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OEM Installation Manual

Prepared by

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FCC ID: N4TLEAP1000
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: To assure continued compliance, any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

When carrying the product or using it while close your body, maintain a distance of 20 cm from the body to ensure compliance with RF exposure requirements. All wireless devices are sensitive to interference, which can impair the functionality of the device.

FCC Label:

FCC ID: N4TLEAP1000

1 Installation

This manual provides comprehensive instructions to integrators for proper integration in end products. This document clearly provides subsequent associated parties, manufacturers, and integrators the conditions and limitations for authorized uses of the modular transmitter.

This radio module has two hardware version, one with on-board chip antenna and the other one with off-board external antennas. 4 different external antennas were tested.

On-board antenna version is with C20, L3 and L4 populated which serve as impedance matching, RF path selection and filtering purpose; these components are not required for Off-board antenna version thus being removed. The antenna circuit changes at C20, L3, and L4 will only be performed by manufacturer before delivering to OEM Integrator or Host Manufacturer.

This module is limited to OEM installation ONLY. The OEM integrator is responsible for ensuring that the end-user has no manual instruction to remove or install the module.

The module is limited to installation in mobile or fixed applications.

Please note that if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label may use the wording “Contains Transmitter Module FCC ID: XYZMODEL1.”

A separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations.

The OEM/Integrator must include the following statements in the host’s user manual:

“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. In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the Internet, the information required by this section may be included in the manual in that alternative form, provided the user can reasonably be expected to have the capability to access information in that form.”

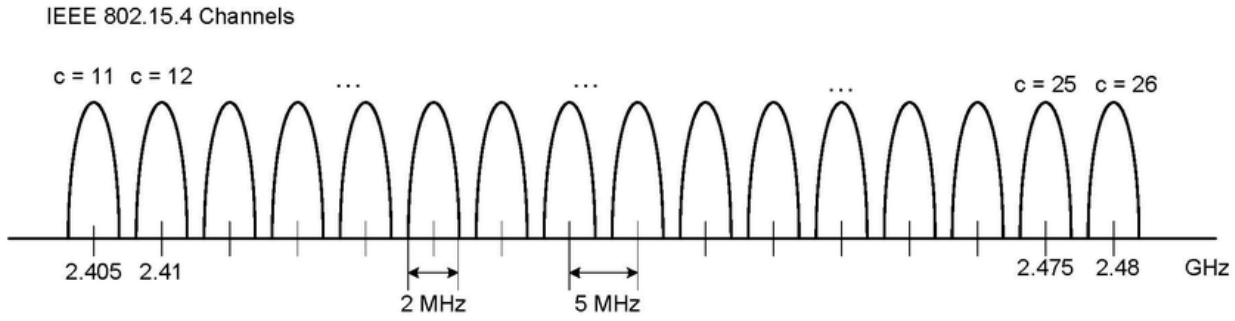
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and the body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter than the ones stated in this document.

Guidance with be provided to the host manufacturer for compliance with the Part 15B requirements.

2 Leap Module Specifications

Key Specifications:

RF Output Power:	+18dBm Nom
Receive Sensitivity:	-TBD dBm
FCC Rule:	15.247
IEEE Standard:	802.15.4
Channel Spacing:	5 MHz
Min Channel:	2405 MHz (Channel 11)
Max Channel:	2470 MHz (Channel 24)



Dimensions:	1.34” x .88”
RF Output Options:	Direct port or on board antenna (board stuff option)
Direct Port Connector:	U.FL
On Board Antenna:	PIFA (Amotech #AMAN301512ST01)
On Board Antenna Gain:	3.4dBi
RFIC:	SiLabs EFR32MG series.
Programming:	Serial Port, TTL levels.
Power supply:	3.3V Battery Nom
RF TX Voltage:	3.6V Regulated.

3 Antenna Installation

3.1 Separation

All antennas should be installed and kept a minimum distance of 20 cm to the human body. The antenna must not be co-located or operating in conjunction with any other antenna or transmitter than the ones stated in this document.

3.2 Antenna Selection

Only the certified antennas can be used with this module. The corresponding RF output power level setting per the table in section 4 must be followed to ensure compliance with FCC rules.

3.3 Antenna coupling

The certified antennas are equipped with unique SMA or U.FL connector.

Antenna	Connector type	Coupling method to module
Internal PIFA Antenna (Amotech #AMAN301512ST01)	N/A	Direct connection
Folded Dipole Long (#ANT-2.4-CW-HW)	RP-SMA	RF cable with unique RP-SMA and U.FL connector
Folded Dipole Short (#W24-RSMA-M)	RP-SMA	
Monopole (# HG2407RD-RSP)	RP-SMA	
Yagi (#HG2412SY-NF)	U.FL	Direct connection

The coupling method between antennas and module are listed in above table.

For dipole antennas, two RF cables will be used. RF cables with non-unique RF connector shall not be used. Guidance will be provided to OEM Integrator or Host Manufacturer.

Antenna coupling RF cable	P/N	Connector type
Four Star Communications	SMA-RKY/U.FL-113-100B	RP-SMA and U.FL
Lantronix	500-180-R-ACC	RP-SMA and U.FL

For Yagi antenna, it will have an adapter and RF cable permanently connected with industrial epoxy, “Loctite” or solder to make the connection permanent prior to delivering to OEM Integrator or Host Manufacturer. The connector type on the final assembly will be U.FL.

3.4 Installation

Phase IV Engineering will provide guidance to and help the OEM integrator with the antenna installation into their host to ensure it is done properly.

4 Output Power Settings

Refer to 5.3 for setting output power options.

Antenna	Output Power Setting
Internal PIFA Antenna (Amotech #AMAN301512ST01)	20 dB at all frequencies
Folded Dipole Long (#ANT-2.4-CW-HW-SMA)	20 dB at all frequencies
Folded Dipole Short (#W24-ASMA-M)	20 dB at all frequencies
Monopole (#HG2407RD-SM)	20 dB at all frequencies
Yagi (#HG2412SY-NF)	20 dB at all frequencies except 15 dB at 2470 MHz

5 Test Modes

Two modules will be provided to the lab incorporating the internal and external antenna options. Each will be mounted on a test PCB, which will have a power supply and communication interface.

For the external antenna PCB, two antennas will be provided, a monopole, and a folded dipole.

The following test modes can be implemented via text commands using a terminal emulator.

5.1 Continuous Transmit CW (use tone command)

In this mode, the transmitter outputs a continuous CW carrier. Any of the 16 channels can be accessed via this command.

5.2 Continuous Transmit DSSS (use modulate command)

In this mode we will simulate continuous data transmission at the maximum data rate, which is 250kbps. Since this system is DSSS, the chipping rate is defined as 2Mbps or 8 chips per bit. This mode can be accessed on any of the 14 channels.

5.3 Normal Operation

In this mode we will simulate normal communication to the gateway at the highest supported sample rate.

6 Test Software

6.1 Hardware Requirement

- USB to Serial cable.
- LEAP Module (sensor version).
- 3.3V power supply for LEAP Module (sensor version).
- LEAP Module (gateway version).
- 5V power supply for LEAP Module (gateway version).
- Computer
- “RadioTest.exe” software.

6.2 Test Setup

1. Save the “RadioTest.exe” to PC.
2. Open device manager and take note of the COM port you will connect in the next step.
3. Plug in the USB to serial cable to the computer.
4. In the device manager window note the COM port that appears as the serial cable is connected (COMXX).
5. Open a command prompt window and navigate to the location where the “RadioTest.exe” was saved.
6. To run the program, type in the command prompt window, “RadioTest.exe –serial_port COMXX”

   If successfully connected the following message will display:

   “Running test
   Running the Interactive Radio Test Suite. Type ‘help’ for command list”.

7. Type “help” to display the list of commands available.

6.3 Command List and Descriptions

Command	Description
get_channel	Returns the current radio channel
set_channel <uint16_t>	Set the current radio channel. Valid channels are 11-26
set_power <int8_t>	Sets power in dBm. Valid power is up to 20dBm.
	Note: The radio will set the power to the closest available power level 0 = 0 1 = 1 2 = 1 3 = 3 4 = 3 5 = 5 6 = 6 7 = 7 8 = 7 9 = 9 10 = 10 11 = 11 12 = 11 13 = 13 14 = 14 15 = 15 16 = 15 17 = 17 18 = 18 19 = 19 20 = 20
get_power	Returns power in dBm
rx <bool>	Enables (1) or Disable (0) radio receiver
tone <bool>	Enables (1) or Disable (0) transmitting continuous tone
modulate <bool>	Enables (1) or Disable (0) transmitting continuous modulated data
get_serial	Returns device serial number
reset	Resets the microcontroller
exit	Exit the interactive radio text