

XeThru Regulatory Approval

Introduction to Regulatory Requirements and Related Setup of XeThru Modules

XeThru Application Note **by Novelda AS**

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Summary

This application note gives an introduction to the regulatory requirements for UWB radar equipment and, if necessary, guides the reader on how to configure the XeThru modules correctly for the required measurements.





1 Introduction

In order to bring a product containing a UWB transmitter to the market, it is necessary to either self-declare or certify the product before launch. The requirements will vary between different geographically regions and also the nature of the actual end-product containing the UWB transmitter. Self-declaration/certification for the UWB part based on XeThru pre-approved modules can in many cases be used in the end product directly. Check the relevant XeThru product datasheet for the current certification status. Novelda has experience with product certification and may also recommend test-labs in different regions.

2 UWB Regulations

Regulatory compliance is a critical requirement for introducing products into the market. Novelda modules are designed to meet world-wide UWB regulations and modules already have regulatory approval for several key markets. In markets where modules are within regulations, the user has to understand:

- regulatory requirements for the use case of the planned product
- if and how Novelda's approval can be reused

A typical scenario can be a home automation product for indoor use where Novelda's modular approval for FCC/ISED or EU Declaration of Conformity for ETSI can be re-used. See the respective datasheets for details and requirements.

Below is a short overview of the most important regulations, for details refer to ETSI's overview of the UWB worldwide regulatory situation [1].

EU/CEPT: The regulatory framework is provided by the Radio Directive defined by the European Commission and based on a set of harmonized standards defined and maintained by ETSI. Market introduction is possible through self-declaration if the product and use case is in line with the requirements of a harmonized standard. If the product/use-case does not directly fall within the harmonized standard it is still possible to introduce a product to the market as long as it is in line with the intentions of the regulation. This is done through a so-called notified body approach where an accredited lab/body evaluates the product and states that it is in line with the regulations. This approach may work for borderline applications, but not cases which are obviously not in line with the intentions of the regulator (EU). Both approaches will enable full market introduction into the CEPT area (EU+EEC). The third alternative is to apply in individual countries which may offer a larger flexibility, but since a relatively complicated procedure must be completed for each individual country, this approach is not recommended unless one aim only at one specific country or small region.

USA: In US, FCC both defines the harmonized standards and controls the regulatory framework. Since self-declaration is not possible within US, an FCC application is necessary to introduce a product into the market. Novelda's modular FCC approval allows the module to be used in an end product without obtaining new UWB related authorization for the product. In general the FCC standards are more general and leaves a larger room for uncertainty than for EU/ETSI, meaning that some applications may be difficult to assess without having a meeting with FCC. Typically this is done using a lawyer with expertise on FCC prior to submitting the FCC application. If the application/customer case does not fall into the harmonized regulations, it is possible to apply for a waiver, but this procedure can be complicated and time/resource consuming.



Canada: In Canada ISED handles the regulations. For all practical purposes, the Canadian regulations are similar to US/FCC and the same test-reports etc may be used.

ASIA: The large markets in Asia are China, Korea and Japan. While the Chinese regulations are very similar to the European, Korea and Japan has defined a higher frequency band (7.25GHz - 10.2GHz) for generic use. The test procedure and certification in Asian countries are typically slightly more complicated than in EU/FCC/Canada as they will require both radiated and conducted samples for testing. Test labs will advice on the detailed procedure.

Fig.1 depicts a rough overview of the allowed frequency ranges for some areas and countries worldwide.

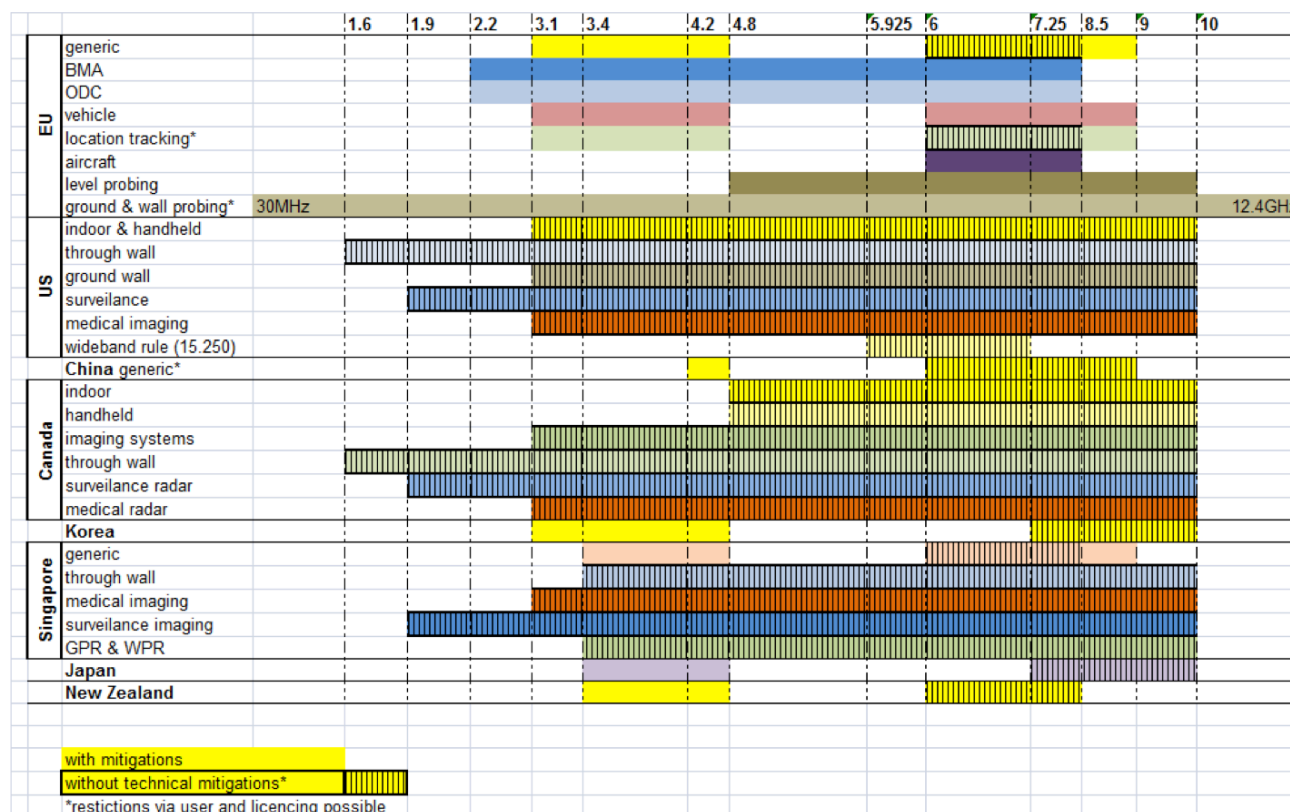


Fig. 1. Worldwide UWB regulations [2].

Some situations require new UWB regulatory approval. Certification or self-declaration in all regions typically require that an accredited test lab tests the planned product and a number of samples and product details must be submitted to this lab. The company developing the end-product must check the regulatory requirements for the planned use case and determine whether the regulatory approvals obtained from Novelda are sufficient for their product. To ease this process, certification modes in the standard module firmware may be activated by jumper settings and without need for a computer to run the emission tests.

3 Required Certification Modes

The following modes have been identified to cover the measurements required for UWB regulatory approval.



3.1 TX Only

Enables continuous UWB transmission, with all other activities disabled. Meaning that only the digital circuitry needed for operating the UWB transmitter, and the UWB transmitter is enabled. This mode is used to demonstrate the isolated emissions from the UWB transmitter, and the emissions generated by the digital circuitry needed to enable UWB transmission. The UWB transmitter must be set to continuous worst-case transmission, i.e. that a pulse is sent at every Pulse Reptition Interval for the given chip setting, to maximize the average energy emitted from the module.

3.2 TX Digital Only

Enables only the digital part used for continuous UWB transmitting, with all other activities disabled. The exact same settings as TX Only mode is used, but with the UWB transmitter disabled. This mode demonstrates radiated emissions from digital circuitry used to enable operation of the UWB transmitter.

3.3 Stream

Normal operation of the module with UWB transmitter and all other associated digital devices, used to control additional functions or capabilities on module, activated. This mode is used to demonstrate typical emissions from a module during normal operation.

3.4 Stream TX Off

Same as Stream mode, with the UWB transmitter disabled. Disables continuous UWB transmitting, while associated digital devices used to control additional functions or capabilities on module is operating. This mode is used to demonstrate emissions from unintentional radiators not needed for, or generated by, UWB transmission.

3.5 RX Fail Detection

In normal operation, the FW monitors the sampler outputs to ensure acknowledgement of reception. If no such acknowledgement is received, the EUT will shut down the transmitter within 10 seconds.

During certification test, this situation can be provoked / emulated by forcing the receiver to not provide an acknowledgement of reception.

4 Module Certification Modes

XeThru Embedded Platform (XEP) and other XeThru X4 module application firmwares implements the required set of certification modes. These can be activated directly through the protocol (available for TX Only, TX Digital Only and Stream TX Off), or by jumpers after setting the module in certification mode. All cases requires pymoduleconnector [3] to be installed.



4.1 Activating Modes Through Protocol

Certification modes can be directly activated by using the protocol command `system_run_test` with the arguments 0x1D (Tx Only, defined as `XTS_SSTC_CERT_TX_ONLY`), 0x1E (TX Digital Only, defined as `XTS_SSTC_TEST_CERT_TX_ONLY_TX_OFF`) and 0x1F (Stream TX Off, defined as `XTS_SSTC_TEST_CERT_STREAM_TX_OFF`). The Python script below gives an example on how to set EUT in TX Only mode.

```
from pymoduleconnector import ModuleConnector
import pymoduleconnector.moduleconnectorwrapper as mcw
from pymoduleconnector.extras.auto import auto
# Manually set the device name, e.g. "COM3"
# or set to "auto" to search for the device
device_name = "auto"
if device_name == "auto":
    device_name = auto()[0]

mc = ModuleConnector(device_name)
xep = mc.get_xep()
app = mc.get_x4m300()

data = mcw.ucVector()
app.system_run_test(0x1D, data)
mc.close()
```

A hardware reset or power toggle is required to get the module back to normal operation, and to be able to change modes.

4.2 Activating Modes Through Jumpers

4.2.1 Preparing Module for Certification Mode

Before attempting to run a test, EUT must be set in certification mode. This can be done by connecting EUT to a PC and running the Python script below. To prevent EUT from immediately starting a test, make sure no jumpers are mounted on the header.



```
from pymoduleconnector import ModuleConnector
import pymoduleconnector.moduleconnectorwrapper as mcw
from pymoduleconnector.extras.auto import auto
# Manually set the device name, e.g. "COM3"
# or set to "auto" to search for the device
device_name = "auto"
if device_name == "auto":
    device_name = auto()[0]

mc = ModuleConnector(device_name)
xep = mc.get_xep()
app = mc.get_x4m300()

data = mcw.ucVector()
app.system_run_test(0x1A, data)

xep.module_reset()
mc.close()
```

After EUT has been successfully set to certification mode, the RGB LED will be steady yellow. Note that some tests (e.g. TX Only) will set the RGB LED off, so make sure no certification mode is selected when trying to verify that EUT is in certification mode.

The EUT can run in the test chamber without having any USB communication, it only requires battery power (USB power bank).

The test mode setting survives a power cycle. This means that the unit under test can be power cycled as many times as required in the test chamber without the need for any further USB communication.

When in test mode, the different settings are controlled by jumpers. The jumper settings will be explained.

To bring EUT back to normal operation, run the following script:

```
from pymoduleconnector import ModuleConnector
import pymoduleconnector.moduleconnectorwrapper as mcw
from pymoduleconnector.extras.auto import auto
# Manually set the device name, e.g. "COM3"
# or set to "auto" to search for the device
device_name = "auto"
if device_name == "auto":
    device_name = auto()[0]
mc = ModuleConnector(device_name)
xep = mc.get_xep()
app = mc.get_x4m300()

data = mcw.ucVector()
app.system_run_test(0x1B, data)

xep.module_reset()
mc.close()
```



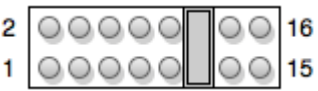

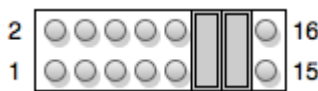
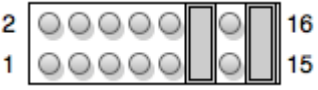
4.2.2 Starting Test in Certification Mode

Tests are started by following the procedure:

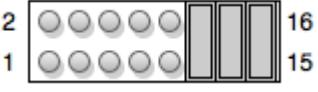

1. Set the EUT in the desired test mode using the jumper settings described in the table below.
2. Power up the EUT using a standard USB cable connected to a USB power or hub.
3. The EUT shall now be operating in the desired test mode and measurements can start.
4. To switch between test modes, disconnect the USB power and change jumper settings to the new test mode. Then connect USB power and the EUT should now be in the new test mode.

Test modes are controlled by interconnecting IO-pins available on the 16-pin header, by e.g. placing jumpers over the pins. Refer to Table 1 for jumper settings for each test mode.

Table 1. Jumper settings for each test mode.

Certification Mode	Jumper Setting	Description
Tx Only		Enables continuous UWB transmission, with all other activities disabled. Meaning that only the digital circuitry needed for operating the UWB transmitter, and the UWB transmitter is enabled. This mode is used to demonstrate the isolated emissions from the UWB transmitter, and the emissions generated by the digital circuitry needed to enable UWB transmission. The UWB transmitter must be set to continuous worst case transmission, i.e. that a pulse is sent at every PRI interval for the given chip setting, to maximize the average energy emitted from the module. LED is off in this mode to minimize noise.
Tx Only Digital		Enables only the digital part used for continuous UWB transmitting, with all other activities disabled. The exact same settings as Tx only mode is used, but with the UWB transmitter disabled. This mode demonstrates radiated emissions from digital circuitry used to enable operation of the UWB transmitter. These emissions should comply with FCC 15.521, § 15.209. LED is off in this mode to minimize noise.
Stream Tx Off		Disables continuous UWB transmitting, while associated digital devices used to control additional functions or capabilities on module is operating. This mode is used to demonstrate emissions from unintentional radiators not needed for, or generated by, UWB transmission. LED is orange in this mode.
Stream		Normal operation of the module with both UWB transmitter and associated digital devices, used to control additional functions or capabilities on module, activated. This mode is used to demonstrate typical emissions from a module during normal operation. LED is orange in this mode.



Certification Mode	Jumper Setting	Description
Rx Fail Detection		<p>In normal operation, the FW monitors the sampler outputs to ensure acknowledgement of reception. If no such acknowledgement is received, the EUT will shut down the transmitter within 10 seconds.</p> <p>During certification test, this situation can be provoked / emulated by forcing the receiver to not provide an acknowledgement of reception. The procedure is as follows: 1. Power off the device. 2. Set the EUT in Stream mode by the appropriate jumpers (11/12 and 15/16). 3. Power up the device by connecting the USB cable. The EUT should now emulate normal operation. 4. Set RX Fail emulation jumper (13/14), this will emulate a missing acknowledgement within 3 seconds. 5. TX should now be shut down by the standard FW.</p> <p>Alternatively, all three jumpers may be set in step 2 and then power up and omit step 4. The EUT will start transmitting and within maximum 10 seconds shut down. LED is orange in this mode.</p>
End Certification Test		<p>Setting this jumper setting while the device is powered will return the module to normal operation after the execution of a power cycle. The module will then respond to the normal API over USB. Note that the EUT may be brought back to any other test mode by the appropriate jumper setting. LED is orange in this mode.</p>

5 References

[1]	ETSI, ICNIRP, "ETSI TR 103 181-3, Short Range Devices (SRD) using Ultra Wide Band (UWB); Part 3: Worldwide UWB regulations between 3,1 and 10,6 GHz", Technical Report, http://www.etsi.org/technologies-clusters/technologies/radio/ultra-wide-band
[2]	Dr. Michael Mahler, "European UWB activities and worldwide UWB harmonization needs", Presentation, ITU workshop on short range devices and ultra wide band, slide 9, Jun. 2014
[3]	Novelda, "Module Connector", www.xethru.com

6 Document History

Rev.	Release Date	Change Description
A	2018-05-05	Initial release.



Rev.	Release Date	Change Description
B	2018-12-04	Add detailed description for certification modes.



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