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1 Acronyms, Glossary, Conventions

Table 1-1 introduces the acronyms used inside the document:

Acronym	Meaning
BLE	Bluetooth Low Energy
GFSK	Gaussian Frequency Shift Keying
IC	Integrated Circuit
LDO	Low Drop Out
MCU	Micro-controller Unit
OTAP	Over the Air Programming
UART	Universal Asynchronous Receiver Transmitter
SMT	Surface Mount Technology
TBD	To Be Defined

Table 1-1

Table 1-2 introduces the Glossary of terms used inside the document:

Term	Meaning

Table 1-2

Table 1-3 introduces the conventions list adopted by the document:

Convention	Meaning

Table 1-3

2 Bibliography and Reference Documents

Table 2-1 shows the list of books, articles and documents cited within the document and the correlation with the code used for their citation:

Citation Data	Code

Table 2-1

3 Document Subject

The document integrates:

- The analysis of modular approval conditions applied to Midatronics BLE module
- The test setup
- The firmware

4 Analysis of Modular Approval Conditions Applied to Midatronics BLE Module

Relating FCC Part 15.212(a) the modular approval conditions applied to Midatronics BLE Module are analyzed:

Requirement	Compliance
The radio elements must have the radio frequency circuitry shielded. Physical components and tuning capacitor(s) may be located external to the shield, but must be on the module assembly	<p>YES</p> <p>All the radio electronics is covered by a shield. Specifically covered by a shield there are:</p> <ul style="list-style-type: none"> • The radio IC • The oscillator • The switching power supply that generates the power supply of the module • The antenna matching circuit
The module must have buffered modulation/data inputs to ensure that the device will comply with Part 15 requirements with any type of input signal	<p>YES</p> <p>The microcontroller is inside the module and manages the data packets that are charged into the radio IC. The radio IC manage the Bluetooth Low Energy (all the communication layers) protocol to send data.</p>
The module must contain power supply regulation on the module	<p>YES</p> <p>The module contains a switching power supply integrated inside the main ASIC that generates all the regulated and stable power supply.</p>
The module must contain a permanently attached antenna, or contain a unique antenna connector, and be marketed and operated only with specific antenna(s), per Sections 15.203, 15.204(b), 15.204(c), 15.212(a), 2.929(b)	<p>YES</p> <p>The module has two versions: one with PCB integrated antenna and one with an uFL connector that hosts an external antenna.</p>

Requirement	Compliance
<p>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)).</p>	<p>YES</p> <p>A minimal host has been provided for the tests. It contains the module and pin strips in order to get out all the I/O pins and the supply signals.</p>
<p>The module must be labelled with its permanently affixed FCC ID label, or use an electronic display (See KDB Publication 784748 about labelling requirements)</p>	<p>YES</p> <p>In the final version the shield will be covered by a label with FCC ID.</p>
<p>The module must comply with all specific rules applicable to the transmitter including all the conditions provided in the integration instructions by the grantee</p>	<p>YES</p> <p>To demonstrate during the FCC tests.</p>
<p>The module must comply with RF exposure requirements</p>	<p>YES</p> <p>To demonstrate with specific calculations.</p>

Table 4-1

5 The Test Setup

The module with integrated PCB antenna picture is reported in Figure 5-1:

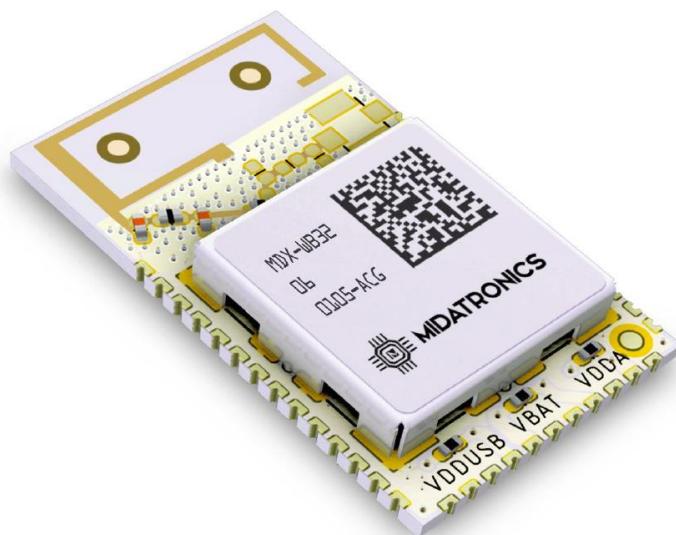


Figure 5-1

The module with uFL connector and external antenna picture is reported in Figure 5-2:



Figure 5-2

As shown in Figure 5-3, the module must be soldered on a host.

Actually we have a simple host as shown in Figure 5-3 (the specific figure shows the module without shield). This specific host extend the module functionalities to realize a thermal controller:



Figure 5-3

6 The Firmware

The firmware is distinguished into two different parts:

- The BLE communication stack
- The application firmware

The BLE communication stack will remain always unchanged for RF point of view.

The application firmware is in charge of the customer.