EUGSTER / FRISMAG

«Ihre Idee
unsere Kompetenz
Ihr Erfolg»

Bluetooth LE Module EFBTLE16

Data Sheet

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EUGSTER / FRISMAG

PURPOSE

This document contains descriptions and specifications of the BLE Module EFBTLE16.

2 ABBREVATIONS

DTM Direct Test Mode

BLE Bluetooth Low Energy

3 REFERENCES

[1] ZEM024-BTLE-PCB-008-A production data: SVN #373

[2] Needed_Technical_Information_for_Safety_Measurements_General.docx

[3] Kingboard Lamina FR4 E123995.pdf

[4] nRF51822 specifications, Nordic http://www.nordicsemi.com nRF51822-PS.pdf

[5] Evaluation Board for BLE Module evaluation and testing: EVB 1.01, SVN #211

[6] CETECOM RF test report 1-0526/15-01-03 for EN 300 328

4 RATINGS

Supply voltage VDD: 2.65 – 3.6V
Supply current: Max. 15mA
Power consumption: Max. 54mW
IO Voltage: Max VDD + 0.3V
Operating temperature: -20 – 80°C

For detailed specifications please refer to the nRF51822 specifications from Nordic [2].

5 PRODUCT DESCRIPTION

Bluetooth Version: 4.1

Band support: 2.4GHz, 40 Channels (2.402MHz – 2.480MHz)

Typical conducted output power: 0dBm

Radiated output Power (EIRP): -1.9 – 0.1 dBm over all 40 Channels (with on board PCB antenna)

Antenna Type: on board PCB Antenna (no external antenna applicable)

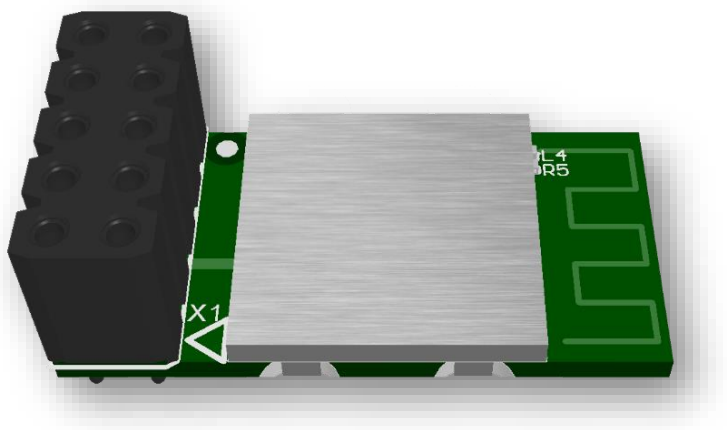
Antenna gain: -0.5dB

Supports 2.4GHz Bluetooth Low Energy radio Modes

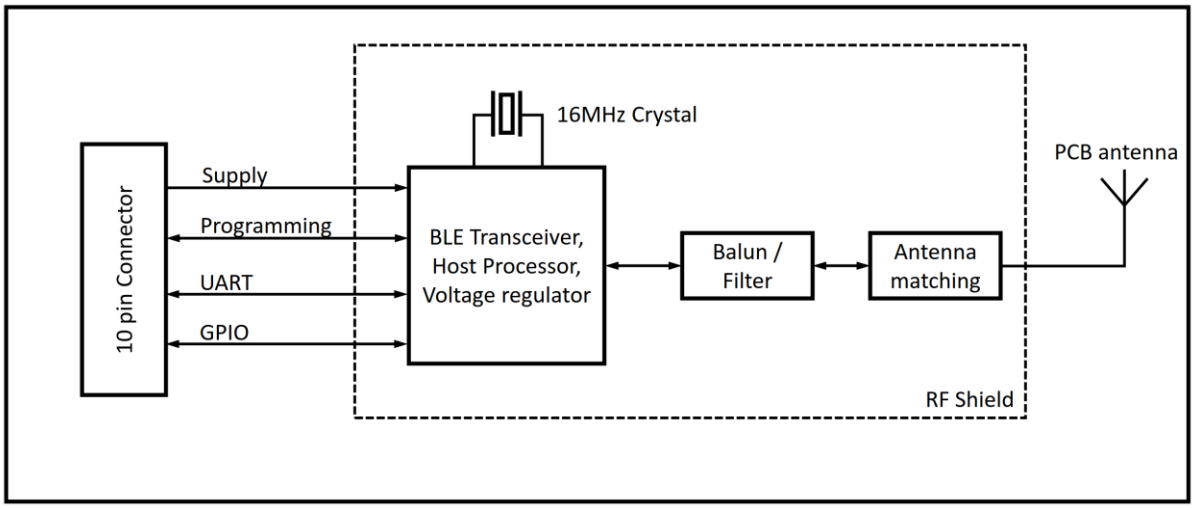
Supported BLE data rates: 1Mbps

6 MODULE OVERVIEW

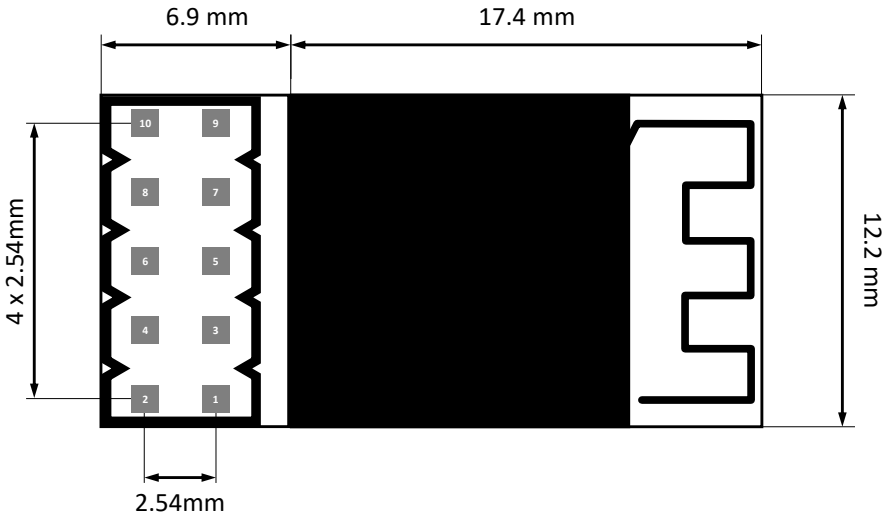
The EFBTLE16 module is equipped with an integrated PCB antenna, a RF shielding and a socket connector for easy applying to a host controller board.



6.1 BLOCK DIAGRAM



6.2 DIMENSIONS (TOP VIEW)



1. SWDIO
2. SWCLK
3. GPIO1
4. COM_DISABLE
5. VDD
6. GND
7. RTS/CLK
8. CTS/CS
9. TXD/MISO
10. RXD/MOSI

Image 1 Module dimension, top view with pinout (not to be scaled)

6.3 PIN DESCRIPTION

Pin	Name	Description	Direction
1	SWDIO	Serial Wire debugging, connect to testpoint or connector (see Image 2)	input/output
2	SWCLK	Serial Wire debugging, connect to testpoint or connector (see Image 2)	Input
3	GPIO1	General purpose input/output / ADC input	input/output
4	COM_DISABLE	Disable communication interface, active high	input
5	VDD	Power supply positive voltage	-
6	GND	Power supply GND	-

7	RTS/CLK	UART ready to send / SPI clock	output/input
8	CTS/CS	UART clear to send / SPI chip select	input
9	TXD/MISO	UART output / SPI Master input	output
10	RXD/MOSI	UART input / SPI Master output	input

Table 1 Pin description

6.3.1 Power Supply

Decoupling capacitors between VDD and GND are not mandatory.

6.3.2 Host Interface

Communication between BLE module and host can be established through UART or SPI by using TXD/MISO, RXD/MOSI, CTS/CS and RTS/CLK. The communication interface is disabled through COM_DISABLE pin.

6.3.3 GPIO

GPIO1 can be used for any purpose and has analogue capabilities.

6.3.4 JTAG/SWD

SWDIO and SWCLK are required for programming and debugging and must be accessible on the BLE Module. Image 2 shows the standard 10 pin cortex debug connector.

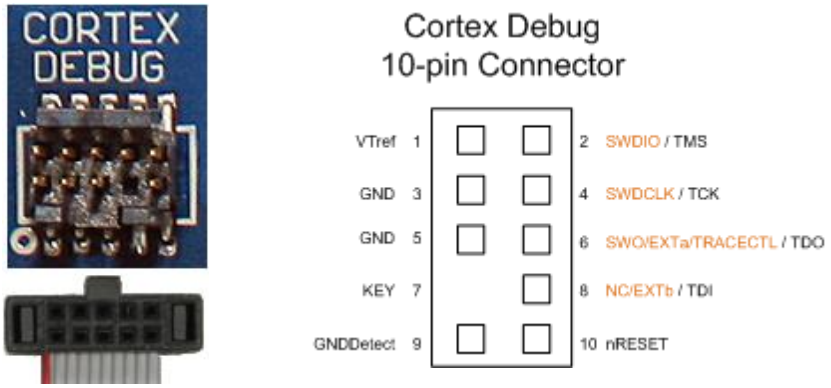
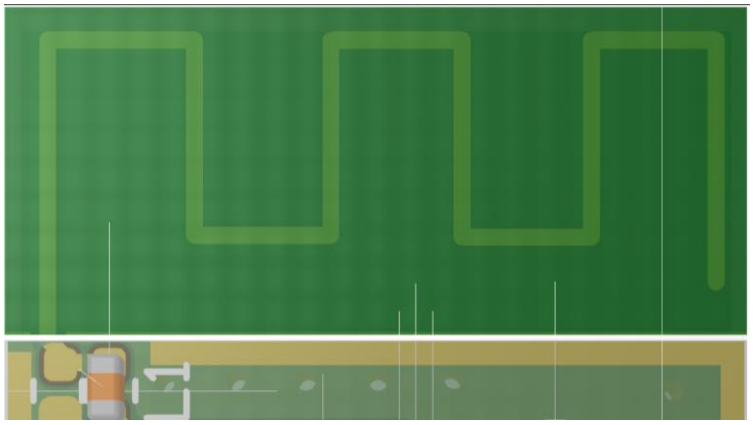


Image 2 Programming interface

7 RF PERFORMANCE

7.1 ANTENNA DESIGN

The EFBTLE16 comes with a microstrip PCB antenna. There is no option for using an external antenna or any antenna matching by the module integrator. The EFBTLE16 is FCC approved with only this antenna type.



7.2 ANTENNA MATCHING

The antenna matching is performed on a standalone BLE Module with RF Shield mounted. The RF Filter components where removed and a Vector Network Analyzer (VNA) was connected to the antenna matching circuit to measure the antenna impedance and SWR as seen by the PA.

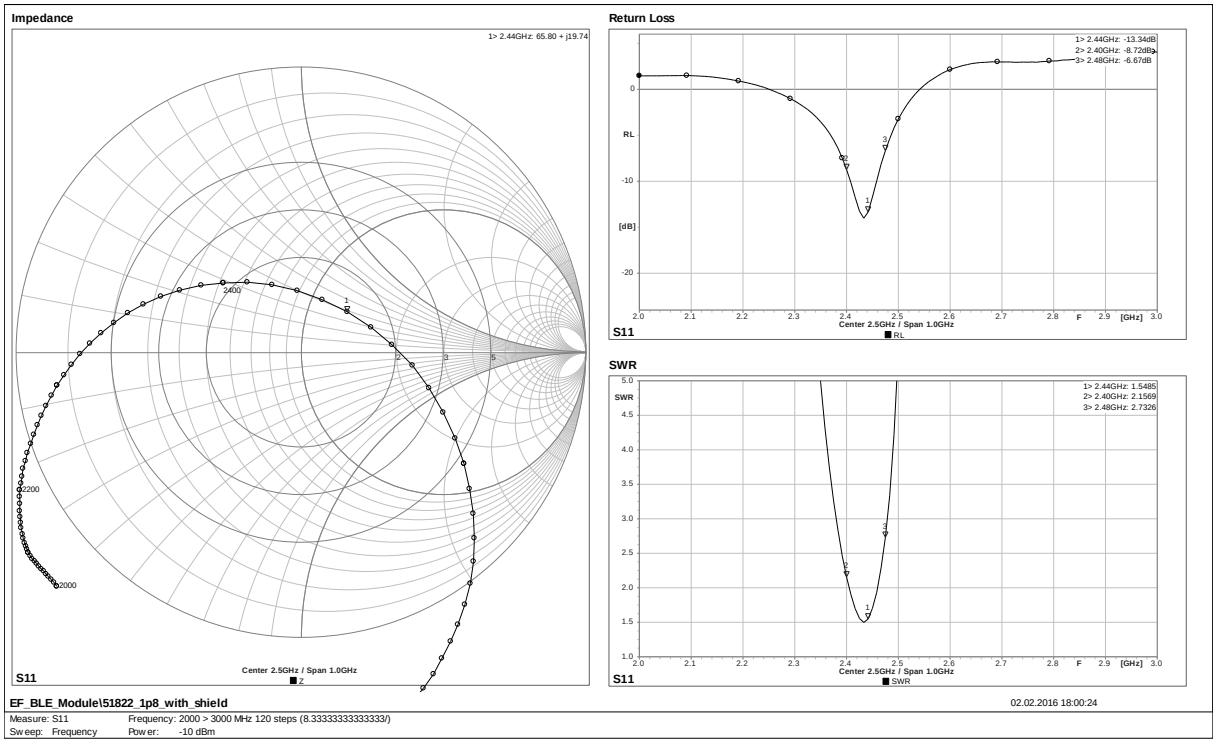


Image 3 Antenna tuning

7.3 Radiation pattern

The radiation pattern where recorded in an anechoic chamber to see the characteristic radiation pattern.

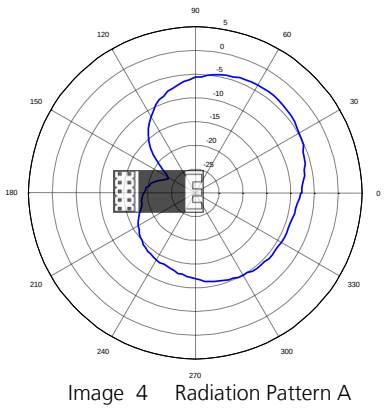


Image 4 Radiation Pattern A

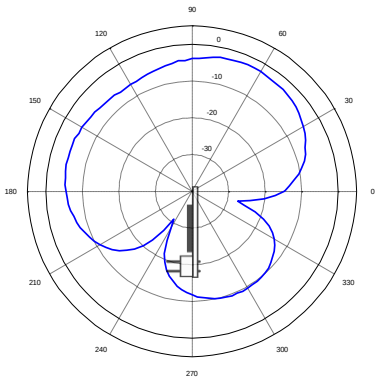


Image 5 Radiation Pattern B

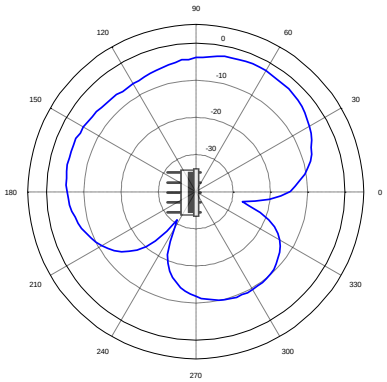


Image 6 Radiation Pattern C

8 Layout and Integration Guidance

This module comes with an integrated PCB antenna only. When integrating the module in host applications the following design rules shall be considered:

- Avoid any high speed or sensitive traces below the module
- Place the module as far away from other components such as DCDC converters and processors as possible
- For best RF performance, place the module on the border of the PCB and centred to be as symmetrical as possible.
- Around the antenna area, all layers of the host circuit board should be free of any metal objects. Specifically, there should be no ground plane, traces or metal shield case
- Host circuit PCB length is longer than 40mm to get optimal performance by using ground plane
- Right side of antenna area also should be free of grounds
- Metal and plastic materials should be away from the module. (more than 3mm)
- Place the module as far away from any metal components such as enclosure, screws as possible

9 PCB Specifications

To maintain RF performance and to comply with the regulations, the PCB specifications during production must not change and must follow the specifications below. Detailed material properties can be found in [2][3].

9.1 Layout

Number of layers: 4

Min track width: 0.152mm (6 mil)

Min drill size: 0.25mm (9.8 mil)

Solder resist: Top and bottom (green)

Silk screen: white

9.2 Material

For detailed material properties and manufacturer speficiations please check [2][3].

9.3 PCB Production

9.3.1 Sideplating

Please note, the 4 slots for soldering the RF shield must be plated. Therefore, these holes must be produced together with the vias (see Image 7).

9.3.2 Panel connections

Connections to the panel are only allowed on the upper and lower border of the module. Panel connections in the antenna area are prohibited (see Image 7).

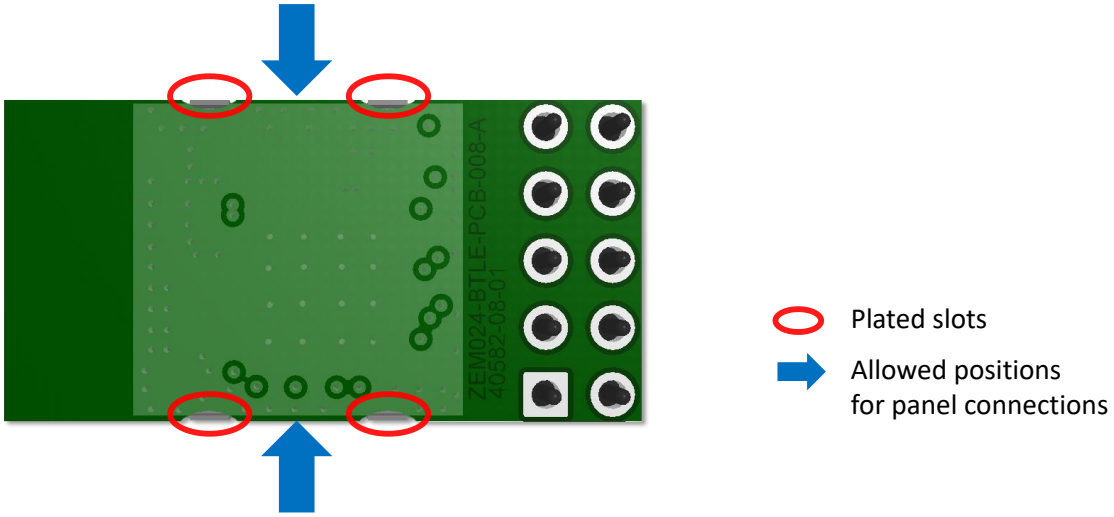


Image 7 Production hints

10 SHIELD SPECIFICATIONS

The RF shield reduces RF emissions and immisions and helps to better place the assembled module on the target hardware. Product descriptions and information (such as FCC-ID e.g.) are printed on the shield. The shield is also required for FCC modular approvals.

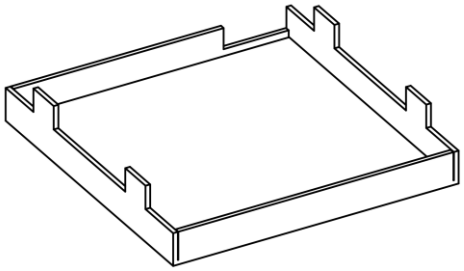


Image 8 RF shield 3D visualisation

10.1 TOP VIEW

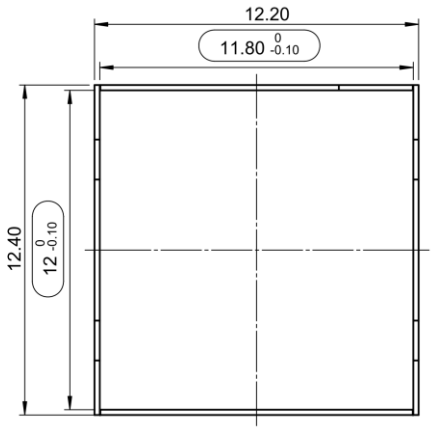


Image 9 RF shield top view

10.2 FRONT VIEW

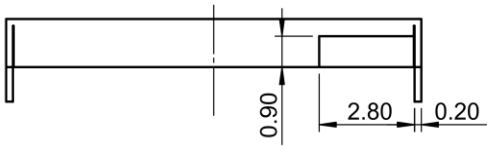


Image 10 RF shield front view

10.3 SIDE VIEW

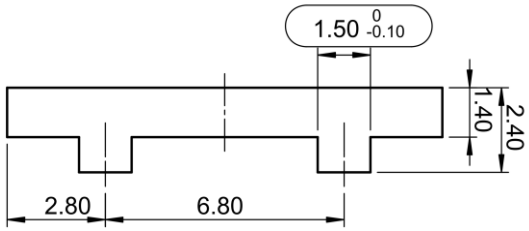
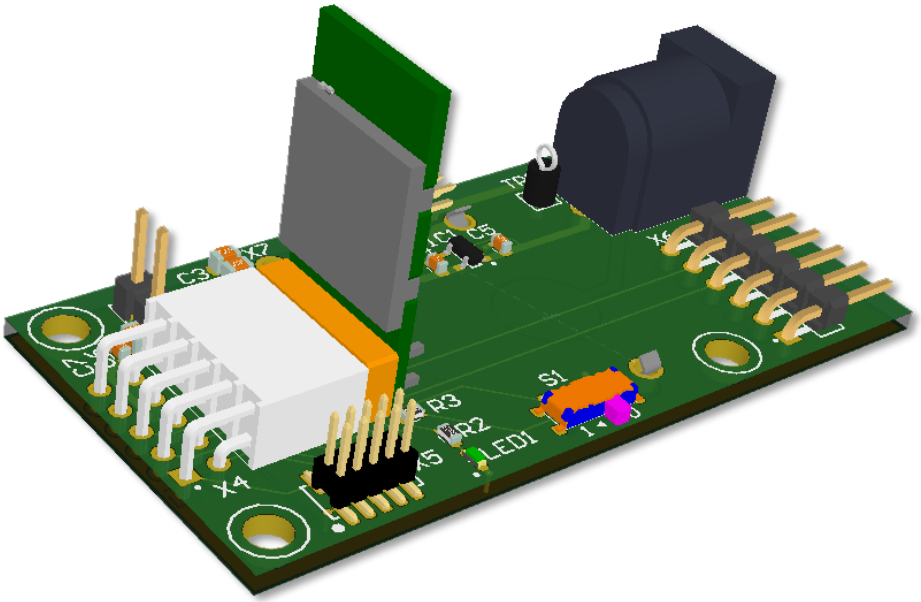


Image 11 RF shield side view

11 TEST BOARD

For initial programming and testing, the Test Board [5] as shown below is used. Using the Test Board, following tasks are possible:

- Programming / debugging
- DTM communication
- Current measurements
- Radiated and conducted RF testing



12 RF EXPOSURE

This equipment complies with radiation exposure limits set forth for an uncontrolled environment. This equipment is in direct contact with the body of the user under normal operating conditions. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Cet équipement est conforme aux limites d'exposition aux radiations dans un environnement non contrôlé. Cet équipement est en contact direct avec le corps de l'utilisateur dans des conditions de fonctionnement normales. Cet émetteur ne doit pas être co-localisées ou opérant en conjonction avec tout autre antenne ou transmetteur.

If the module will be used for portable applications, the device must undergo SAR testing.

The following statement must be included as a CAUTION statement in manuals for the products to alert users on FCC RF exposure compliance:

"WARNING: To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operations at closer distances than this are not recommended."

13 QUALIFICATION AND APPROVALS

The table below shows the regulatory compliance status of the EFBTLE16 module.

Regulatory Body	Standard	Certificate ID
FCC	Part 15	2AIWT-EFBTLE16
IC	RSS-210	21696-EFBTLE16
ETSI	EN300 328, Ver. 2.1.1 ETSI EN301.489 - 17	Compliant
Bluetooth SIG	BT 4.2	Declaration ID D031329

13.1 FCC NOTICE (USA)

Warning: Changes or modifications to this device not expressly approved by Eugster could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The FCC requires the module integrator to be notified that any changes or modifications not expressly approved by Eugster may void the user's authority to operate the equipment. While an application of the EFBTLE16 module in a product is not required to obtain a new FCC authorization for the module, this does not preclude the possibility that some other form of authorization or testing may be required for that end product.

This device has been tested to comply with FCC CFR Part 15. The device meets the requirements for modular transmitter approval as detailed in the FCC 47 CFR 15.212.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the module.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver.
- Is connected.
- Consult Eugster or an experienced RF technician for help.

13.2 FCC Labeling Requirements

When integrating the EFBTLE16 into a product the FCC labeling requirements must be met. This includes a clearly visible label on the outside of the finished product specifying the EFBTLE16 FCC identifier (FCC ID: 2AIWT-EFBTLE16) as well as the notice above. The exterior label can use wording such as "Contains Transmitter Module FCC ID: 2AIWT-EFBTLE16" or "Contains FCC ID: 2AIWT-EFBTLE16" although any similar wording that expresses the same meaning may be used.

13.3 IC Notice (Canada)

The term "IC" before the certification/registration number only signifies that the Industry Canada technical specifications were met.

Le terme "IC" devant le numéro de certification /d'enregistrement signifie seulement que les spécifications techniques Industrie Canada ont été respectées.

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to The following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil est conforme avec Industrie Canada RSS standard exempts de licence (s). Son utilisation est soumise à Les deux conditions suivantes: (1) cet appareil ne peut pas provoquer d'interférences et (2) cet appareil doit accepter Toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement du dispositif.

This device complies with Health Canada's Safety Code 6 / IC RSS-210. The installer of this device should ensure that RF radiation is not emitted in excess of the Health Canada's requirement. Information can be obtained at: http://www.hcsc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct-eng.php

Cet appareil est conforme avec Santé Canada Code de sécurité 6 / IC RSS-210. Le programme d'installation de cet appareil doit s'assurer que les rayonnements RF n'est pas émis au-delà de l'exigence de Santé Canada. Les informations peuvent être obtenues: http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct-eng.php

13.4 IC LABELING REQUIREMENTS

The host device should be properly labeled to identify the module within the host device. The Industry Canada certification label of a module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labeled to display the Industry Canada certification number of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as follows:

Contains transmitter module IC: 21696-EFBTLE16, where 21696-EFBTLE16 is the module's certification number.

13.5 ESTI COMPLIANCE (EUROPE)

This device has been tested for use in the European Union. The EFBTLE16 comply with the following regulation test. ETSI EN300 328, Ver. 2.1.1 ETSI EN301.489 - 17

If this device is used in a product, the module integrated has responsibility to verify compliance of the final product to the EU standards. A Declaration of Conformity must be issued and kept on file as described in Annex II of the Radio and Telecommunications Terminal Equipment Directive.