from the device OTA testing is required.

4.1 OTA Performance Testing

OTA performance testing verifies the radiated performance of the cellular radio within the device. The exact test details are described in the "CTIA Test Plan for Wireless Device Over-the-Air Performance". This document can be found on the CTIA website at <http://www.ctia.org/policy-initiatives/wireless-device-certification/certification-test-plans>. For a high level overview this is broken down into three separate tests to verify the baseline performance the cellular transmitter, receiver, and overall device performance. These are listed below:

- 1.) TRP (Total Radiated Power) testing is run to validate the performance of the cellular transmitter and antenna integration. This test measures the radiated transmit power at various locations surrounding the device and then integrates those measurements over the sphere to give a single TRP measurement. This test is run on the low, mid, and high channels of each supported North American band on the cellular module. There are no TRP limits to directly pass or fail PTRCB certification, but TRP performance limits could be imposed by cellular carriers.
- 2.) TIS (Total Isotropic Sensitivity) is run to validate the performance of the cellular receiver and antenna integration. This test measures the radiated receive level at various locations surrounding the device and then integrates those measurements over the sphere to give a single TIS measurement. This test is run on the low, mid, and high channels of each supported North American band on the cellular module. There are no TIS limits to directly pass or fail PTRCB certification, but TIS performance limits could be imposed by cellular carriers.

3.) RSIC (Relative Sensitivity on Intermediate Channels) testing is run to verify cellular receiver performance on every channel of every North American band supported by the module. This is a requirement that needs to be met in order to pass PTCRB certification. This test orientates the device in the best location and polarization found during TIS testing. With the device held in that location the receive sensitivity level of each channel is measured and compared to the EIRP measured at the low, mid, and high reference channels during TIS testing. The receive sensitivity level for each channel in each band must be within the margin specified in the "CTIA Test Plan for Wireless Device Over-the-Air Performance" documentation in order to pass PTCRB.

4.2 RSE Testing

This is active and idle mode radiated spurious emission testing. This is a requirement to pass PTCRB certification.

The active mode RSE test measures the radiated signal strength of the harmonics of the transmitted cellular signal. This testing needs to be completed on every band that is supported by the module.

Idle mode emissions testing measures the emissions coming from the device while it is in "idle" mode (i.e. cellular radio is not transmitting). This is similar to FCC Part 15B unintentional emissions testing.

4.3 SIM Card Electrical Testing

SIM Card electrical testing verifies the implementation of the SIM card interface external to the module. A test SIM card is placed in the SIM card holder and is connected to a SIM card test simulator. The testing measures the various electrical characteristics of the SIM electrical interface (Power supply voltage drop, rise/fall times, timing requirements, etc.). This test must be passed to complete PTCRB certification.

5. Cellular Carrier Certification

All U.S. carriers will require your GSM device to be FCC and PTCRB certified to be allowed on their network. Along with passing FCC and PTCRB certification the carrier may also have limits imposed on the TRP/TIS performance results measured during PTCRB testing. If your device performs under these required limits it may not be allowed on the network. There may also be certification testing required by your carrier that needs to be performed by them to ensure your device is operating properly on the network without causing interference.

Each cellular carrier has its own unique requirements, so it is important to talk to your intended carrier early on to solidify the proper requirements and required certification testing. These details could dramatically affect device design, functional use cases, and your end business model.