interactive EFR24CM Compute Module Instruction Manual

Contents

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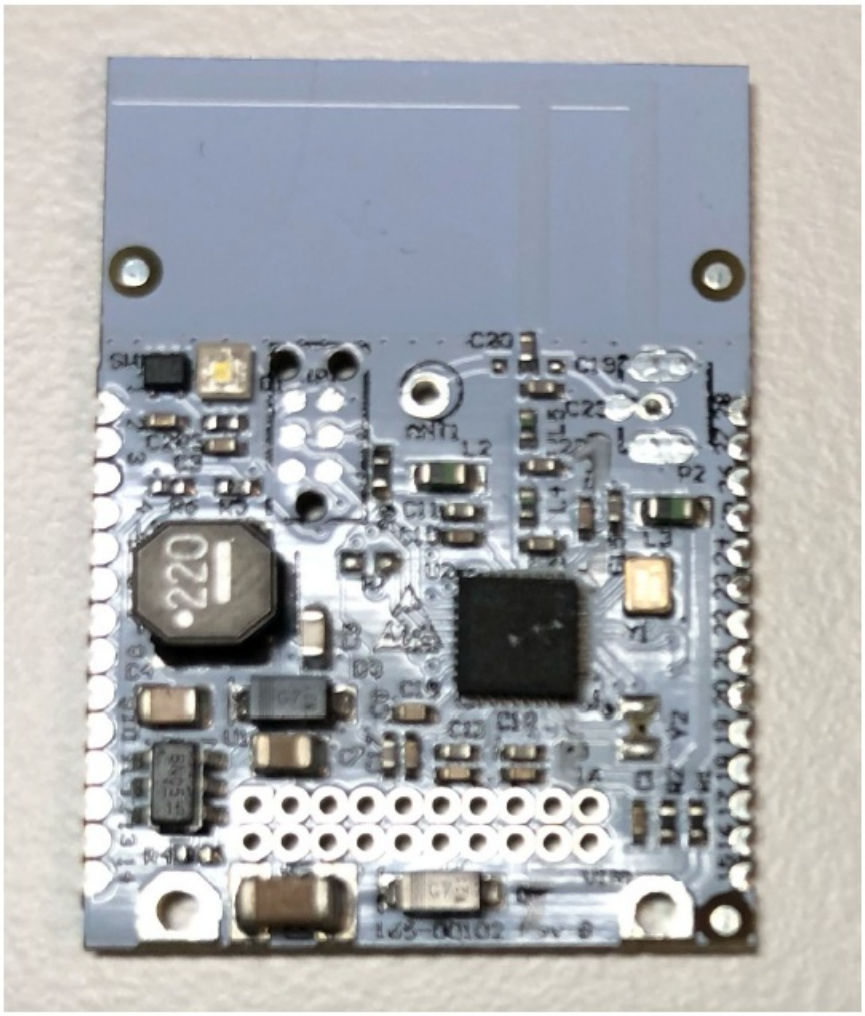


Product Information

Specifications

- Manufacturer: Interactive Technologies, Inc
- Product Name: EFR24CM Compute Module
- MCU: Silicon Labs EFR32MG21 series Mighty Gecko MCU
- Wireless Support: BLE and 802.15.4
- Features: Pixel LED, Hall sensor, 36V tolerant Power regulator
- Antennas: Printed inverted `F' 2.4GHz antenna (included), Optional 3cm wire antenna or U.FL connector
- GPIO Pins: 20 pins available from EFR32MG21, 4 ground pins, access to 3V3 and 12V rails
- MCU Specs: ARM Cortex M33, 80MHz, 96KB RAM, 1024KB Flash

Product Usage Instructions

Installation and Configuration

The EFR24CM Module must be configured at installation:

- For printed antenna: North-facing 10pF capacitor required
- For external 8dBi antenna: East-facing 10pF capacitor and optional U.FL connector required
- For soldered wire antenna: West-facing 10pF capacitor required

- **NOTE:** Only one capacitor is supported at a time.

Power Supply
Power can be provided directly via the 3V3 rail or the 12V which feeds the power regulator. Exercise caution with 36V on the 12V rail.

Module Connections
The Module features various connections including GPIO pins, ground pins, and access to power rails. Refer to the pinout diagram for details.

FAQ

- Q: Can I use multiple antennas simultaneously with the EFR24CM Module?
  A: No, only one antenna can be used at a time due to the supported capacitor configurations.
- Q: What is the maximum voltage tolerance for the EFR24CMModule?
  A: The module can tolerate up to 36V on the 12V rail, but caution must be taken when applying such voltage.

Description

- The EFR24CM Compute Module (aka. The “Module”) features Silicon Labs EFR32MG21 series “Mighty Gecko” MCU with built-in BLE and 802.15.4 wireless support. Additionally, the Module is equipped with a pixel LED, Hall sensor, and 36V tolerant Power regulator.
- The Module comes with a printed, inverted ‘F’ 2.4GHz antenna, but has connections for an optional 3cm wire antenna or U.FL connector.
- The left and right edges of the board expose the 20 GPIO pins from the EFR32MG21 and offer 4 ground and access to the 3V3 and 12V rails, and the LEDs output line to allow daisy chaining of additional LEDs. Thru-hole pins are also provided to allow for varied build configurations where space is an issue.
- Power can be provided to the Module directly via the 3V3 rail, which supplies the various ICs, or via the 12V rail which feeds the power regulator.
- **NOTE**: The module can tolerate 36V on the 12V rail, but be cautious when applying a voltage of this magnitude as the Module has no transient current protection.
- The Module includes the EFR32MG21F1024A020IM32 MCU manufactured by Silicon Laboratories, Inc, which features an 80MHz ARM Cortex M33 , 96KB of ram, 1024KB of on-die Flash, and built in BLE and 802.15.4 wireless support.

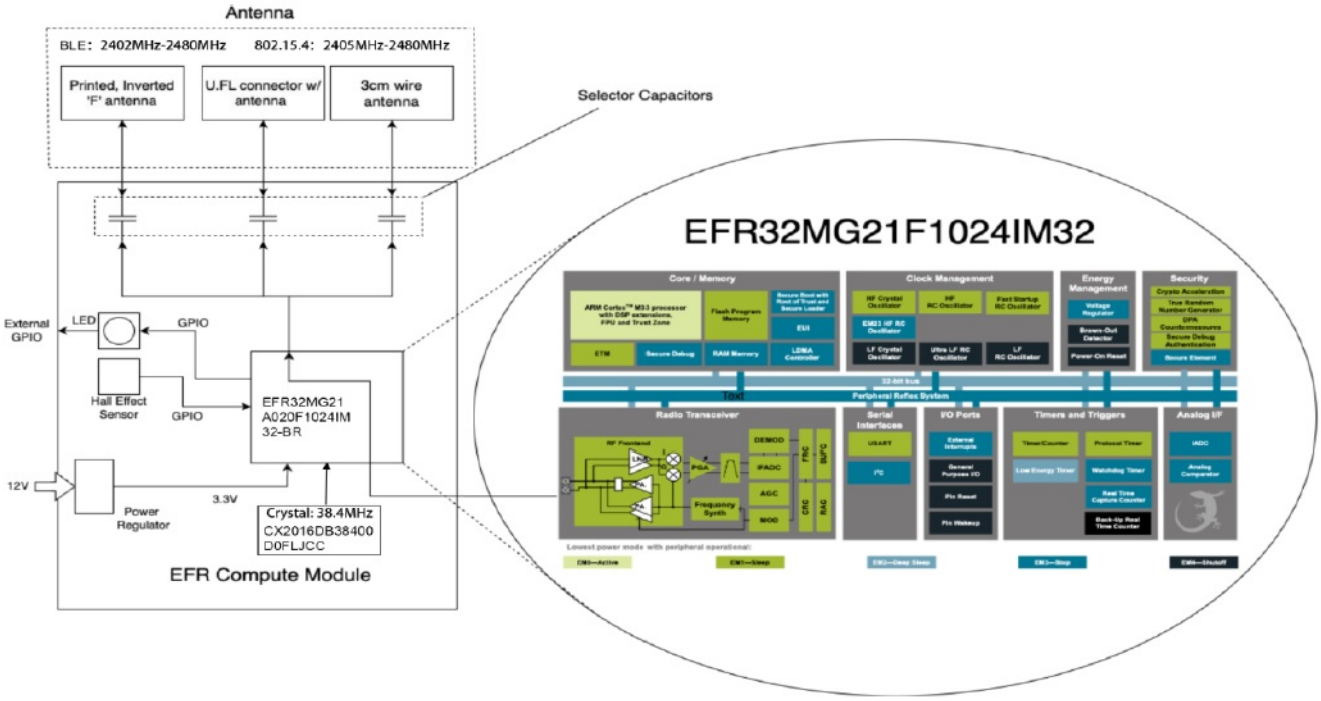
Features

- Bluetooth
  - Bluetooth 5.1support
  - Bluetooth Mesh support
- 802.15.4
  - Zigbee support
  - Thread support
- Radio HW
  - Sensitive to -104.5dBm reception

- Frequency Range:
  - 2400MHz –
  - 2483.5MHz

Module Theory of Operation

Figure 2: Block diagram of Module



Operation

The EFR24CM Module must be configured at installation.

- Proper antenna must be selected
  - North-facing 10pF capacitor must be present to use the printed antenna *
  - East-facing 10pF capacitor and optional U.FL connector must be present to use the external 8dBi antenna
  - West-facing 10pF capacitor must be present to use a soldered wire antenna.
  - NOTE: ONLY ONE capacitor is supported at a time.
- Printed antenna may be removed from the Module if unused.

Power must be provided:

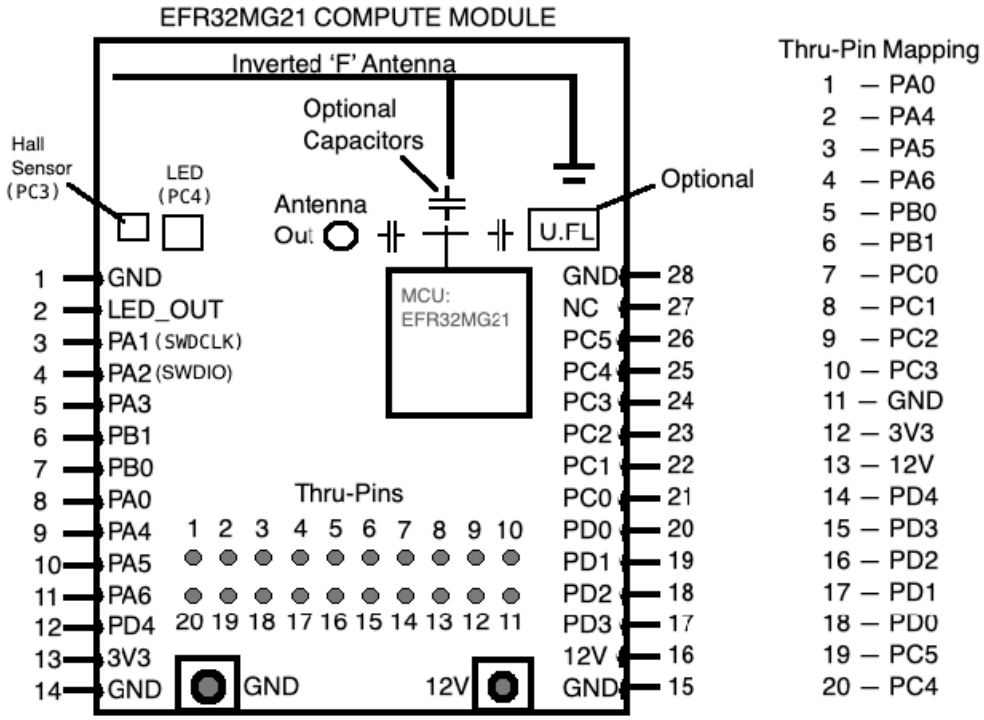
- May supply 2.0 – 3.6 volts to the 3V3 rail of the Module to power the MCU and components, or…
- May instead supply 6 – 26V to the 12V rail of the Module (Note: be cautious of power insertion above 26V as the module has no transient voltage protection.

  All other connections and behavior of the module are dependent upon application of the module. Please refer to any additional documentation included with module, or included with the product which contains the module for additional operating parameters.

Module Layout

Connections

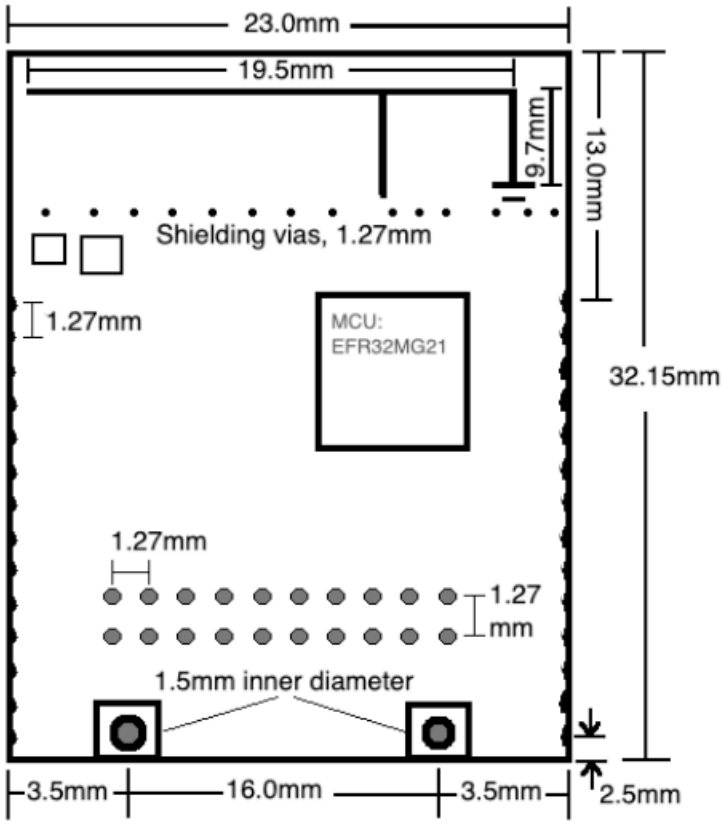
Figure 3: Module connections



- Figure 2 to the right shows the Pinout for the Module. The edge and thru-hole pin pads connect to the MCUs general purposed, configurable GPIO. Some Pins share functionality with hardware on the module:
- Edge pins 3 and 4 can program the device.
- Edge pin 25(thru-pin 20) connects to the input pin for the on-board LED.
- Edge pin 24(thru-pin 10) connects to the output of the hall-effect sensor.

Typically, the Module is configured to use the printed 'F' antenna; however, by moving the north-facing, 10pF capacitor, the board can be used with either a U.FL connector (using an east-facing capacitor), or a 3cm wire antenna (using a west-facing capacitor). Typically, the board would also be cut or snap off just above the shielding vias (see Figure 3 below) to lessen the Module's footprint.

Figure 4: Board Dimensions



Dimensions

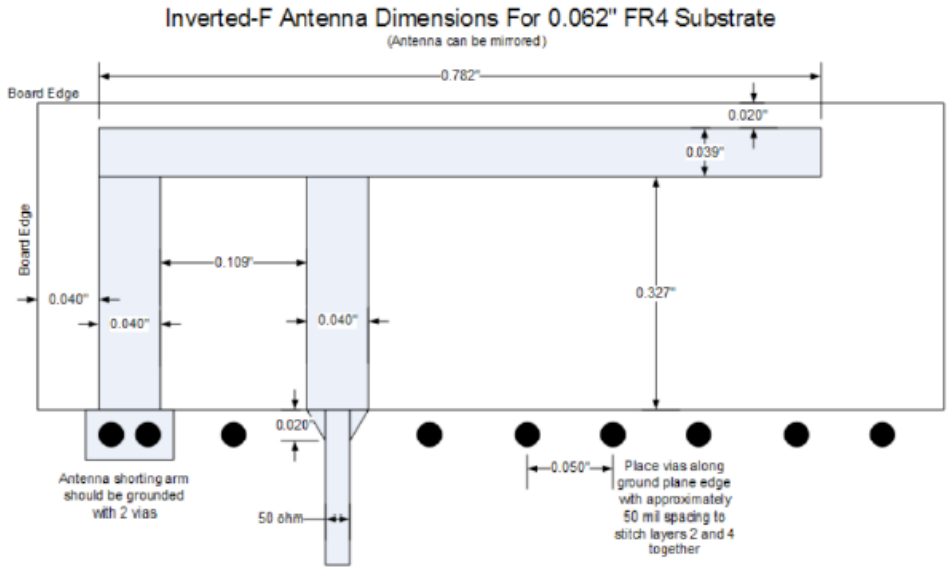
- Figure 3 (left) illustrates the Module's connections are pitched to an industry standard 1.27mm, which allows for easy alignment with 3rd part ICs, as well as the 1.27mm shielding vias. Overall dimensions of 23.00mm x 32.15mm make the footprint of the module roughly thumb-print-sized.
- For power, the 12V connection pads at the south end of the board have a 1.5mm inside diameter allowing for easy clipping of power leads during development.
  NOTE: While able to accept large-gauge wire, the power requirements of the Module do not warranty such wiring.

Optional Antennas

The antenna on the module can be disconnected and reconnected to the MCU via the 10pF steering capacitor. North-facing capacitor path is used for the printed antenna, the east-facing is used for the optional U.FL connector, and the west-facing is used for soldered wire antennae.
NOTE: The north-facing capacitor MUST be removed from the module if the east- or westfacing capacitors are installed; only on capacity at a time may be present.

Inverted 'F' Printed Antenna
Antenna design in the Module based on Silicon Laboratories' document AN1088. This design nominally yields 1.44dBi gain at 2445MHz. Excerpt from AN1088 for the antenna below

Figure 4:



8dBi, Dual-band antenna

The external 8dBi, dual-band antenna in Figure 5 tothe right is included with some project builds based on the needs of the client. The antenna would require the optional U.FL connector and the east-facing capacitor added to the Module.

Figure 6: External Antenna Dimensions

Electrical Specifications

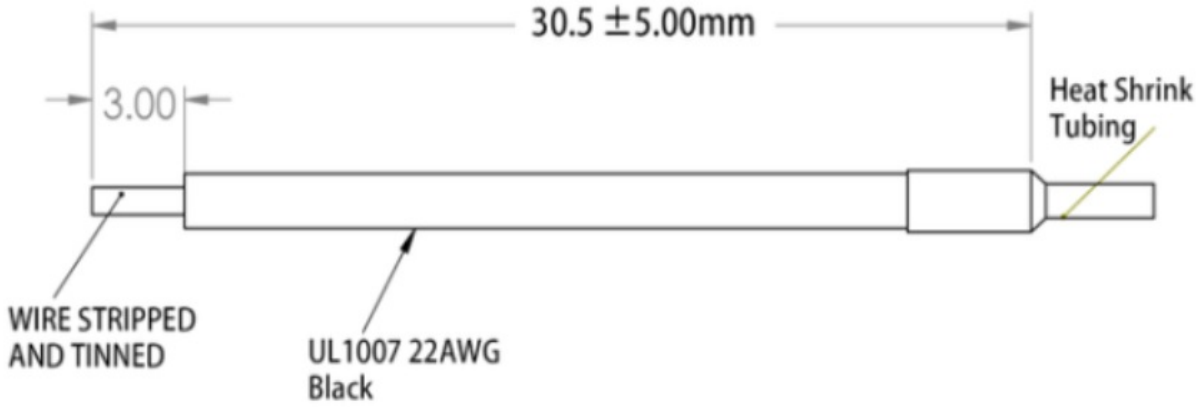
- Frequency Range (MHz): 2400-2650
- Bandwidth (MHz): 2000
- Input Impendence (Ω): 50
- V.S.W.R : ≤ 2.0
- Gain (dBi) : 8

- Max Input Power (w) :5

Mechanical Specifications

- Antenna Length (mm) : 220
- Connect Type : SMA male
- Radome Color: Black
- Weight (g): 30

3cm Wire antenna
The final antenna option is the 3cm wire antenna, which is a shrink-tube-capped, 30.5mm, 22AWG wire that is soldered through the Module board near the top center. It needs to be connected via the west-facing capacitor pad to make a connection to the MCU. Brief specifications are below.



Model Name	3 CM Antenna		
Frequency	2400MHz	2450MHz	2500MHz
Gain (dBi)	-1.02dBi	-0.45dBi	0 dBi
MAX. Gain	0 dBi		
Impedance	50 Ω		
Antenna Length	30.5mm		
Manufacturer	Designs Midwest Hong Kong, Ltd		
Address	Room 2705, Block C, Tiley Central Plaza II, No.3 Haide Road, NanShan District, Shenzhen, Guangdong, China		

FCC STATEMENT

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. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a Class B digital device, under 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 by 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 or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/ TV technician for help.

FCC Radiation Exposure Statement:
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. To avoid the possibility of exceeding the FCC radio frequency exposure limits, Human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

List of applicable FCC rules
FCC Part 15 Subpart C 15.247 & 15.209

Specific operational use conditions
The module with BLE/802.15.4 function. Operation Frequency: BLE 2402-2480MHz; 802.15.4 2405~2480MHz;

Number of Channel: BLE: 40 Channel, 802.15.4: 16 Channel, Modulation: GFSK, OQPSK Type: PCB antenna Wire antenna Dipole Antenna Gain: PCB antenna: 1.44dBi Wire antenna: 0dBi Dipole Antenna: 8dBi

The module can be used for mobile applications with a maximum 8dBi antenna. The host manufacturer installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide information

Limited module procedures
Not applicable. The module is a Single module and complies with the requirement of FCC Part 15.212.

Trace antenna designs
Not applicable.

RF exposure considerations
The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and the user's body; and if RF exposure statement or module layout is changed, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

Antennas
Antenna Specification are as follows: Type: PCB antenna Wire antenna Dipole Antenna Gain: PCB antenna: 1.44dBi Wire antenna: 0dBi Dipole Antenna: 8dBi

This device is intended only for host manufacturers under the following conditions: The transmitter module may not be co-located with any other transmitter or antenna; The module shall be only used with the internal antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a 'unique' antenna coupler. As long as the conditions above are met, further transmitter tests will not be required. However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

Label and compliance information
Host product manufacturers need to provide a physical or e-label stating "Contains FCC ID: ULP-EFR24CM" with their finished product.

Information on test modes and additional testing requirements Operation Frequency: BLE 2402-2480MHz; 802.15.4 2405~2480MHz; Number of Channel: BLE: 40 Channel, 802.15.4:16 Channel, Modulation: GFSK, OQPSK Host manufacturer must perform a test of radiated & conducted emission and spurious emission, etc according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product. Only when all the test results of test modes comply with FCC requirements, then the end product be sold legally.

Additional testing, Part 15 Subpart B disclaimer
The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 & 15.209 and the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed

Federal Communication Commission Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, under 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 by 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 of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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.

FCC Caution:
Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

IMPORTANT NOTES
Co-location warning:
This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

OEM integration instructions:

This device is intended only for OEM integrators under the following conditions: The transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the external antenna(s) that has been originally tested and certified with this module. As long as the conditions above are met, further transmitter tests will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.). Validity of using the module certification:
If these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End product labeling:
The end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID: ULP-EFR24CM.

Information that must be placed in the end user manual:
The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product that integrates this module. The end user manual shall include all required regulatory information/warnings as shown in this manual.

Documents / Resources

	**interactive EFR24CM Compute Module** [pdf] Instruction Manual EFR24CM Compute Module, EFR24CM, Compute Module, Module

References

- **User Manual**